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Hype Cycle for Emerging Technologies, 2012

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This Hype Cycle brings together the most significant technologies from across Gartner's research areas. It provides insight into emerging technologies that have broad, cross-industry relevance, and are transformational and high impact in potential.

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What You Need to Know

This Hype Cycle targets strategic planning, innovation and emerging technology professionals by highlighting a set of technologies that will have a broad-ranging impact across the enterprise. It is the broadest aggregate Gartner Hype Cycle, selecting from the more than 1,900 technologies featured in Gartner's Hype Cycle Special Report for 2012. It features technologies that are the focus of attention because of particularly high levels of hype, or those that may not be broadly acknowledged, but that Gartner believes have the potential for significant impact. Because this

Hype Cycle pulls from such a broad spectrum of topics, many technologies that are featured in a specific year because of their relative visibility will not necessarily be tracked throughout their life cycles. Interested readers can refer to Gartner's broader collection of Hype Cycles for items of ongoing interest. Note that, although we use the term "technologies" in the title and description of this Hype Cycle, it also includes a number of higher-level concepts, trends and disciplines that are enabled by technology, and that we expect will follow the path of the Hype Cycle. For information on interpreting and using Gartner's Hype Cycles, see "Understanding Gartner's Hype Cycles, 2012."

Senior executives, CIOs, strategists, innovators, business developers and technology planners will want to consider these technologies when developing emerging business and technology portfolios. This Hype Cycle is intended as a starting point, and should be selectively augmented or revised based on input from other technology and industry Hype Cycles, as well as from detailed technology planning that targets organizational requirements.

The Hype Cycle

This Hype Cycle presents technologies individually, but we also encourage enterprises to consider the technologies in sets or groupings, because so many new capabilities and trends involve multiple technologies working together. For example, the future of the smartphone will be shaped by battery technology, natural-language question answering and gesture control — in addition to the usual emerging mobile technologies, such as Near Field Communication (NFC).

The theme of this year's Hype Cycle is the concept of "limiting factors." We are at an interesting moment — a time when the scenarios we've been talking about for a long time are almost becoming reality. Case in point: the smarter smartphone. It's now possible to look at a smartphone and unlock it via facial recognition, and then talk to it to ask it to find the nearest bank ATM. However, at the same time, we see that the technology is not quite there yet. We have to remove our glasses for the facial recognition to work, our smartphones don't always understand us when we speak, and the location-sensing technology sometimes has trouble finding us.

If enterprises are to deliver new business value and experiences through a set of technologies rather than individual technologies, then it is important for enterprises to understand which technologies are already mature and which ones are not there yet. Often, it's just one or two technologies that are not quite ready that limit the true potential of what is possible. In the previous example, it's not the handset device, mobile broadband access, and mapping data that prevent the scenario from working out, but rather the natural-language understanding, image recognition and indoor location-sensing technologies. We refer to these technologies as "tipping-point technologies" because, once they mature, the scenario can come together from a technology perspective. Business, regulatory and social constraints may remain, but at least from a technology standpoint, the scenario will work.

Here are some of the more significant scenarios and the tipping-point technologies that need to mature so that enterprises and governments can deliver new value and experiences to customers and citizens.

Any Channel, Any Device, Anywhere — Bring Your Own Everything

The technology industry has long talked about scenarios in which any service or function is available on any device, at any time and anywhere. This scenario is being fueled by the consumerization trend that is making it acceptable for enterprise employees to bring their own personal devices into the work environment. The technologies and trends featured on this Hype Cycle that are part of this scenario include BYOD, hosted virtual desktops, HTML5, the various forms of cloud computing, silicon anode batteries and media tablets. Although all these technologies and trends need to mature for the scenario to become the norm, the following technologies are particularly strong tipping-point candidates:

- **HTML5:** Currently, making applications and services available on any device (especially mobile) requires that apps be developed for each single major platform (for example, Apple iOS, Android and Windows). HTML5 will eliminate much, although not all, of this effort and create a more cross-platform-friendly environment — similar to the cross-browser capability of HTML on the Web.
- **Hosted virtual desktops:** Once this technology matures, enterprise IT departments will have a much better set of technologies to deliver, and with which maintain a secure virtual enterprise environment on personal tablets, smartphones and PCs.
- **Silicon anode batteries:** As devices become more powerful, power management technology needs to keep up. Lower-consumption components and smart software and OS design have helped the industry keep pace, but a breakthrough in batteries is required. There are a number of different battery technologies that are trying to meet this challenge — silicon anode batteries represent one of the more promising ones.

Smarter Things

A world in which things are smart and connected to the Internet has been in the works for more than a decade. Once connected and made smart, things will help us in every facet of our consumer, citizen and employee lives. There are many enabling technologies and trends required to make this scenario a reality. On the 2012 Hype Cycle, we have included autonomous vehicles, mobile robots, Internet of Things, big data, wireless power, complex-event processing, Internet TV, activity streams, machine-to-machine communication services, mesh networks: sensor, home health monitoring and consumer telematics. The technologies and trends that are the tipping points to success include:

- **Machine-to-machine communication services** and **mesh networks: sensor:** There are already more things than people connected to the Internet. As even more things become connected, many will do so wirelessly; thus, the industry needs to find the right balance of cost, bandwidth and power consumption to make it plausible for the massive-scale connection of things. The common wireless protocols of 3G/4G cellular, Wi-Fi and Bluetooth will need to be complemented with wireless networks that are better designed for things (for example, ZigBee, Dash7, or the wide-area ubiquitous network [WAUN] in Japan) to keep costs down.

- **Big data, complex-event processing** and **activity streams:** Much of the insight and "smartness" that will come from things will originate from activity streams from sensors and the analytics that will make sense of the real-time streams. That is why big data, and especially the complex-event processing facet of big data, is a limiting factor in this scenario. Today, the focus is mainly on being able to consume and analyze the huge amounts of data that can be streamed from things. This focus is quickly changing to being able to handle the scale and speed, but doing so at a low cost.

Big Data and Global-Scale Computing at Small Prices

This broad scenario portrays a world in which analytic insight and computing power are nearly infinite and cost-effectively scalable. Once enterprises gain access to these resources, many improved capabilities are possible, such as better understanding customers or better fraud reduction. The enabling technologies and trends on the 2012 Hype Cycle include quantum computing, the various forms of cloud computing, big data, complex-event processing, social analytics, in-memory database management systems, in-memory analytics, text analytics and predictive analytics. The tipping-point technologies that will make this scenario accessible to enterprises, governments and consumers include:

- **Cloud computing:** This concept sits behind all large-scale computing needs that can work in a centralized and often public architecture — and therein lie the constraints. Currently, the industry is only beginning to produce a solution that meets the needs of many enterprises. Security, integration, cost and privacy stand out as today's biggest challenges. In the future, think about the "smarter things" scenario. Is it reasonable to think that all connected things will send their activity data streams back into the cloud? Probably not at today's bandwidth, storage and computing costs, but costs will continue to decrease, and enterprises will get better at knowing what to store.
- **Big data:** This is often described as a style of data analysis and management that is marked by very large data volumes, that comes in at various velocities (including real time), and that is composed of a variety of data types (structured and unstructured). While the hype in the industry is focused on the fact that we can now deal with each of these three facets, less attention is being focused on how to do so at low costs that scale reasonably. This tipping-point technology will really blossom when the cost equation works out — when enterprises and governments get sufficient benefit from the costs of handling big data.
- **In-memory database management systems:** All enterprises run on some form of ERP and legacy applications. These systems are usually dependent on some form of database that accesses data on physical storage drives. In-memory database management systems will remove this need by making database access into something that occurs in memory chips — which are much faster than disks. The result is that the legacy systems that run our corporate and government world will become significantly faster. Books are closed in minutes, planning scenarios are calculated in seconds, and transactions are instantly posted. Although cloud computing gets much of the spotlight, in-memory database management systems are the tipping point that will benefit the enterprise greatly once the technology matures.

The Human Way to Interact With Technology

This scenario describes a world in which we interact a lot more naturally with our technology. The technologies on the Hype Cycle that make this possible include human augmentation, volumetric and holographic displays, automatic content recognition, natural-language question answering, speech-to-speech translation, big data, gamification, augmented reality, cloud computing, NFC, gesture control, virtual worlds, biometric authentication methods and speech recognition. Many of these technologies have been "emerging" for multiple years and are starting to become commonplace (for example, gesture control and speech recognition). However, a few stand out as tipping-point technologies:

- **Natural-language question answering:** Once this works well at an enterprise and a consumer level, the possibilities for more natural interaction with technology will be transformational. Apple's Siri and Google's recent voice recognition effort in its latest Android version are tackling the consumer world. IBM Watson is a good example of this capability in the enterprise world. The limiting factors of natural-language question answering are computing power (cloud and distributed) and algorithms.
- **NFC:** This doesn't change the way humans interact with technology, but it does change the way humans use technology to interact with the physical world. For example, NFC can turn a smartphone into a hotel key or car key. Samsung TecTiles are NFC stickers that consumers scan when entering a movie theater. Swiping the TecTile automatically silences their phones for the duration of the movie. NFC could also authenticate an employee doing maintenance on field assets — allowing him or her to do only certain maintenance operations on the machine. The mobile wallet also demonstrates the promise of how NFC might change the way we interact with physical payment terminals, public transportation turnstiles, and other payment and access control situations.

What Payment Could Really Become

This scenario envisions a cashless world in which every transaction is an electronic one. This will provide enterprises with efficiency and traceability, and will provide consumers with convenience and security. The technologies on the 2012 Hype Cycle that will enable parts of this scenario include NFC payment, mobile OTA payment and biometric authentication methods. Related technologies will also impact the payment landscape — albeit more indirectly. These include the Internet of Things (that is, things being able to do their own transactions), mobile application stores (that is, Apple iTunes possibly becoming a payment vehicle — see Apple EasyPay trials and Passbook) and automatic content recognition (that is, technology that enables the smartphone to recognize a song, movie or product via the microphone or camera, and allows the consumer to purchase it). The tipping point will be surpassed when these technologies mature:

- **NFC payment** and **mobile OTA payment:** These technologies are just two of a set of technologies that aim to turn the smartphone into a wallet. However, success in these two areas will pave the way for the full potential of the mobile wallet — which is why we view them as limiting factors. Consumer adoption and merchant adoption are the two biggest challenges

to be overcome. We expect the level of success of these technologies to be country-specific, so, unlike other limiting factors, success and failure will be local.

The Voice of the Customer Is on File

Humans are social by nature, which drives a need to share — often publicly. This creates a future in which the "voices of customers" are stored somewhere in the cloud and can be accessed and analyzed to provide better insight into them. Recording what gets shared, liked, streamed, viewed, consumed and timelined, and who friends or follows whom, creates an extremely rich pool of insight — at the cost of being alarmingly unprivate. The 2012 Hype Cycle features the following enabling technologies and trends: automatic content recognition, crowdsourcing, big data, social analytics, activity streams, cloud computing, audio mining/speech analytics and text analytics. The tipping-point technologies are:

- **Privacy backlash:** Although not a trend featured on the Hype Cycle, it is the single biggest showstopper that will limit this future scenario. Each country and domain (for example, social networks versus Internet TV) will have its own privacy limitations.
- **Big data:** Is it worth the investment in storing and analyzing huge amounts of data to be better at selling to or servicing a customer or citizen? In some instances, the business case will make sense; in others, it won't — this will limit the effort industry and government will make to pursue this scenario.

3D Print It at Home

This scenario paints a future in which 3D printing allows consumers to print physical objects, such as toys or housewares, at home — just as they print digital photos today. While more robust forms of additive manufacturing technology allow enterprises and academia to produce 3D designs that were never before possible (for example, special airfoils and medical implants), this scenario focuses on mass consumer use of 3D printing. Combined with 3D scanners, it may be possible to scan certain objects (for example, action figures) with a smartphone and print a near-duplicate. As with other scenarios, we're not quite there yet, but this one will take more than five years to mature beyond the niche market. 3D printing is the tipping-point technology:

- **3D printing:** The cost, speed and print materials are the three major limiting factors for mass adoption by consumers. These three will determine what will get printed and by whom (for example, will retailers, manufacturers or consumers 3D print?). While these three factors limit mass consumer consumption, industrial and niche markets (for example, medical) will still continue to grow.

New on the 2012 Hype Cycle for Emerging Technologies

This Hype Cycle features new entrants that enable a more fine-grained analysis of major trends, including analytics and consumer and Web technologies. The following technologies have been added to the 2012 Hype Cycle that were not part of the 2011 Hype Cycle, although many have been previously featured on other Gartner Hype Cycles:

- **Volumetric and holographic displays:** Volumetric displays create visual representations of objects in three dimensions, with an almost 360-degree spherical viewing angle in which the image changes as the viewer moves around it. Recent high-profile events, such as an "appearance" by the late rapper Tupac Shakur (using projection to give the illusion of a hologram) at a live concert, have given renewed prominence to holographic displays.
- **Automatic content recognition:** This refers to the ability of a smartphone or media tablet app to identify a content element — audio, video or digital image — within its proximity, based on sampling a portion of the audio or video (or image), processing the sample and comparing it with a source service that identifies content by its unique characteristics. Popular automatic-content-recognition-enabled apps are currently divisible into three categories: music, TV and shopping.
- **3D scanners:** A 3D scanner is a device that captures data about the shape and appearance of real-world objects to create 3D models of them. 3D scanners for consumer use are low-cost, easy-to-operate devices that provide basic scan, capture and export of 3D images. Their relevance is growing, along with the broader use of 3D printers, as a way to create an initial version of the 3D model.
- **Autonomous vehicles:** An autonomous vehicle is one that can drive itself from a starting point to a predetermined destination in "autopilot" mode using various in-vehicle technologies and sensors. This topic was last included on the "Hype Cycle for Emerging Technologies, 2010," and has been reincluded based on developments such as Nevada's new law that allows licenses to be issued to driverless cars.
- **Silicon anode batteries:** These are an extension of widely used lithium ion batteries that deliver significantly higher energy storage and longer battery life. Longer working times will facilitate more powerful mobile devices and applications, and a smaller physical size and weight will support equipment with smaller footprints.
- **Crowdsourcing:** This describes the processes for sourcing a task or challenge to a broad, distributed set of contributors using the Web and social collaboration techniques. The tools to establish a crowdsourcing environment, particularly those involving recognition incentives or micropayments, are becoming widely available. There is a large, untapped potential in applying crowdsourcing to a much broader range of tasks and goals, but there is still more to be learned and experienced regarding where the practice is most effective compared with other approaches.
- **HTML5:** This is the proposed specification for the next generation of HTML. It is important because it brings to the Web much of the rich-Internet-application-like capabilities that have required additional software. There is visible momentum around HTML5; however, as with most technologies, especially on the Web, interest is occurring primarily outside the enterprise sector — among progressive Web designers and among mobile application developers.
- **BYOD:** Bring your own device (BYOD) is an alternative strategy allowing employees, business partners and other users to use a personally selected and purchased client device to execute enterprise applications and to access data. Debate and interest in BYOD are frenzied. With the

opportunities enabled by consumerization, IT is looking at a radical modification of its device ownership policies, driven principally by smartphones and tablets.

- **Complex-event processing:** This is a kind of computing in which incoming data about events is distilled into more useful, higher-level "complex" event data that provides insight into what is happening. Complex-event processing is used for highly demanding, continuous-intelligence applications that enhance situation awareness and support real-time decisions. Complex-event processing is one of the pillars of the emerging big data movement because of its capability to handle large volumes of data quickly.
- **Audio mining/speech analytics:** This embraces keyword, phonetic or transcription technologies to extract insights from prerecorded voice streams. This insight can then be used to classify calls, trigger alerts/workflows, and drive operational and employee performance across the enterprise.
- **NFC:** This is a wireless technology that enables a variety of contactless applications, such as payments, information retrieval, mobile marketing and device pairing. With NFC now embedded in smartphone platforms, hardware and software companies hope to move beyond payments and provide the developer community with another tool to foster innovative applications.
- **In-memory analytics:** This is an alternative business intelligence (BI) performance layer in which detailed data is loaded into memory for fast query and calculation performance against large volumes of data. BI programs can benefit broadly from the fast response times delivered by in-memory-based processing, but in-memory analytics is of maximum value to users when coupled with interactive visualization capabilities, or when it is used within data discovery tools for highly intuitive, unfettered and fast exploration of data.
- **Text analytics:** This is the process of deriving information from text sources. Interest in text analytics has been cyclical. Currently, interest in three areas — voice of the customer; fraud and public security; and categorization and classification — is resulting in accelerating interest among users and more serious vendor support.
- **Home health monitoring:** This is the use of IT and telecommunications to monitor the health of patients in their homes, and to help ensure that appropriate action is taken. Last featured on the "Hype Cycle for Emerging Technologies, 2009," home health monitoring is starting to move beyond pilots into standardized delivery, such as the U.S. Department of Veterans Affairs' deployment of home health monitoring to more than 50,000 patients with high-cost chronic conditions.
- **Mobile OTA payment:** Mobile payments are transactions conducted using a mobile phone and payment instruments, such as bank accounts, bank cards or prepaid accounts. Over the air (OTA) payment refers to remote payment (for example, using SMS or a downloadable client), as opposed to proximity-based payment using technologies such as NFC. We expect online shopping and payments via mobile phones to experience accelerating growth, driven by services from e-commerce providers, banks, communications service providers and alternative payment providers, such as PayPal.
- **Consumer telematics:** These are end-user-targeted vehicle-centric information and communication technologies and services that use network-enabled cars for consumers. They

provide in-vehicle services, such as emergency assistance, navigation and routing, traffic information, local search (for example, for charging stations or restaurants), financial services (for example, usage-based insurance), and concierge services. As a result of growing consumer demand, automakers are increasingly exploring opportunities to offer cost-effective solutions that ensure sustainable business models.

Fast Movers

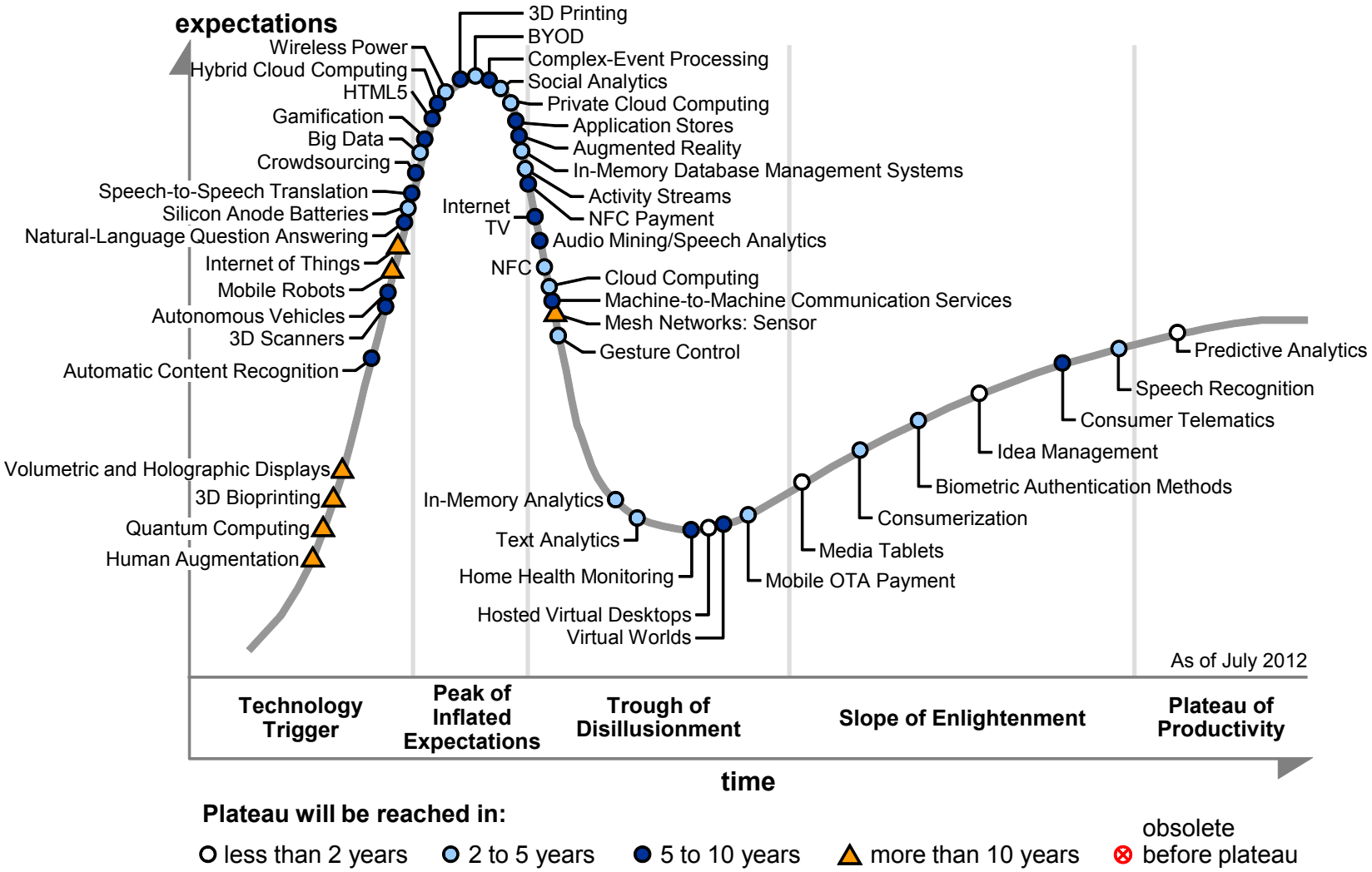
The following technologies have moved noticeably along the Hype Cycle since 2011:

- Big data (formerly called "big data and extreme information processing and management") has moved toward the peak, reflecting growing levels of interest and activity.
- 3D printing, which has been tracked on the Hype Cycle since 2007, has moved to full peak position as its disruptive potential starts to be recognized more broadly.
- Activity streams have started to slide down from its 2011 position at the peak, as it becomes an expected part of mainstream social media.
- Internet TV similarly has dropped from the peak as consumers become more accustomed to Internet-based services like Netflix, and as questions about the economics and disruptive effects of online distribution are starting to replace questions of technical feasibility and consumer acceptance.
- NFC payment has also nudged into a post-peak position as it faces challenges, such as security concerns among consumers, and a lack of NFC mobile phones and the contactless reader infrastructure.
- Cloud computing has moved halfway toward the trough. It is still a visible and hyped term, but at this point, it has clearly passed the Peak of Inflated Expectations. There are signs of fatigue, rampant "cloudwashing" and signs of disillusionment (for example, highly visible failures). Although cloud computing is approaching the Trough of Disillusionment, it remains a major force in IT.
- Media tablets, in a major jump reflecting their achievement as one of the most rapidly adopted technologies ever, have moved from post-peak to the Slope of Enlightenment, and are expected to reach the plateau in less than two years.
- Idea management has moved along the Slope of Enlightenment and is expected to reach the plateau in less than two years, which is down from two to five years in 2011.

Other Changes From 2011

- Gesture recognition has been recast as gesture control, distinguishing its application as a human-computer interaction technology from its uses in video and automatic content recognition.
- Consumerization is now expected to reach the plateau in two to five years, which is down from five to 10 years in 2011.

Figure 1. Hype Cycle for Emerging Technologies, 2012



Source: Gartner (July 2012)

The Priority Matrix

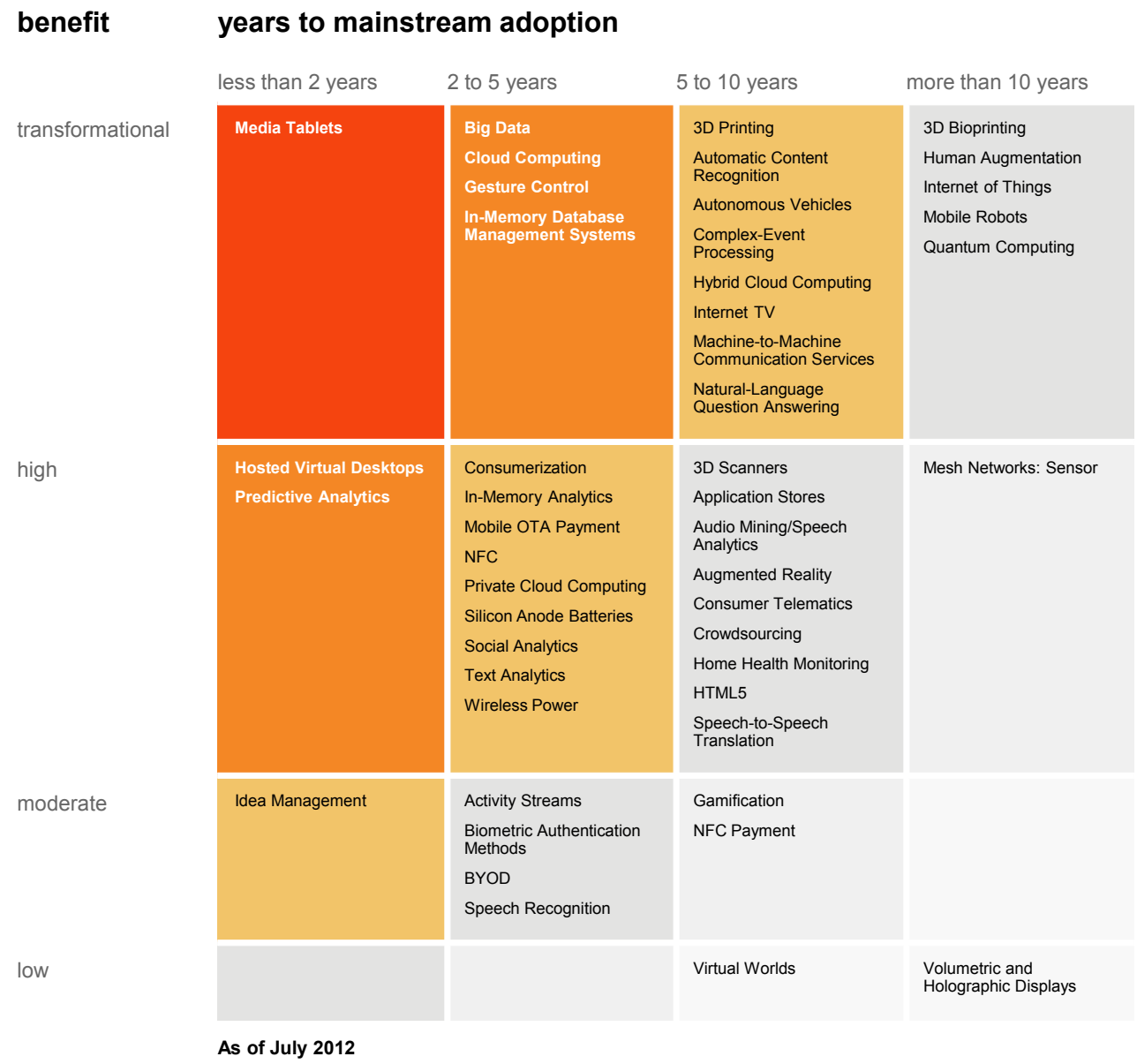
This Hype Cycle has an above-average number of technologies with a benefit rating of transformational or high. This is a deliberate goal of the selection process. We aim to highlight technologies that are worth adopting early because of their potentially high impact. However, the actual benefit often varies significantly across industries, so planners should ascertain which of these opportunities relates closely to their organizational requirements.

The following technologies have been rated transformational in 2012:

- For driving the connected world trend — the Internet of Things and machine-to-machine communication services
- For advancing user interaction with the digital world — media tablets, Internet TV, natural-language question answering, gesture control, automatic content recognition and human augmentation
- For enhancing data management and analytical insight — big data, in-memory database management systems, complex-event processing and quantum computing
- For improving computing power and providing new ways to source and architect computing resources — cloud computing and hybrid cloud computing
- For delivering fundamentally new capabilities into organizations — 3D printing, 3D bioprinting, autonomous vehicles and mobile robots

On the "years to mainstream adoption axis," the majority of technologies fall within the two- to 10-year time frame — again, an intentional bias for the benefit of midrange to long-range planners. We also provide a look ahead at some highly significant, but slow-moving, developments beyond the 10-year time frame, such as 3D bioprinting, human augmentation, mobile robots and quantum computing.

Figure 2. Priority Matrix for Emerging Technologies, 2012



Source: Gartner (July 2012)

Off the Hype Cycle

Because this Hype Cycle pulls from such a broad spectrum of topics, many technologies are featured in a specific year because of their relative visibility, but not tracked over a longer period of time. Technology planners can refer to Gartner's broader collection of Hype Cycles for items of ongoing interest. The following technologies that appeared in the "Hype Cycle for Emerging Technologies, 2011" do not appear in this year's report:

- Computer-brain interface — see "Hype Cycle for Human-Computer Interaction, 2012"

- Social TV — see "Hype Cycle for Broadcasting and Entertainment, 2012"
- Context-enriched services — see "Hype Cycle for Context-Aware Computing, 2012"
- Image recognition — not included in Gartner's Hype Cycle Special Report for 2012
- Group buying — see "Hype Cycle for E-Commerce, 2012"
- Virtual assistants — see "Hype Cycle for Consumer Services and Mobile Applications, 2012"
- Cloud/Web platforms — see "Hype Cycle for Cloud Computing, 2012"
- E-book readers — see "Hype Cycle for Consumer Devices, 2012"
- QR/color code — see "Hype Cycle for E-Commerce, 2012"
- Location-aware applications — see "Hype Cycle for Wireless Devices, Software and Services, 2012"

On the Rise

Human Augmentation

Analysis By: Jackie Fenn

Definition: The field of human augmentation (sometimes referred to as "Human 2.0") focuses on creating cognitive and physical improvements as an integral part of the human body. An example is using active control systems to create limb prosthetics with characteristics that can exceed the highest natural human performance.

Position and Adoption Speed Justification: Human augmentation moves the world of medicine, wearable devices and implants from techniques to restore normal levels of performance and health (such as cochlear implants and eye laser surgery) to techniques that take people beyond levels of human performance currently perceived as "normal." In the broadest sense, technology has long offered the ability for superhuman performance — from a simple torch that helps people see in the dark to a financial workstation that lets a trader make split-second decisions about highly complex data.

Following many years of fringe and hobbyist interest, the Association for Computing Machinery's Augmented Human International Conference has been held annually since 2010, launching the field as a respectable academic discipline. The Olympic-class performances of runner Oscar Pistorius, who has two prosthetic legs, have further moved the concept of human augmentation from the lab to the commercial and ethical foreground. It is already possible to replace the lens in the aging human eye and give it better-than-natural performance.

Although most techniques and devices are developed to assist people with impaired function, some development of superhuman capabilities has started. Makers of power-assisted suits or exoskeletons, such as Raytheon, are aiming to provide increased strength and endurance to soldiers and caregivers. Other researchers are experimenting with creating additional senses for

humans, such as the ability to sense a magnetic field to develop the homing instinct of birds and marine mammals. To date, these systems are worn or strapped onto the body, rather than surgically attached or implanted, but with advances such as thought activation of mechanical limbs, the distinction between "native" versus augmented capabilities will start to blur.

Increasing specialization and job competition are demanding levels of performance that will drive more people to experiment with enhancing themselves. Augmentation that reliably delivers moderately improved human capabilities will become a multibillion-dollar market during the next quarter century. However, the radical nature of the trend will limit it to a small segment of the population for most of that period. The rate of adoption will vary according to the means of delivering the augmentation. Drugs and wearable devices are likely to be adopted more rapidly than those involving surgery.

However, the huge popularity of cosmetic surgery is an indicator that even surgery is not a long-term barrier, given the right motivation. For example, some individuals have implanted magnets in their fingertips to sense electrical activity. Ethical controversies regarding human augmentation will emerge even before the technology becomes commonplace. Several states have already passed bills banning employers from requiring chip implants as a condition of employment. Future legislation will need to tackle topics such as whether an employer is allowed to prefer a candidate with augmented capabilities over a "natural" one. Longer term, the potential for genetic and epigenetic manipulation to improve desirable characteristics will further inflame deep ethical divides.

User Advice: Organizations aiming to be very early adopters of technology, particularly those whose employees are engaged in physically demanding work, should track lab advances in areas such as strength, endurance or sensory enhancement. As the synthesis of humans and machines evolves, evaluate the broad societal implications of these changes.

Business Impact: The impact of human augmentation — and the ethical and legal controversies surrounding it — will first be felt in industries and endeavors demanding extreme performance, such as the military, emergency services and sports. In parallel, consumer applications using sensory enhancement (for example, collision alerts or "friend nearby" notifications) will be delivered initially through mobile or wearable devices.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Recommended Reading: The feelSpace belt

"Reach and Grasp by People With Tetraplegia Using a Neurally Controlled Robotic Arm"

"9 Cyborg Enhancements Available Right Now"

"A Sixth Sense for a Wired World"

Quantum Computing

Analysis By: Jim Tully

Definition: Quantum computers use atomic quantum states to effect computation. Data is held in qubits (quantum bits), which have the ability to hold all possible states simultaneously. This property, known as "superposition," gives quantum computers the ability to operate exponentially faster than conventional computers as word length is increased. Data held in qubits is affected by data held in other qubits, even when physically separated. This effect is known as "entanglement." Achieving both superposition and entanglement is extremely challenging.

Position and Adoption Speed Justification: Several technical problems limit the effectiveness of current attempts at quantum computing.

Qubits must be held and linked in a closed quantum environment and must not be allowed to interact with the outside world, because they are very susceptible to the effects of noise. Two stages are involved in quantum computation. Stage one involves execution of the algorithm and stage two is the measurement of the resulting data. Measurement is extremely difficult and, typically, destroys the quantum state as this involves interaction with the outside world. Some classes of problem would be executed extremely fast with quantum computers, including optimization, code breaking, DNA and other forms of molecular modeling, large database access, encryption, stress analysis for mechanical systems, pattern matching and image analysis.

The technology is in the relatively early research stage. However, a number of significant advances have been made during the past decade or so:

- Five-qubit computation using nuclear magnetic resonance (NMR) was demonstrated by the Technical University of Munich in 2000.
- The first execution of Shor's algorithm using NMR techniques took place at IBM's Almaden Research Center and Stanford University in 2001.
- In February 2007, D-Wave Systems demonstrated a 16-qubit quantum computer, based on a supercooled chip arranged as 4x4 elements. The company followed this with longer qubit demonstrations. Lockheed Martin subsequently purchased a D-Wave One computer and has it in operation at the University of Southern California's facility.

To date, D-Wave's demonstrations have involved superposition, but have not demonstrated entanglement. These are not therefore considered to be "true" quantum computers by many researchers. D-Wave has most recently focused its attention on the use of quantum techniques for adiabatic processing for optimization purposes; specifically, a topic known as "quantum annealing." This technique finds the mathematical minimum in a dataset very quickly. There are many types of problems where quantum adiabatic processing will provide a material improvement in the scale of problem that can be attacked, even at the modest number of qubits in the current machine. Google, for example, has experimented with a quantum computer for machine learning research.

Many researchers believe that general-purpose quantum computers will never be developed. They will instead be dedicated to a narrow class of use — such as the optimization engine of D-Wave

Systems. This suggests architectures where traditional computers offload specific calculations to dedicated quantum acceleration engines. Researchers generally talk of 100 qubits as being the threshold that marks the real value of quantum computing in comparison with traditional architectures.

The technology continues to attract significant funding, and a great deal of research is being carried out. Considerable problems exist in increasing the number of linked qubits available for computation, because of noise. The slightest amount of noise or interference while computation is occurring will cause the system to drop out of the quantum state and generate random results.

This noise is minimized using two techniques:

- Operating at very low temperatures using superconductors.
- Enclosing the system within an intense magnetic field (or a comparable shielding scheme) for isolation reasons.

Shielding is probably the biggest single problem in quantum computing. In practical quantum computers, total isolation would not be feasible — so error correction schemes are being developed to compensate for small amounts of interference. Much of the current research on quantum computing is focused on these error correction schemes. Averaging out errors through multiple computations is the most promising approach, because it is not clear that fundamental quantum noise can be reduced. Some kinds of quantum cryptography actually make use of this difficulty in maintaining the quantum state. In quantum key distribution, for example, unauthorized access to the key can be detected through observation of the destroyed quantum state.

We have not seen any significant progress on the topic over the past year and we have therefore left the technology's position on the Hype Cycle unchanged.

User Advice: If a quantum computer offering appears, check if access is offered as a service. This may be sufficient, at least for occasional computing requirements. Some user organizations may require internal computing resources, for security or other reasons. In these cases, use of the computer on a service basis would offer a good foundation on which to evaluate its capabilities.

Business Impact: Quantum computing could have a huge effect, especially in areas such as: optimization, code breaking, DNA and other forms of molecular modeling, large database access, encryption, stress analysis for mechanical systems, pattern matching, image analysis and (possibly) weather forecasting.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: D-Wave Systems; IBM; Stanford University; University of Southern California

3D Bioprinting

Analysis By: Vi Shaffer

Definition: 3D bioprinting is a medical application of 3D printers. It is a system directed by medical imaging data and software that specifies the design of living tissue and organs, plus the printing device to create a functioning human organ from an individual's own or other cells.

Position and Adoption Speed Justification: Based on R&D and funding progress in the past year, we have nudged this up a bit. However, it is still in the very early stage of the Hype Cycle, requiring substantial further R&D.

While we don't track most medical devices in our healthcare-IT-oriented Hype Cycles, we decided to feature this one, because it so clearly illustrates the potential breakthrough nature of the future fusion of computing, software, hardware and genomics advances. A May 2011 Washington Post article described the technology as looking like, "the offspring of an Erector set and an inkjet printer. The 'ink' feels like applesauce.... But the goo is made of living cells, and the machine is 'printing' a new body part." Cornell University scientists, for example, are focused on a process that would leverage the capabilities of solid free-form fabrication to create living tissue directly from computer-aided design (CAD) data.

3D bioprinting is one of several innovative (to say the least) tissue-growing approaches being studied by scientists, with interest from entrepreneurs and venture funds. At this formative stage, it could also be overtaken in various targeted domains by other methods using technologies yet to be developed.

Other options being studied include implanting tissue "wafers," injecting stem cells directly into the body, placing cells in a detailed tissue mold and helping organs regenerate themselves by injecting substances to improve the microenvironment for a sick organ.

Another example of the state of this industry is Organovo (which calls itself a "three-dimensional biology company"). It has started describing its approach as "tissue on demand for research and medical applications." Its NovoGen MMX Bioprinter is "part of a 3D human tissue generation platform that works across a broad array of tissue and cell types to recapitulate in vivo biology." In March 2012, the company received a grant from the U.S. National Institutes of Health to support the development of functional human liver technology utilizing its bioprinting technology, and the same month closed a private-equity placement of about $15.2 million, which illustrates the ongoing interest in this approach.

Professor James Yoo, from the Institute of Regenerative Medicine at Wake Forest University in Winston-Salem, North Carolina, has likened it to a "Dell computer model," in which a physician could order up an organ to specifications. His group, with funding from the U.S. Department of Defense, is developing a system that will print skin directly onto burn wounds. The bioprinter has a built-in laser scanner that scans the wound, evaluating the depth and area. The scan is converted into 3D digital images that enable the device to calculate how many layers of skin cells need to be printed on the wound to restore the skin to its original configuration.

In 2012, 3D bioprinting is marketed mostly as a "must have" for research labs and developers, including academic medical centers and research centers. These are often funded through government grants, as mentioned above. It will take an unpredictable course and a long time to move into mainstream tissue and organ production.

User Advice: Life science companies and academic medical centers that lead in the investigation of such potential breakthroughs will be participating in or closely following approaches to tissue engineering.

Although this area falls more into the realm of major emerging technologies and life science or biomedical developments, as opposed to "classic" healthcare IT, it illustrates the continuing significance of IT's application to the transformation of medicine. Uses like this are still far in the future. However, as healthcare delivery organization CIOs get closer to the core, clinical processes of healthcare and to management responsibility over biomedical devices, tracking technology possibilities such as this one helps illustrate the constant potential for dramatic medical innovations. Enabling technologies like 3D bioprinting remind CIOs of the weighty changes in the landscape of medical technologies.

In addition, the detailed organ design, bioprinter device used, and organ production and placement data will no doubt need to be incorporated into the electronic health record (EHR) of the future, and custom organs would be one more type of computerized order set. This is yet another example of how the volume and variety of data to incorporate into EHR systems and enterprise data warehouses will continue to explode in the years to come.

Business Impact: Bioprinting is one approach to solving a difficult dream for tissue engineers: Fulfill tissue engineering designs for human organs, arteries and the like. This is one of the most dramatic examples of the potential breakthroughs that the future fusion of medicine, engineering and IT may hold. The impact of successful commercialization on the business of healthcare and on its definition of services offered will be profound, creating an unprecedented demand for new, custom production services of replacement organs. It would change the business fundamentals of currently lucrative transplant centers, and offer an intriguing service line for medical tourism centers. Moreover, it would create new dilemmas with regard to cost-benefit analysis and medical-necessity approvals for public and private payers and policymakers.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: Cornell Creative Machines Lab; Organovo

Recommended Reading: Berkowitz, B., "3-D Printers May Someday Allow Labs to Create Replacement Human Organs," The Washington Post, 9 May 2011

Volumetric and Holographic Displays

Analysis By: Stephen Prentice

Definition: Volumetric displays create visual representations of objects in three dimensions, with an almost 360-degree spherical viewing angle in which the image changes as the viewer moves around. Unlike most 3D planar displays, which create the illusion of depth through visual techniques (stereoscopic or autostereoscopic), volumetric displays create lifelike images in 3D space.

Holographic displays can recreate a 3D image, but they are not true volumetric displays.

Position and Adoption Speed Justification: True volumetric displays fall into two categories: swept volume displays and static volume displays. *Swept volume displays* use the persistence of human vision to recreate volumetric images from rapidly projected 2D "slices." One approach is to project images onto a rapidly rotating mirror inside a protective enclosure (to protect the viewer from injury, should he or she attempt to touch the images). *Static volume displays* use no major moving parts within the image display volume, but rather rely on a 3D volume of active elements (volumetric picture elements, or voxels) that change color (or transparency) to create a 3D image within the display volume. Low-resolution displays may use transparent elements such as light-emitting diodes (LEDs), while some higher-resolution displays use techniques such as pulsed lasers that are directed by scanning mirrors to create balls of glowing plasma at the location of each voxel.

Holograms can be deployed as an alternative to a volumetric display, but with a more restricted viewing angle. It should be noted that the term "holographic display" is frequently (but incorrectly) applied to any image that creates an appearance of 3D. Some current theatrical and conferencing displays allow realistic images to appear out of thin air and can, with care, allow other individuals to walk "around" them. However, they are simply 21st-century implementations of the 19th-century Pepper's Ghost illusion using high-intensity projectors and Mylar display films and not true volumetric or holographic displays.

Volumetric displays have barely emerged from the laboratory, and developments remain in the very early stages, with little movement on the Hype Cycle during the past 12 months. At Siggraph 2010, Sony demonstrated its RayModeler device (a cylindrical autostereoscopic display), but this, like most others, remains firmly in the lab environment. Several companies, including InnoVision Labs and Realfiction, demonstrated 3D holographic images generated from their projectors, but none of them has been commercialized yet. The use of holographic techniques is, by far, the most advanced, but due to the intensive computing calculations required to generate the holographic image, the cost of generating the display image is one of the hurdles toward real-life adoption. Simpler and much lower-cost solutions would be required for mass adoption, and the growing availability of 3D displays is likely to divert demand for less-specialized applications (such as marketing and retail displays) toward these less-challenging technologies.

Swept and static volumetric displays suffer from the significant dangers of rapidly moving parts or ionized particles in the vicinity of people, especially because the volumetric nature of the generated image convinces the brain that it is solid and "real" and, therefore, can be touched. In all cases, the volume of data required to generate a volumetric image is considerable — typically on the order of 1,000 times more to create a 24-bit voxel image (1,024 layers on the z-axis) than the corresponding 2D image. In all cases, the amount of CPU processing required is equally significant compared with creating a 2D image.

3D televisions create a visual impression of depth, but rely on spatially multiplexed images that deliver different views to each eye and allow the brain to reconstruct a 3D representation. They are planar displays that simulate depth through visual effects, rather than true volumetric displays that create an image in a display volume with real depth.

User Advice: Outside of specialized areas, where budgets are not significant constraints, this technology remains firmly in the lab, rather than in commercial applications. Current technologies limit the size of volumetric space that can be displayed, and the mechanical solutions create potentially dangerous, rapidly moving parts. Until alternative approaches can be delivered (which seems unlikely in the foreseeable future), volumetric displays will remain an extreme niche product. Concurrently, the rapid growth and continuing development of 3D televisions in the mainstream markets threaten to overwhelm the continuing development of volumetric and holographic displays outside of specialized markets.

Business Impact: General applications are not well-developed for business use. To date, simple applications in marketing have been deployed — usually targeted at high-end retail environments, and there are some specialized applications for geospatial imaging to enhance 2D maps, and for use in architectural rendering. However, most of these can be achieved at much lower costs using other more-commercialized technologies, such as 3D displays (which have developed rapidly during the past 12 months) and virtual worlds. Potential application areas include medical imaging, consumer entertainment and gaming, and design, but costs will need to fall dramatically for these to be viable for using true volumetric displays. With the growing availability of affordable 3D manufacturing capabilities and 3D gestural input technologies, such as Microsoft's Kinect, there is growing interest from the arts and design fields to experiment with these technologies, and volumetric displays are already being explored in this context, with numerous experimental designs for (low resolution) volumetric displays now emerging.

Benefit Rating: Low

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: InnoVision Labs; Musion Systems; Optics for Hire; Quince Imaging; Realfiction; Sony; viZoo; Zebra Imaging

Automatic Content Recognition

Analysis By: Andrew Frank; Mike McGuire

Definition: Automatic content recognition (ACR) refers to the ability of a client application (typically a smartphone or media tablet app) to identify a content element within its proximity — audio, video or digital image — based on sampling a portion of the audio or video (or image), processing the sample and comparing it with a source service that identifies content by its unique characteristics such as audio or video fingerprints or watermarks.

Position and Adoption Speed Justification: ACR brings significant new context identification capabilities to context-aware computing applications on mobile devices. Popular ACR-enabled apps are currently divisible into three categories: music, TV and shopping.

Music recognition apps, such as SoundHound and Shazam, have been around for many years. These apps use ACR to generate potential new transaction triggers from each act of recognition by a consumer to drive a download sale, CD order or concert ticket, or encourage consumers to add that song to their listening sessions with their online music subscription service. Commercial associations with music are also enabled. If a band licenses a song to an automobile manufacturer, for example, there's a potential ad opportunity when the band's song is recognized and a sales opportunity (song downloads or concert tickets) every time that advertisement appears either on TV, radio or online, assuming the consumer is using a smartphone or media tablet with an ACR-enabled application.

More recently, TV recognition apps have seen a surge in adoption. Social-oriented consumer TV check-in apps, such as IntoNow (owned by Yahoo), GetGlue, Miso and yap.TV, utilize various approaches to identify a TV program on a nearby screen by its audio track and then synchronize the application's on-screen activity to the specific show or broadcast. Other vendors are taking the approach of enabling service providers and programmers to incorporate ACR features into their own apps, such as Gracenote Entourage, Digimarc, TVcheck, zeebox and Tunerfish. A few transmedia tool vendors, such as Storify, are beginning to incorporate feeds to and from ACR-enabled apps into content design features.

Such ACR-enabled applications offer the benefits of enhanced program features and social context to programmers, increasing engagement with the viewer and, in some cases, encouraging real-time viewing over time-shifting. Enhancement features can be genre-specific, for example:

- Distributing a featured recipe on a cooking show (and adding an opportunity to buy the ingredients)
- Offering behind-the-scenes content and back-story for scripted dramas (with expanding advertising and merchandising possibilities)
- Enhancing financial news coverage with stock picks and outlook summaries (including in-context trading opportunities)
- Adding athlete and team statistics to a sports broadcast (and, where legal, gambling opportunities)

Additionally, there are significant opportunities for advertisers to distribute targeted and interactive long-form versions of ads along with tailored incentives, such as coupons and special offers. This particular scenario has given rise to a spin-off of TV ACR apps known as TV incentive apps (examples include Viggle and ACTV8.me).

It's in the shopping context, however, that ACR becomes most disruptive. Amazon has created controversy with its Price Check app, which can identify an item of merchandise from a camera shot and offer an immediate discount, converting in-store shoppers into e-commerce customers.

Although drafting in-store shoppers may be the most disruptive example, TV ACR also has disruptive potential to intercept well-established control points in the monetization of media audiences. In an "audience drafting" scenario, when an advertiser's ad starts to run on a broadcast, an ACR-enabled app can enable a competitor of the broadcast ad to run their own ad in the synchronized app. This scenario could also apply to content promotion, with creators of one police procedural enticing viewers of a competing show by drafting its audience via a second-screen application. Such scenarios foreshadow the transit of ACR past the peak and into the Trough of Disillusionment before new opportunities begin to overtake disruptive influences.

User Advice: Organizations creating audio visual content for marketing or training purposes should explore the use of ACR to enhance content streams with interactive features leveraging context-aware computing capabilities as a potential source of innovation and competitive advantage. ACR can also be put into service to identify unauthorized uses of content, such as outside an authorized perimeter.

Content owners should leverage ACR to increase content discovery, identify unauthorized usage and generate incremental transactions (virtual goods, merchandise and ticket sales) or targeted advertising. To fully exploit the opportunity, content owners need to work with partners that enable them to own, or at least define, the resolution of fingerprints and watermarks. They should also press mobile platform providers, such as Apple and Google, to standardize ACR technology at the open OS level and make it available to apps in a copyright-respecting manner.

Broadcasters, advertisers and advertising agencies must develop strategies to address the audience-drafting problem by offering incentives to participating app developers, such as access to enhanced content feeds and a share of incremental ad or transaction revenue, to encourage voluntary compliance with nondrafting policies.

Business Impact: ACR has the potential to significantly disrupt retail and other physical-world-based business models by providing contextual access to previously unavailable sources of contextual information and competitive transaction opportunities.

ACR also has the ability to shore up the value of television (and perhaps radio) advertising by delivering additional context, addressability, social features and interactivity to second-screen ensemble interactions driven from linear media, effectively achieving new levels of convergence without requiring any modifications to existing broadcast or cable infrastructure.

For a variety of content owners and creators, ACR-based applications are likely to provide significant cross-marketing and transactional opportunities.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Civolution; Digimarc; Gracenote; Intrasonics; Nielsen; Nuance; Shazam; Yahoo

Recommended Reading: "Amazon, Apple, Facebook, Google, Microsoft and Sony Lead the Fight for Media Supremacy in the Clouds"

"Smart TVs and Second-Screen Experiences Provide Game-Changing Innovation Opportunities"

3D Scanners

Analysis By: Pete Basiliere

Definition: A 3D scanner is a device that captures data about the shape and appearance of real-world objects to create 3D models of them. 3D scanners for consumer use are low-cost, easy-to-operate devices that provide basic scan, capture and export of 3D images.

Position and Adoption Speed Justification: A 3D scanner captures the characteristics of the physical item, ranging from products to human body shapes, and converts them into digital form. 3D scanners are finding a consumer market by enabling users, who may not have access to computer-aided design (CAD) software or may not be proficient in its use, to more easily create a CAD drawing of the item by starting with a file that replicates the original.

A 3D scanner collects information about the surfaces in its field of view through either a contact or noncontact technology. As the term suggests, contact scanners rely on physical touch. Noncontact devices emit light, ultrasound or x-rays and then detect the emission's reflection to measure the object, or they rely on measuring radiation from the object itself.

The device collects information about the distance from the scanner from points on the surface that collectively describes the variations in the surface (and colors, when so enabled). Multiple scans from different perspectives are made, and the descriptive points are then brought into registration, resulting in a comprehensive 3D image of the object. A related noncontact technology is photogrammetry, the use of photography similar to panoramic photos, which digitally stitches images together to create the 3D model.

Continued technological advancements, improved functionality and price decreases in 3D scanners will mean consumers can justify a modest expenditure to try 3D image capture and 3D printing.

Among recent advances in 3D scanners are:

- The NextEngine 3D Scanner captures objects with "an all-new electro-optical architecture and sophisticated new algorithms (that use) an array of lasers to scan in parallel," according to the manufacturer. Its $2,995 price is one-tenth the cost of most 3D scanners, putting it within the range of some consumers and many hobbyists. NextEngine reportedly has thousands of mainly enterprise users in more than 80 countries.
- HP's TopShot LaserJet Pro has a camera and light mounted above the top of the printer on which an item is placed. An image is captured and processed, and then a 3D representation of the item is printed on 2D paper.

- Artec Group's EVA 3D scanner is a light handheld scanner that captures and processes up to 16 frames per second (each frame is a 3D image) in 24-bit color at 1.3-megapixel resolution. No marker, electromagnetic tracking or calibration is required.

Nevertheless, an obstacle to widespread consumer 3D scanner use is the need for specialist skills in finishing off the model once the scan is done; more automation here will be required for widespread adoption. One approach, taken by PhotoModeler, is a desktop photogrammetry software that creates 3D images from multiple 2D photographs.

A second approach is Autodesk's 123D Catch, which is an example of photogrammetry-based 3D image capture using a cloud application to create the 3D model. The user takes multiple photos of stationary objects and uploads them to Autodesk's cloud, where its stitching technology creates a model as a movie or .obj or .dwg files. 123D Catch is an example of a cloud-based 3D image processing service that will foster the growth of 3D printing in the consumer and business sectors by providing easy-to-use consumer software tools.

Other limitations on the extensive usage of 3D scanners have been their high cost and lack of portability. However, with the technology becoming less expensive and relatively simple to use, consumers and enterprises are reconsidering whether scanners are now worth an investment.

User Advice: Scanner, camera, and 2D and 3D printer manufacturers must continue research and development work aimed at improving 3D scanner price, usability and performance. The 3D printer technology providers, in particular, must ensure scanners enable consumers to easily create the 3D files that can be used to print 3D output on their devices.

Educational institutions should use low-cost 3D scanners not only for engineering and architectural courses as a complement to traditional design programs, but also in creative arts programs (for instance, to enable students to artistically modify items from nature). Manufacturing enterprises should explore the use of 3D scanning technology in product design, rapid prototyping and reverse-engineering. Whether in an enterprise or an educational institution, 3D scanners should be used in conjunction with design and creative programs that employ 3D printers to produce physical output from CAD software and other similar software.

Business Impact: Practical uses for 3D scanners will continue growing as their features improve and prices decline. Sales will grow as their use becomes more widespread, driving down purchase costs and enabling more enterprises and consumers to justify their purchase.

The commercial market for 3D scanning and printing applications will continue expanding into architectural, engineering, geospatial, medical and short-run manufacturing. In the hobbyist and consumer markets, scanners must have a lower cost before they will enjoy widespread acceptance for artistic endeavors, custom or vanity applications (such as the modeling of children's toys, pets and gamers' avatars), and "fabbing" (the manufacture of one-off parts).

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: 3D Digital Corp.; 3D Systems; Artec Group; Autodesk; Creaform; David Vision Systems; Eos Systems; HP; Konica Minolta; NextEngine; Roland

Recommended Reading: "Emerging Technology Analysis: 3-D Printing"

Autonomous Vehicles

Analysis By: Thilo Koslowski

Definition: An autonomous vehicle is one that can drive itself from a starting point to a predetermined destination in "autopilot" mode using various in-vehicle technologies and sensors, including adaptive cruise control, active steering (steer by wire), anti-lock braking systems (brake by wire), GPS navigation technology, lasers and radar.

Position and Adoption Speed Justification: Advancements in sensor, positioning, imaging, guidance and communications technologies, combined with advanced software and cloud computing, are gaining in precision to bring the autonomous vehicle closer to reality. However, complexity challenges remain before autonomous vehicles can achieve the reliability levels needed for actual consumer use cases. The development of autonomous vehicles largely depends on sensor technologies. Sensor data needs high-speed data buses and very high-performance computing processors to provide real-time route guidance, navigation and obstacle detection. The introduction of autonomous vehicles will occur in phases including the introduction of automated vehicles that will perform certain tasks such as steering automatically, but they won't be completely autonomous.

Autonomous vehicles can also help reduce vehicle emissions by applying throttle more evenly and avoiding repeated stops at traffic lights because driving speed is matched with traffic management data. Efforts by nonautomotive companies like Google are helping to achieve critical advances in autonomous driving and to educate consumers on the benefits and maturity of the technology. Key challenges for the realization of autonomous vehicles aren't limited to cost reductions for the technology, but they increasingly include legal considerations, such as liability and driver-related aspects. For example, can an intoxicated driver use an autonomous vehicle? Can children use a self-driving vehicle? First applications of autonomous vehicles will occur during the next 10 years, and early examples might be limited to specific road and driving scenarios. A potential challenge will come from those consumers who reject autonomous driving. However, over time the benefits of autonomous vehicles (for example, reduced insurance costs) will likely convince even those skeptics.

User Advice: Automotive companies should collaborate with technology vendors (for example, software, hardware and sensor providers) to share the high cost of experimentation with the required technologies and carefully balance accuracy objectives with user benefits. Initial autonomous vehicle functions will be limited to slow driving applications. Consumer education is critical to ensure that demand meets expectations once autonomous vehicle technology is ready for broad deployment.

Business Impact: Autonomous vehicle efforts focus on safety, convenience and economical applications, positioning this as a driver assistance technology, as well as an autopilot system in future deployment scenarios. Autonomous vehicles can help to address distraction issues for in-vehicle content consumption, with the rise of infotainment applications. Automotive companies will be able to market autonomous vehicle features as innovative driver assistance, safety and convenience features, as well as an option to reduce vehicle fuel consumption. The interest of nonautomotive companies highlights the opportunity to turn self-driving cars into mobile-computing platforms that offer an ideal platform for the consumption and creation of digital content, including location-based services (LBSs) and vehicle IT. Autonomous vehicles are also a part of mobility innovation, which automotive companies should explore.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: Bosch; Continental Automotive Systems; Google

Recommended Reading: "German Consumer Vehicle ICT Study: Demand for In-Vehicle Technologies Continues to Evolve"

"U.S. Consumer Demand for Vehicle ICT Expands From the Connected Vehicle to the Connected Driver"

"Google Moves Autonomous Cars Closer to Reality"

"Automobile of the Future: The Ultimate Connected Mobile Device"

Mobile Robots

Analysis By: Jackie Fenn

Definition: Mobile robots move and navigate in an autonomous or semiautonomous (that is, via remote control) manner, and have the ability to sense or influence their local environments. Mobile robots may be purely functional, such as vacuum-cleaning or warehouse robots, or may be humanlike in their appearance and capabilities.

Position and Adoption Speed Justification: Mobile robots have emerged from their traditional niches in the military, toy and hobbyist markets, providing practical value in home and enterprise markets. Mobile videoconferencing (also referred to as telepresence) has been the focus of multiple commercial introductions in the past few years — for example, VGo Communications and Anybots for remote meetings, and InTouch Health for physicians in hospitals. Prices for mobile videoconferencing are dropping sharply due to the ability to use mainstream technology on a mobile base (e.g., MantaroBot's $1,500 TeleMe robot that uses Skype on a tablet or smartphone). Warehousing is another growing application, with robots that deliver warehouse shelves to picking stations. Amazon's recent purchase of Kiva Systems, one of the early entrants in warehousing robots, shows the strategic importance of this next generation of mobile robots. Outdoor

autonomous vehicles are becoming viable for industry-specific uses (for example, ore-hauling robots or self-guiding underwater monitoring robots) and general road navigation (e.g., Google's self-driving car). Patient care in hospitals and home care for the elderly are also receiving attention. More advanced capabilities under development include safely lifting an object or person.

At the high end of the market, Sony and Honda have developed human-looking robots that can walk, run, jump and respond to gestures and voice commands. Boston Dynamics is developing a series of robots with distinct movement capabilities, including moving over rough terrain, jumping over fences and snaking through inaccessible areas. These are still research prototypes and not yet at commercially viable prices, but they indicate the level of physical performance and responsiveness that will be available in the next decade. Further advances will be driven by improving price/performance ratios for onboard sensors, such as cameras and lidar, and increases in algorithmic power that allow massively faster calculations in response to real-world conditions. Companies such as Microsoft (Robotics Developer Studio), iRobot (Create) and Willow Garage (which is open source) have introduced development tools that significantly reduce robotic software development barriers.

The Hype Cycle positioning for mobile robots reflects an average of the various applications. Some applications, such as robotic pets, are already widespread. Others, such as robots for lawn mowing and cleaning, have progressed into regular use as routine consumer purchases, while many of the potentially transformational applications and capabilities are still in development.

User Advice: Evaluate mobile robots for cleaning, delivery, warehousing and other task-specific applications. Evaluate mobile videoconferencing applications for remote consultation, management, collaboration, telecommuting and security, and prepare for mobile robots to appear as new endpoints in corporate IT networks. Examine robotic development tools to develop custom robots for "dirty, dull and dangerous" tasks.

Business Impact: During the next five years, applications for mobile robots will include cleaning, delivery, security patrolling, greeting of visitors and a range of other applications enabled by mobile videoconferencing and low-cost sensors. Use of mobile robots in warehousing and material handling applications will grow rapidly. Robots can also add value in deploying infrastructure technologies (for example, mounting RFID readers on a mobile robot to track assets over a large area at a much lower cost than blanket coverage through fixed readers). Longer term, mobile robots will deliver a broader spectrum of home help and healthcare capabilities. As costs fall, they may play a growing role in automating low-wage tasks in activities such as food preparation.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Adept MobileRobots; Aethon; Aldebaran Robotics; Anybots; Honda; iRobot; InTouch Health; Mitsubishi; Pal Robotics; RoboDynamics; Seegrid; VGo Communications

Recommended Reading: "Innovation Insight: Mobile Robot Innovations Move New Business Opportunities"

"Mobile Robots Carry the Internet of Things Into New Opportunity Areas"

"Insights on a Future Growth Industry: An Interview With Colin Angle, CEO, iRobot"

"Cool Vendors in Emerging Technologies, 2010"

Internet of Things

Analysis By: Hung LeHong; John Mahoney

Definition: The Internet of Things is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment.

Position and Adoption Speed Justification: Applying the definition for the Internet of Things to industry, government and consumer areas produces many rich scenarios and opportunities. For example, televisions and cars are starting to connect to the Internet to access and provide content and services. Similarly, smart meters, parking meters and agricultural sensors are public and enterprise assets that can also be connected to the Internet to provide new services and information.

Although many opportunities are possible, this year, the Internet of Things has seen the most interest in the areas of smart grid, smart city, the connected car, the connected home, healthcare and operational technology (OT). Many of the recent business cases for the Internet of Things have been rooted in energy savings, sustainability and content delivery, while shorter equipment outages have been made possible by safety and reliability monitoring.

Over the past decade of progression, there have been many variations on the "network of things." Some have used proprietary networks (for example, for manufacturing control). The network of things has also varied from large numbers of simple objects (for example, sensor nodes) to smaller numbers of complex objects, such as cars. In these networks, some things have been full Internet members with IP connections. Others, such as sensor nodes, have been limited in that they don't support the full range of IP behavior, and may talk to the Internet only via gateways.

The point has already been reached where the number of things connected to the Internet has surpassed the number of PCs and mobile devices that connect to the Internet — making the Internet more of an Internet of Things, than a PC or mobile Internet. The number of things that connect to the Internet will continue to increase exponentially. There will be many variations in the way things connect and are networked. For example, enterprises can have an "intranet" of things to control security and access. Things may be connected to one another as part of a mesh network and have only a handful of nodes actually connected to the Internet (a common approach in connected lighting). Ad hoc networks of things can be established and changed on the fly. For example, all cars in an area may communicate with one another and traffic lights to optimize traffic flow and avoid accidents.

The Internet of Things concept will take more than 10 years to reach the Plateau of Productivity — mainly due to security challenges, privacy policies, data and wireless standards, and the realization that the Internet of Things requires the build-out of a topology of services, applications and a connecting infrastructure.

User Advice: As you plan how the Internet of Things will be applied in your enterprise or area, start by identifying opportunities and the benefit areas, and then, work out all the elements that will be required to implement the opportunities. For benefits, base your business case on tangible areas, such as energy savings, reduced operational costs, new revenue from connected services or content monetization, and then, add intangible areas, such as customer experience and citizen well-being. For implementation considerations, expect the need for a topology of services, applications and a connecting infrastructure. This will require most enterprises to seek out an ecosystem of partners, such as system integrators, real-time data vendors and architects, telecom operators, middleware vendors that specialize in machine-to-machine technology, and specialists in the area of choice (for example, smart buildings, telematics or telemedicine).

There is still much to innovate in the Internet of Things, so budget for much experimentation. Enterprises seeking to gain competitive advantage from technology should consider the Internet of Things as one of the top areas of opportunity because of the undiscovered opportunities.

Business Impact: The value of the Internet of Things is in its applications. For example, cities can become "smart cities" as sensors on buildings, lampposts, parking spots and many other city infrastructure items become connected. Energy savings, sustainability and citizen well-being are at the forefront of the benefits in areas such as energy efficiency programs drawing on building occupancy, temperature and humidity data, along with weather data; real-time traffic management and in-vehicle information applications; and agricultural applications capturing in real time soil moisture levels to control irrigation.

On the consumer side, retailers and consumer product companies can provide added services and marketing channels or completely transform products by having their products connected to the Internet and to one another. The connected home and car are examples.

The benefits can range from incremental improvements (such as having parking meter sensors communicate the availability of parking spots) to transformational changes (for example, connected healthcare scenarios).

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Emerging

At the Peak

Natural-Language Question Answering

Analysis By: Whit Andrews

Definition: Applications that provide users with a means of asking a question in plain language that a computer or service can answer with a meaningful response in a reasonable time frame.

Position and Adoption Speed Justification: IBM's virtuosic performance with its Watson application-computer combination on television quiz show "Jeopardy" was enormously successful from a marketing perspective and captured the attention of the world in February 2011. It was a benchmark in the progression toward cognitively effective reasoning by artificial actors. It joins a long line of immediately fascinating if broadly constrained custom-made knowledge calculation devices. And later in 2011, Apple's Siri joined it as a new way for users to interact with informational systems by incorporating speech-to-text technology with natural-language processing query analysis to wow users (at least some of the time).

Another example is Wolfram Alpha, a Web answer engine that converts queries to mathematical values and does some natural-language analysis. However, the challenges in effective interpretation of idiomatic interrogative speech, matching it to knowledge bases of potentially infinite scope, and the selection of a limited number of answers (even just one) remain profoundly difficult. Simple answers such as the one answer available for a trivia question are far easier than the multivariate, nuanced answers inherent in real human communication (cold or flu? why not cold *and* flu!).

Solutions ultimately must discover means of communication with humans that are intuitive, effective, swift and dialogic. The ability to conduct even a brief conversation, with context, antecedent development and retention, and relevancy to individual users is well beyond conception — for now. However, nonconversational, information-centered answers are indeed already possible, with the right combination of hardware and software, and surely as in all technology categories, the availability of such resources can only become cheaper and easier. More than five years will pass before such capabilities are commonplace in industry, government or any other organizational environment, but they will be available to leaders in such categories.

User Advice: The computing power required to accomplish a genuinely effective trivia competitor is great, but will become more accessible with time. Any projects founded on such facility must be experimental, but in the foreseeable future will include diagnostic applications of many kinds, as well as commercial advice and merchandising and strategic or tactical decision support. "Augmentation" is the key thought. No decision support application springs, full formed, from the ether — it will be expert humans who build it, design the parameters and develop the interface, and humans will, similarly, evaluate its advice and decide how to proceed.

Business Impact: Ultimately, the ability for line workers or unschooled consumers to achieve effective responses from machines without using expertise in framing queries (which is the necessary case even in simple-interface applications such as Google.com) will generate new kinds of information exploitation by diminishing information friction yet more. Given a limited set of answers and an effective means of capturing plain language requests, it is easy to see computers

more effectively providing guidance in various environments. Business cases such as diagnostic support in healthcare — whether for expert or non-expert users — consumer services (such as those Siri provides) are some use cases.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Apple; Autonomy; Cognitive Code; EasyAsk; IBM; Microsoft; Vlingo; Wolfram Alpha

Silicon Anode Batteries

Analysis By: Jim Tully

Definition: Silicon anode batteries are an extension of widely used lithium ion (Li-Ion) batteries. Early generation Li-Ion batteries used lithium as the anode material. This was replaced with carbon/graphite following a number of widely reported overheating and explosion incidents. Next-generation Li-Ion batteries are likely to make use of silicon anodes that utilize silicon nanotubes, or a comparable coating process. This will result in significantly higher energy storage and longer battery life.

Position and Adoption Speed Justification: Claims from companies and research teams range from three-to-10 times greater energy storage than current Li-Ion batteries (with three-times greater being more realistic in the short term). Significant volume and weight savings and a longer operating lifetime are additional benefits of the technology. Charging times will be similar to those of existing Li-Ion batteries. The technology will find widespread use in mobile devices, PCs, electric vehicles (EVs) and home energy storage/solar installations. Environmental benefits are achieved from reduced material usage, lower transportation costs in the supply chain and increased energy efficiency during usage.

A number of suppliers are rushing to develop and evaluate this technology. During 2010, Nexeon announced the signing of material evaluation agreements with a number of battery and automotive companies. Around the same time, Panasonic announced its intention to start volume production of silicon anode Li-Ion batteries for PCs in 2012. 3M has recently announced further research activities and an acceleration of manufacturing plans. Nevertheless, developments have been relatively slow over the past year, mostly because of the economic climate. We have therefore left the position unchanged compared with 2011.

Initial implementations will probably offer modest performance improvements, compared with the full capability of the technology. However, there is now considerable momentum behind moving the technology into production.

User Advice:

- Users should monitor developments. If the technology looks useful for the purpose, interest should be expressed to vendors of equipment like PCs or smartphones.
- Vendors should evaluate the technology aggressively and begin to make appropriate system design changes in anticipation of the new batteries.
- Users of equipment in isolated areas, with limited power availability, should evaluate offerings in preparation for early adoption.
- Makers of EVs should evaluate these batteries. While charging time is not affected, the energy stored is significantly higher, resulting in a longer journey time between charges.

Business Impact:

- Longer working times will facilitate more powerful mobile devices and applications.
- Due to their smaller physical size and weight, silicon anode Li-Ion batteries offer the potential for use in mobile devices and other equipment with smaller footprints.
- EVs and related systems should receive a boost from this battery technology.
- End-of-life issues are unchanged for this change of anode technology. No additional impact (on recycling or toxicity) is expected at this time.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: 3M; LG Chem; Nexeon; Pacific Northwest National Laboratory; Panasonic; Sanyo

Speech-to-Speech Translation

Analysis By: Adib Carl Ghubril

Definition: Speech-to-speech translation involves translating one spoken language into another. It combines speech recognition, machine translation and text-to-speech technology.

Position and Adoption Speed Justification: A host of recent low-cost apps for mobile phones from companies such as Cellictica (Trippo VoiceMagix), Jibbigo and SpeechTrans are showing the viability of speech-to-speech translation for consumer and tourist applications, in which approximate translations are often good enough. Google has announced "Conversation Mode" for its Google Translate Android app, and NTT Docomo has demonstrated cloud-based near-real-time simultaneous translation between Japanese and English. Other major players, including Microsoft and IBM, have demonstrated highly accurate speech translation in their labs.

For highest accuracy, developers need to constrain the task to a limited vocabulary, such as IBM's system for the U.S. military in Iraq. Some solutions involve an interim stage of generating a textual rephrasing of the spoken sentence, so the speaker can check that the system has found the right context prior to translation into the target language. While there has been little adoption of the

technology by enterprises to date, due to accuracy limitations, the availability of the low-cost mobile consumer products may drive interest and progress for higher-end applications. We anticipate rising hype and capabilities during the next two years, and a growing breadth of applicability during the next five years.

Vendors can build on their speech recognition know-how, such as in Apple's Siri, to create a translation system that can be used to support dialogue. Also, a multimodal approach is being experimented with, in which information from gestures and facial expression is being used to execute translation in context with dialogue.

User Advice: Do not view automated translation as a replacement for human translation but, rather, as a way to deliver approximate translations for limited dialogues in which no human translation capability is available. Evaluate whether low-cost consumer products can help during business travel or first-responder situations. Leading-edge organizations can work with vendors and labs to develop custom systems for constrained tasks.

Business Impact: Consumer mobile applications are the first to attract significant interest. Potential enterprise applications include on-site interactions for fieldworkers, as well as government security and emergency and social service interactions with the public. Longer term, multinational call centers and internal communications in multinational corporations will benefit, particularly for routine interactions. Internal collaborative applications may be limited because strong team relationships will unlikely be forged with automated translation as the only way to communicate.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Cellictica; Google; IBM; Jibbigo; Philips Speech Processing; Science Applications International Corp.; SpeechTrans

Crowdsourcing

Analysis By: Carol Rozwell

Definition: "Crowdsourcing" describes the processes for sourcing a task or challenge to a broad, distributed set of contributors using the Web and social collaboration techniques. Crowdsourcing applications typically include mechanisms to attract the desired participants, stimulate relevant contributions and select winning ideas or solutions.

Position and Adoption Speed Justification: Crowdsourcing is being successfully applied to narrowly defined tasks, open-ended challenges or simply calls for ideas. It may be used internally or externally and, in either case, may be open to any participant or confined to a group of experts.

Successful crowdsourcing requires the sponsoring organization to:

- Specify the task or challenge (including time frame for responses, guidelines and rules) and notify potential contributors.
- Manage payments.
- Assess intellectual property implications.
- Ensure some level of quality control regarding access, contributions (particularly if prizes or payments are involved) and voting.

In its broadest sense, crowdsourcing could be viewed as synonymous with collective intelligence (that is, Web-mediated mass collaboration such as Wikipedia or open source), but it is more often used to refer to a focused effort by a company or organization to achieve a specific task, or identify opportunities, by drawing on contributors outside the immediate control of its management or contractual structures.

Crowdsourcing has been applied in a range of areas in government and private-sector organizations for nearly a decade, with rapid acceleration in its use during the past two to three years for idea generation in organizational innovation programs. Innovation activities where customers or "the collective" create and rank ideas, or design marketing campaigns, are the most popular. These crowdsourcing activities generate ideas that are increasingly selected through voting by participants — with the final selection made and developed by the organization's employees.

As more people interact on the social Web, providing frequent updates on their location and activities, crowdsourcing all types of status information — mixed with context information — becomes practical. For example, drivers can alert fellow "road warriors" to traffic conditions, travelers can offer suggestions for good restaurants nearby, and knowledgeable people can answer other people's questions.

There is a large, untapped potential in applying crowdsourcing to a much broader range of tasks and goals, but there is still more to be learned and experienced about where the practice is most effective compared with other approaches. The tools to establish a crowdsourcing environment, particularly those involving recognition incentives or micropayments, are becoming widely available. However, as with any technology, effective practices in crowdsourcing remain the critical success factor.

User Advice: Look for creative ways to use crowdsourcing, beyond idea generation. Consider tasks that can be broken down into smaller chunks and attacked in parallel, such as classifying images, as candidates for crowdsourcing. Use crowdsourcing for innovation in areas that can be focused and well-defined as a challenge. Look, in particular, for opportunities to crowdsource tasks to which volunteers (internal or external) would be prepared to contribute, and extend your ability to innovate or resolve these tasks in a resource-constrained environment. Government organizations are particularly well positioned to take advantage of the willingness of citizens to help out in areas that affect their local environment or special interests.

Also, when employing crowdsourcing with non-employees, be prepared to grapple with intellectual property (IP) issues. In some cases, you will reveal your own IP (for example, your internal or future

plans) to outsiders; in other cases, you will need to deal with the terms of IP ownership for any relevant contributions from external participants.

Business Impact: There are multiple areas of business impact:

- First, is the potential to open your innovation efforts by stimulating and capturing creative ideas from outside your organization.
- Second, crowdsourcing offers the ability to increase dramatically the available human resources that can be applied to a task or challenge — well-designed crowdsourcing efforts will attract interest and creativity to a task.
- Third, there is an opportunity for organizations to crowdsource core business competencies, extend their access to key capabilities and change their associated cost structure.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Amazon; Clickworker; CloudCrowd; Crowdcast; CrowdFlower; IdeaScale; InnoCentive; Quora; TopCoder

Recommended Reading: "The Impact of Crowdsourcing on IT Support"

"Allstate Crowdsources Innovation With Blitzes"

"Cool Vendors in Content Management, 2012"

Big Data

Analysis By: Mark A. Beyer; Sid Deshpande

Definition: Big data is high-volume, -velocity and -variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making.

Position and Adoption Speed Justification: A wide array of hardware and software solutions has emerged to address the partial issue of volume. Big data is almost at the Peak of Inflated Expectations. Because the practices are developing quickly, it will go over the Peak of Inflated Expectations and possibly start into the Trough of Disillusionment in 2012. However, big data should spend very little time in the trough. MapReduce is the current darling of big data processing, but it is a batch solution and therefore has to be combined with other information management and processing technologies to provide complex-event processing support and support for larger user populations. Hadoop implementations require expert-level staff or system implementers. Attempts to combine MapReduce with Graph will follow, as well as natural-language processing and text analytics. Other big data assets, such as images, video, sound and even three-dimensional object modeling, will also drive big data into the trough. Some big data technologies represent a great leap

forward in processing management. As a result, these new technologies represent a capability to overtake existing technology solutions when the demand emerges to access, read, present or analyze any data. Throughout 2010 and 2011, big data focused primarily on the volume issues of extremely large datasets generated from technology practices such as operational technology, Internet logging, social media and streaming sources.

The larger context of big data refers to the wide variety and extreme size and count of data creation venues in the 21st century. Big data practices introduce the concept that all data can be integrated and promote the development of new technologies. This is in stark contrast to the current view that only selected data can be integrated due to existing technology limitations. As a new issue with requirements that demand an approach, the expansion of traditional boundaries will occur extremely fast because the many sources of new information assets are increasing geometrically (for example, desktops became notebooks and now tablets); portable data is everywhere and in multiple context formats. The increasing number of digital information devices is causing exponential increases in data volumes. Additionally, the information assets include the entire spectrum of the information content continuum, from fully undetermined structure ("unstructured") to fully documented and traditionally accessed structures ("structured"). As a result, organizations will seek this as differentiation from their competitors, so they can become leaders in their markets in the next two to five years. This makes big data a current issue demanding almost immediate solutions. Vendors are almost universally claiming that they have a big data strategy or solution. However, Gartner clients have made it clear that big data must include large volumes processed in streams as well as batch (not just MapReduce) and an extensible services framework that can deploy processing to the data or bring data to the process, and that spans more than one variety of asset type (for example, not just tabular, or just streams or just text). Importantly, the different aspects and types of big data have been around for more than a decade — it is only recent market hype around legitimate new techniques and solutions that has created this heightened demand.

The final and most important point is that current specialized technologies will become mainstream, and then the next big data issue will emerge and force even newer technologies and practices, constantly renewing itself.

User Advice:

- Identify existing business processes that are hampered in their use of information because the volume is too large, the variety is too widespread or the velocity creates processing issues. Then identify business processes that are currently attempting to solve these issues with one-off or manual solutions.
- Review existing information assets that were previously beyond existing analytic or processing capabilities (referred to as "dark data"), determine if they have untapped value to the business, and make them a first or pilot target of your big data strategy. In particular, look for information use cases that combine extremely diverse information assets into analysis and data mining solutions.
- Plan on utilizing scalable information management resources, whether they are public cloud, private cloud or resource allocation (commissioning and decommissioning of infrastructure), or some other strategy. Do not forget that this is not just a storage and access issue. Complex,

multilevel, highly correlated information processing will demand elasticity in compute resources similar to the elasticity required for storage/persistence.

- Extend the metadata management strategies already in place and recognize that more is needed to enable the documentation of these information assets, their pervasiveness of use, and the fidelity or assurance of the assets, tracking how information assets relate to each other and more.

Business Impact: There are three principal aspects to big data — success will be limited unless all are addressed. The quantitative aspects of big data generally do not emerge one by one. Volume, variety and velocity most often occur together. The second aspect is that innovation must be cost-effective both in costs to deploy and maintain, and in terms of time to delivery — solutions that arrive too late are useless regardless of cost. Finally, the focus must be on increased insight by the business into process optimization from immediate automation through the development of completely new business models. Big data permits greater analysis of all available data, detecting even the smallest details of the information corpus — a precursor to effective insight and discovery. The primary use cases emerging are: leveraging social media data, combining operational technology (machine data) with back-office and business management data, and further validating existing assets (increasing their "fidelity").

Big data has multiple use cases. In the case of complex-event processing, queries are complex with many different feeds, and the volume may be high or not high, the velocity will vary from high to low, and so on. Volume analytics using approaches such as MapReduce (the Apache Hadoop project, for example) are valid big data use cases. In addition, the business intelligence use case can utilize it in-database (for example, Aster Data and Greenplum), or as a service call managed by the database management system (IBM Big Insights, for example), or externally through third-party software and implementation services (such as Cloudera or MapR). Enterprises using portals as a business delivery channel have the opportunity already to combine geospatial, demographic, economic and engagement preferences data in analyzing their operations, and/or to leverage this type of data in developing new process models. Life sciences generate enormous volumes of data in clinical trials, genomic research and environmental analysis as contributing factors to health conditions.

The primary imperative remains. A new standard in determining cost-effective solutions has emerged. Gartner estimates that organizations that have introduced all 12 dimensions of big data to their information management strategies by 2015 will begin to outperform their unprepared competitors within their industry sectors by 20% in every available financial metric.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Cloudera; EMC-Greenplum; HortonWorks; IBM; MapR; Teradata-Aster Data

Recommended Reading: "'Big Data' Is Only the Beginning of Extreme Information Management"

"How to Choose the Right Apache Hadoop Distribution"

"CEO Advisory: 'Big Data' Equals Big Opportunity"

"The Importance of Big Data: A Definition"

Gamification

Analysis By: Brian Blau; Brian Burke

Definition: Gamification is the use of game mechanics to drive engagement in non-game business scenarios and to change behaviors in a target audience to achieve business outcomes. Many types of games include game mechanics such as points, challenges, leaderboards, rules and incentives that make game-play enjoyable. Gamification applies these to motivate the audience to higher and more meaningful levels of engagement. Humans are "hard-wired" to enjoy games and have a natural tendency to interact more deeply in activities that are framed in a game construct.

Position and Adoption Speed Justification: Gamification can be implemented with software systems and applied to many different challenges relating to customer engagement, education, employee performance, innovation management, supply chain management and healthcare, for example. While the concepts behind gamification are not new, its first use in 2007 coalesced specifically around using game mechanics derived from video games. Now, gamification is emerging as a trend in enterprise. Its current "sweet spot" is the consumer market and it is a key aspect of marketing campaigns, customer loyalty programs, product design of mobile apps and services, and is intended to increase customer interaction and engagement.

Early adopters, such as mobile smartphone apps and consumer services, report that gamification has a significant positive impact on user engagement rates when applied in a suitable context. However, gamification also has significant challenges to overcome before widespread adoption occurs. Designing games is no easy task — during four decades of video game development many games have failed, despite their developers having the best intentions. A basic level of game mechanics (a points system, leaderboard, achievements, awards or basic challenges) is often not enough to sustain increased engagement, as incentives and rewards must be aligned to motivate the target audience. Gamifying activities represents another challenge, one that requires careful planning and execution, and iteration. Overcoming these challenges will require successive integration of gamification in a wide variety of consumer and enterprise scenarios.

User Advice: Gamification of consumer services, applications and enterprise processes can increase user interactivity and change behavior, resulting in greater user engagement. For example, users who have fun can are more likely to become loyal users. Gamification has many uses that target consumers, customers, employees or another defined audience and it impacts many areas of business and society.

Organizations planning to leverage gamification must clearly understand the target audience they intend to engage, what behaviors they want to change, what motivates the audience and maintains their engagement and how success will be measured.

Gamification technology comes in three forms; "gamified" platforms (such as Foursquare, SCVNGR and shopkick), software services that integrate with custom-developed applications (such as Badgeville, BigDoor, and Bunchball) and purely custom implementations.

Recognize that simply including game mechanics is not enough to realize its core benefits and that making them sufficiently rewarding requires careful planning, design and implementation with ongoing adjustments to keep users interested. Before designing the game mechanics, it is essential to determine an appropriate tempo and stimulus to reinforce desired behavior, along with appropriate rewards or penalties.

Enterprises seeking to encourage new behaviors can use gamification to motivate employees. For example, enterprise architects might use it for scenario planning exercises or future state visioning during enterprise context sessions, or it could be used to advance adoption of social media either internally, with employees, or externally with customers. Organizations should examine where gamification can be used as a mechanism to inspire and reward new business options and markets and to recognize contribution and participation that augments and furthers the purpose of their businesses and their customer communities.

The intended behavioral learning and the rewards that users will associate with gamification depend on the nature of a game's mechanics, the setting and context of the scenario and progression of the process. Implementing gamification means matching game mechanics and incentives to target business outcomes to attract and sustain a deeper level of interactivity, relationship or engagement with users.

Business Impact: Gamification techniques can be used in a wide range of scenarios to enhance product and service strategies. Its use is relevant to marketing managers, product designers, customer services managers, financial managers and human resources staff, among others, whose aim is to bring about longer-lasting and more meaningful interactions with customers, employees or the general public.

Even though gamification can be beneficial, it's important to design, plan and iterate on its use to avoid negative business implications through unintended consequences, such as behavioral side effects or gamification fatigue.

User engagement is at the heart of today's "always connected" culture. Incorporating game mechanics encourages desirable behaviors, which can, with the help of carefully planned scenarios and product strategies, increase user participation, improve product and brand loyalty, advance learning and understanding of complex process, accelerate change adoption and build lasting and valuable relationships with target audiences.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Badgeville; BigDoor; Bunchball; Foursquare; SCVNGR

Recommended Reading: "Marketing Essentials: Strategic Alternatives for Increased Engagement Using Gamification"

"Innovation Insight: Gamification Adds Fun and Innovation to Inspire Engagement"

"Gamification Primer: Life Becomes a Game"

"Marketing Essentials: How to Create a Mobile Game for Your Brand or Product"

"Maverick* Research: Motivation, Momentum and Meaning: How Gamification Can Inspire Engagement"

"Market Insight: Lessons and Trends From the Evolution of Video Games"

HTML5

Analysis By: David Mitchell Smith; Ray Valdes

Definition: As the heir apparent to HTML4, HTML5 is a next logical step in the development of HTML. However, the term "HTML5" is often used to mean more than the formal specification, and less simultaneously (see "HTML5 and the Journey to the Modern Web"). HTML5 is the proposed specification for the next generation of HTML. It is important, because it brings to the Web much of the rich Internet application (RIA)-like capabilities that have required additional software.

Position and Adoption Speed Justification: HTML5 has increased in visibility and has garnered extremely charged opinions as a result. The extreme opinions range from "HTML5 will make everything else (especially Flash) irrelevant" (see "HTML5 and the Future of Adobe Flash") to "It will take more than a decade for HTML5 to be ratified, so we don't need to pay attention to it until then." The reality is, as usual, somewhere in between, and is time- and scenario-dependent.

HTML5 is not one thing. At one extreme, the hype and aura around the term can lead to using it to mean one particular feature (e.g., video). At the other extreme, treating it as if it is one large, inseparable thing will lead to a "wait until it's done" approach, which will be a bad choice for most companies. HTML5 consists of many components, including video, canvas, audio and offline capabilities. In addition, other modern Web capabilities, such as JavaScript, CSS3 and WebSocket, are closely related and are often grouped together.

The working subset and de facto standards may be driven by mobile devices. OS fragmentation continues to be a significant issue in mobile. However, most mobile browsers for smartphones are, or will be, based on WebKit. OS fragmentation increases the need for a viable cross-platform strategy. The common technology base of WebKit and the evolution of working subsets and the de facto nature of HTML5 pieces may fit this need.

HTML5 usage and stability will appear first in mobile environments, then on the desktop. HTML5 usage and stability will be driven by desktop and mobile use scenarios, and there will be different drivers for both environments.

User Advice: Developers should:

- Familiarize themselves with the components of HTML5, and the browsers that support them.
- Exploit the available features of HTML5 now, but recognize that they are based on a draft standard and are subject to change. Higher-level frameworks can help insulate developers.
- Consider HTML5 when designing applications that require the broadest reach across the most browsers and devices.

Business Impact: There is visible momentum around HTML5; however, as with most technologies, especially on the Web, interest is occurring primarily outside the enterprise sector — among progressive Web designers and among mobile application developers. Web developers are starting to design around new elements in HTML5, such as canvas, offline mode and video. Developers of RIA-based sites that rely on Flash and Silverlight need a strategy that relies less on Flash and Silverlight. Mobile developers are interested in HTML5 as a cross-platform technology that doesn't rely on "native" applications and proprietary app stores.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Adobe; Apple; Google; Microsoft; Research In Motion

Recommended Reading: "HTML5 and the Journey to the Modern Web"

"Flash, Silverlight and the RIA Dilemma in a World of HTML5"

"Browser Vendors' HTML5 Strategies Are Not All the Same"

"HTML5 and the Future of Adobe Flash"

Hybrid Cloud Computing

Analysis By: David W. Cearley; Donna Scott

Definition: Hybrid cloud computing refers to policy-based and coordinated service provisioning, use and management across a mixture of internal and external cloud services.

Position and Adoption Speed Justification: Virtually all enterprises have a desire to augment internal IT systems with those of cloud services for various reasons, including for additional capacity, financial optimization and improved service quality. Even enterprises that primarily outsource their runtime operations want to augment their systems with cloud resources. Some IT organizations envision third parties providing an infrastructure to their companies, while managing the operations themselves to meet SLAs. While hybrid cloud computing envisions use of a combination of internal and external cloud services, hybrid IT expands the hybrid notion to include more-traditional environments. Hybrid cloud computing refers to the combination of external public cloud computing services and internal resources (either a private cloud or traditional infrastructure,

operations and applications) in a coordinated fashion to assemble a particular solution or to manage and control services uniformly. Hybrid IT and hybrid cloud computing does not refer to using internal systems and external cloud-based services in a disconnected or loosely connected fashion. They imply significant integration or coordination between the internal and external environments at the data, process, management or security layers.

Hybrid IT and hybrid cloud computing can take a number of forms. These approaches can be used individually or in combination to support a hybrid cloud computing approach:

- Joint security and management — Security and/or management processes and tools are applied to the creation and operation of internal systems and external cloud services.
- Workload/service placement and runtime optimization — Using data center policies to drive placement decisions to resources located internally or externally, as well as balancing resources to meet SLAs (e.g., real-time infrastructure).
- Cloudbursting — Dynamically extending an application or a portion of it from an internal, private cloud platform to an external public cloud service based on the need for additional resources.
- Cloud services composition — Creating a solution with a portion running on internal systems, and another portion delivered from the external cloud environment in which there are ongoing data exchanges and process coordination between the internal and external environments. Mashups are a form of integrated solutions where public cloud-based services are combined with internal application components to create a composite application using Web APIs and data success mechanisms (such as RSS feeds).
- Dynamic cloud execution — The most ambitious form of hybrid cloud computing combines joint security and management, cloudbursting, and cloud services compositions. In this model, a solution is defined as a series of services that can run in whole or in part on an internal private cloud platform or on a number of external cloud platforms, in which the software execution (internal and external) is dynamically determined based on changing technical (e.g., performance), financial (e.g., cost of internal versus external resources) and business (e.g., regulatory requirements and policies) conditions. Most companies will use some form of hybrid cloud computing during the next three years. Early adopters are already using mashups and joint security and management approaches. Some are building simple integrated solutions or implementing cloud management platforms to drive policy-based placement and management of services internally or externally. They may also be experimenting with cloudbursting. The grid computing world already supports hybrid models executing across internal and external resources, and these are increasingly being applied to cloud computing. More-sophisticated, integrated solutions and dynamic execution interest users, but are beyond the current state of the art.

Because most vendors of cloud computing services and technologies have moved their marketing beyond the cloud to hybrid cloud, yet hybrid cloud computing is still in its infancy, we have moved this technology near the Peak of Inflated Expectations. Technologies that are used to manage hybrid cloud computing include cloud management platforms, but also specific services supplied by external cloud providers that enable movement and management across internal and external

cloud resources. Most hybrid cloud computing technologies and services seek to lock in customers to their respective technologies and services, as there are no industry standardized approaches.

User Advice: When using public cloud computing services, establish security, management and governance models to coordinate the use of these external services with internal applications and services. Where public cloud application services or custom applications running on public cloud infrastructures are used, establish guidelines and standards for how these elements will combine with internal systems to form a hybrid environment. Approach sophisticated integrated solutions, cloudbursting and dynamic execution cautiously, because these are the least mature and most problematic hybrid approaches. To encourage experimentation and cost savings, and to prevent inappropriately risky implementations, create guidelines/policies on the appropriate use of the different hybrid cloud models. Consider implementing your policies in cloud management platforms, which implement and enforce policies related to cloud services.

Business Impact: Hybrid cloud computing leads the way toward a unified cloud computing model in which there is a single cloud that is made up of multiple sets of cloud facilities and resources (internal or external) that can be used, as needed, based on changing business requirements. This ideal approach would offer the best-possible economic model and maximum agility. It also sets the stage for new ways for enterprises to work with suppliers and partners (B2B) and customers (business-to-consumer) as these constituencies also move toward a hybrid cloud computing model. In the meantime, less-ambitious hybrid cloud approaches still allow for cost optimization, flexible application deployment options, and a coordinated use of internal and external resources.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: BMC Software; CloudStack; HP; IBM; Microsoft; OpenStack; ServiceMesh; VMware

Recommended Reading: "Design Your Private Cloud With Hybrid in Mind"

Wireless Power

Analysis By: Jim Tully; Steve Ohr

Definition: A wireless power supply facilitates the charging or direct powering of electrical and electronic equipment using inductive or radio frequency (RF) energy transfer. Inductive systems are preferred for short ranges (a few centimeters) and can provide very high levels of power equaling several thousand watts or more. RF power transfer operates over longer distances (tens or hundreds of meters or more) and provides more modest levels of power (a few milliwatts or less).

Position and Adoption Speed Justification: Inductive systems are suited for PCs and the fast charging of mobile devices, while RF power is more applicable to remote sensor networks and trickle-charging of mobile phones. Combinations of both induction and RF are also used — for

example, in Near Field Communication (NFC). This operates over short-to-medium range of up to 20 cm, depending on the frequency used. The NFC Forum has specified a version of the technology that operates at 13.56MHz with an operating distance up to about 4 cm.

In its most basic forms, inductive power has been in use for many years — for example, in electric toothbrushes. The focus now is on more flexible, efficient and addressable forms of the technology using resonance techniques. Most users of mobile electronic devices find battery charging to be a real annoyance. It is inconvenient, and different chargers are required for different types of equipment.

The idea of wireless charging is clearly attractive and several solutions have recently been demonstrated. For example, wireless charging schemes are being designed for use in tabletop surfaces and similar environments that will charge a mobile device when it is placed on the surface.

Several competing (and incompatible) offerings are currently available. This highlights the need for standardization before there is any chance of widespread adoption of the technology for mobile devices or PCs. An organization called Wireless Power Consortium has been addressing this issue for some time, and a specification has been published. During the past three months, another group (Alliance for Wireless Power [A4WP]) was formed, and this is likely to cause some confusion in the market. A bigger obstacle is the question of why mobile equipment makers (such as handset vendors) should be interested in this technology.

Mobile phone makers have recently agreed on a set of standards for chargers, which could set back the aspirations of wireless power vendors in this area. Prominent discussion continues about this technology, but Gartner does not see any solid evidence of a progression along the Hype Cycle. Therefore, the position is unchanged this year.

User Advice: Technology planners in organizations with many users of mobile devices should evaluate the benefits of this technology as it becomes available. Vendors of mobile devices, batteries and power infrastructure (such as chargers) should evaluate the alternatives and decide on their position in relation to this technology. Users should investigate this if they need small levels of "trickle" charging for equipment where it is difficult or impossible to connect a physical supply — for example, sensor networks and Bluetooth low-energy devices.

Users in certain vertical organizations should also examine this technology. There may be benefit, for example, in introducing wireless-charging facilities in environments where customers spend time — such as in restaurants. This may attract customers if and when the technology starts to become popular.

Business Impact: The technology is applicable to a wide range of business and consumer situations. Some environments require mobile devices to be charged at all times, and wireless charging is particularly suited to those situations. It also offers advantages of less clutter and reduced e-waste of old chargers. Efficiency is somewhat lower than wired power, which will need to be factored into any decision.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Fulton Innovation; MIT; Nokia; Powercast

3D Printing

Analysis By: Pete Basiliere

Definition: 3D printing is a method of converting 3D model data into a physical, geometrically complex, intricately detailed and potentially functional model or salable new or replacement part.

Position and Adoption Speed Justification: Six basic 3D printing technologies are in use or under development: extrusion, lamination, fused deposition modeling, inkjet, stereolithography and selective heat sintering. 3D printers deposit ink, resin, plastic or another material (including experiments with live matter), layer by layer, to build up a physical model.

Industrial 3D fabricating technologies for product prototyping and short-run part manufacturing have been available since the early 1980s. More recently, the number and type of 3D printers have increased, and printer and supply costs have decreased to a level that broadened 3D printing's appeal to a wider range of businesses, schools and consumers.

Continued quality improvements and price decreases mean enterprises can justify a modest investment that streamlines their product design and development programs. 3D printers with multicolor capabilities (less than $15,000) and single, monochromatic 3D printers (approximately $10,000) are available for a wide range of applications, with simple build-your-own-printer kits costing a few hundred dollars.

A sign of the market's growth and maturation is the consolidation of its technology providers. In 2012, to date we have seen 3D Systems complete its acquisition of Z Corporation (January) and Stratasys announce its intention to acquire Objet (April). Interestingly, the major 2D printer manufacturers basically remain on the sidelines, mainly conducting research or providing OEM capabilities to third parties. HP remains the only 2D printer provider with a 3D product offering, which are basically rebranded Stratasys printers, although Xerox and Ricoh have demonstrated Objet printers in their booths at major printing technology exhibitions.

3D printers remain at "adolescent" technology maturity with a 5%-to-20% market. The variety of providers and their consolidation demonstrate a maturing of 3D printer technology — not fully grown but developing — while users have moved beyond early adopters. There is a tremendous amount of hype around 3D printing and what it can or cannot do. New technology vendors, such as Blueprinter, a 2012 Gartner Cool Vendor for its innovative, patented Selective Heat Sintering (SHS) technology for printing low-cost yet useful 3D models, demonstrate there is still significant opportunity for truly innovative products.

User Advice: Enterprises should explore the use of 3D printing technology in product design and rapid prototyping, as well as for proposals, focus groups and marketing campaigns. Also, enterprises must consider which 3D model formats they want to support, with the most commonly used in 3D printing including JT, 3DXML, VRML, DWF, 3D PDF, and native computer-aided design

formats. Check that the 3D printers you select support the formats that will bring the greatest amount of business. Similarly, the selection of the materials to use in the 3D print and the choice among the six types of printing will be based on the nature of what will be printed and driven by consumer/customer perceptions of quality and the target price.

Secondary and, definitely, postsecondary educational institutions should consider using 3D printers not only for engineering and architectural courses, but also in creative arts programs (for instance, to design masks and props for a theater production).

Printer technology providers must continue research and development work while monitoring competitors' acquisition and go-to-market initiatives.

Business Impact: Uses for 3D printers have expanded as advances in 3D scanners and design tools, as well as the commercial and open-source development of additional design software tools, made 3D printing practical. The cost of creating 3D printers continues to drop, with devices available for an investment of approximately $10,000. The ratio of benefits to cost is high enough for many organizations to justify the modest investment needed to begin testing 3D printing technology.

3D printers, scanners and software have lowered the barriers to entry for companies that are developing product concepts or designing parts, as well as educational institutions with design, engineering and arts programs. Several service bureaus are available to organizations that are still reluctant or unable to make the capital investment in 3D technology yet wish to learn more about its capabilities and the potential applications within their enterprise.

From a sustainability perspective, 3D printers offer potentially significant implications. Enterprises can eliminate unnecessary packaging early in the design process, minimize manufacturing and kitting spoilage, reduce their spare parts inventories, and streamline supply-chain logistics through more effective design and on-demand production.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: 3D Systems; Asiga; Beijing TierTime Technology; Blueprinter; Fab@Home; HP; Leapfrog; MakerBot; pp3dp; RepRap; Stratasys; Ultimaker

Recommended Reading: "Cool Vendors in Imaging and Print Services, 2012"

"Innovation Insight: 3D Printing Enhancements, Low Price Bring Design Process Improvements Within Reach"

"On the Frontiers of Product Design and Life Cycle Management"

BYOD

Analysis By: David A. Willis

Definition: Bring your own device (BYOD) is an alternative strategy that allows employees, business partners and other users to use a personally selected and purchased client device to execute enterprise applications and access data. It typically spans smartphones and tablets, but the strategy may also be used for PCs. It may or may not include a subsidy.

Position and Adoption Speed Justification: Debate and interest in BYOD is at a frenzied pace. With the opportunities enabled by consumerization, IT is looking at a radical modification of its device ownership policies, driven principally by smartphones and tablets. Adoption varies by geography: In the United States, the average CIO expects 38% BYOD adoption in 2012; in Europe, it is only 20%. Variances are due to the complexities of reimbursement and taxation, roaming fees, privacy and other regulations, and differences in employee expectation. We anticipate the discussion to widen to include PCs, especially as new form factors such as Ultrabooks become popular with consumers.

User Advice: In a BYOD approach, users are permitted certain access rights to enterprise applications and information on personally owned devices, subject to user acceptance of enterprise security and management policies. The device is selected and purchased by the user, although IT may provide a list of acceptable devices. In turn, IT provides partial or full support for device access, applications and data: In each case, support may be limited. The organization may provide full, partial or no reimbursement for the device or service plan; IT may also restrict support to a set of appropriate devices.

BYOD is typically restricted to mobile devices, such as mobile phones and tablets; some organizations are also including personal computers and related devices as part of the program. The strategy is often intended for a large minority of professional employees and part-time workers, but it is also being considered for the majority of contractors, consultants and other workers not directly employed by the enterprise.

Best practices for BYOD include creating specific BYO policies (legal and corporate); eligibility analysis; new employee contracts for support, risk and responsibility; adjustments to service levels; funding/reimbursement strategies; employee education; IT publishing specifications on acceptable devices; and IT monitoring of consumer markets for new devices. The approach typically requires customization by country. It may have tax implications for both employee and employer.

BYOD impacts corporate risk, infrastructure and software costs, customer service levels, and total cost of ownership. It typically requires significant technology protections (including authentication, network access control [NAC], mobile device management [MDM]/mobile application management, encryption/containerization, and content protections) and delivery mechanisms (app stores, file-sharing systems and desktop virtualization). It is often forcing adoption of thinner-client architectures, multiplatform mobile application development environments/frameworks, and HTML5 for mobile applications.

Business Impact: BYOD accelerates an organization's ability to leverage the innovations in consumer technology, especially for new mobile devices, applications and services. It can also have a broader impact on the way IT is delivered in a business, extending well beyond devices. In certain instances, it can reduce costs, but it should really be thought of as a way to extend applications well beyond the current mobile user installed base.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: AirWatch; Apple; Fiberlink Communications; Good Technology; Google; MobileIron; Zenprise

Recommended Reading: "Gartner's View on 'Bring Your Own' in Client Computing"

"Best Practices for Supporting 'Bring Your Own' Mobile Devices"

"The Impact of BYOC on Management and Support"

"Creating a Bring Your Own Device (BYOD) Policy"

Complex-Event Processing

Analysis By: W. Roy Schulte; Zarko Sumic

Definition: Complex-event processing (CEP) is a kind of computing in which incoming data about events is distilled into more useful, higher level "complex" event data that provides insight into what is happening. CEP is event-driven because the computation is triggered by the receipt of event data. CEP is used for highly demanding, continuous-intelligence applications that enhance situation awareness and support real-time decisions.

Position and Adoption Speed Justification: Companies can get CEP functionality by custom coding it as part of their application, or by acquiring a general purpose event-processing platform and tailoring it to their specific business requirements. Before about 2004, almost all CEP was custom coded into the application because commercial general-purpose platforms were not widely available. Gartner is now tracking 17 commercial platforms, and developers are using them in a growing number of applications. However, companies still get most of their CEP capability by buying a packaged application or tool with custom-coded CEP logic. For example, security information and event management, supply chain visibility, fraud detection, network and system management, and some financial services trading platform products have purpose-built CEP logic built into the respective applications. In many cases, the fact that the product is using CEP is transparent to the buyers, because they deal only with features that are specific to the application.

Companies, governments and other enterprises are greatly increasing their use of real-time analytics — including (but not only) CEP — because the cost of sensors and adapters to acquire data, networks to move data and computers to process data continues to drop dramatically. The

accelerating pace of business is increasing the emphasis on speed. Speed is a major component in most modern business strategies, including time-based competition, just-in-time inventory, "zero latency" enterprise, real-time enterprise and other strategies.

CEP is the basis for a growing number of Pattern-Based Strategies, particularly those that leverage low-latency operational intelligence. CEP adds real-time intelligence to operational technology (OT) and business IT applications. OT is hardware and software that detects or causes a change, through the direct monitoring and/or control of physical devices, processes and events in the enterprise. OT goes by various names in different industries, and is often owned and operated independently of IT systems. For example, utilities use CEP as a part of their smart grid initiatives, to analyze electricity consumption and to monitor the health of equipment and networks. CEP helps process feeds of event data such as temperature, vibration and revolutions-per-second that, when analyzed together, may predict impending equipment failure. CEP is also used in business-activity monitoring (BAM) applications that have a high rate of input data (high throughput), require very fast response (low latency) or require the detection of complex patterns (especially temporal or location-based patterns). CEP is one of the pillars of the emerging "big data" movement because of its capability for handing large volumes of data quickly.

User Advice: Companies should use CEP to enhance their situation awareness. Situation awareness means understanding what is going on so you can decide what to do.

- CEP is used to help people make faster and better decisions (decision support), and to trigger automated processes that require no human involvement.
- The most common scenario for CEP use involves operational activities that run continuously and need ongoing monitoring, using a sense-and-respond approach.
- CEP can be used wherever a stream of current event data is available from business applications, business partners, social computing, news feeds, sensors, digital control systems or other sources.
- CEP can be used to identify predictable situations that require attention, to identify exceptional threats and to alert users to opportunities that require previously unplanned intervention.

In a utility context, CEP can be used to process a combination of supervisory control and data acquisition events and "last gasp" notifications from smart meters to determine the location and severity of a network fault, and then to trigger appropriate remedial actions. Other common CEP applications include near-real-time precision marketing (cross-sell and upsell), fraud detection, factory floor and website monitoring, customer contact center management, trading systems for capital markets and transportation operation management (for airlines, trains, shipping and trucking). Event-processing platforms are sometimes used in conjunction with intelligent business process management suites to provide more intelligent process monitoring, and to help make flow decisions on a dynamic, context-aware basis.

Business Impact: CEP provides business value in four ways, it:

- Improves the quality of decision making by presenting information that would otherwise be overlooked.

- Enables faster response to threats and opportunities.
- Helps shield business people from data overload by eliminating irrelevant information and presenting only a distilled version of the important information.
- Reduces the cost of manually processing the growing volume of event data in business.

CEP is often structured as an overlay on a conventional application portfolio, enabling a new layer of operational monitoring and real-time response without disrupting the installed base of applications. CEP is one of the key components of emerging intelligent business operations strategies, an approach that integrates event management technology (including CEP and business activity monitoring), decision management technology (including rule engines, predictive analytics, optimization and simulation) and business process management technology (such as workflow and process orchestration) with transactional, run-the-business systems.

- The biggest single source of future demand for CEP may be the emerging "Internet of Things."
- Social computing may be the second largest source of new data and demand for CEP.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: EsperTech; FeedZai; Guavus; HStreaming; IBM; Informatica; Kx Systems; LG CNS; Microsoft; Oracle; Progress Software; SAP; Software AG; StreamBase Systems; Tibco Software; Vitria; WestGlobal

Recommended Reading: "Sourcing Strategies for Complex-Event Processing"

"How to Choose Design Patterns for Event-Processing Applications"

"Apply Three Disciplines to Make Business Operations More Intelligent"

Social Analytics

Analysis By: Carol Rozwell

Definition: Social analytics describes the process of collecting, measuring, analyzing and interpreting the results of interactions and associations among people, topics and ideas. These interactions may occur on social software applications used in the workplace, in internally or externally facing communities, or on the social Web. Social analytics is an umbrella term that includes a number of specialized analysis techniques, such as social filtering, social network analysis, sentiment analysis and social media analytics.

Position and Adoption Speed Justification: The desire to find meaning in the myriad sources of social information available on the social Web, as well as internal information, is spurring interest in social analytics. There are huge volumes of data that appear in a variety of forms and much of this information is changing very rapidly. These issues contribute to the complexity of analysis.

Social software vendors, such as IBM and Microsoft, have added tools for social analytics to their applications that measure adoption and growth to provide an understanding of community dynamics. The data makes individual behaviors, content and interactions visible. Social media monitors look for patterns in the content of conversations across all social media spaces. They extract actionable or predictive information from social media and, in some cases, offline media. The acquisition of Radian6 by salesforce.com is an example of a social software platform vendor extending its social analytics capability to include social media monitoring.

User Advice: Organizations should ensure that their initiatives are positioned to take advantage of social analytics to monitor, discover and predict. Some enterprises will be content to monitor the conversations and interactions going on around them. Enterprises with social software platforms that provide social analysis and reporting can use this information to assess community engagement. They can also easily monitor what is being said about the company, its products and the brand using simple search tools or more sophisticated sentiment analysis applications.

The results of social analytics (for example, discovered patterns and connections) can be made available — often in real time — to the participants of the environment from which the data was collected to help them navigate, filter and find relevant information or people. Other enterprises will mine the social analytics data, actively looking to discover new insights using a wide range of business intelligence applications. At this time, the use of social analytics information for predictive purposes is a largely untapped source of value. However, marketing and product development teams express great interest in this capability.

In many organizations, social analytics applied to external activity (for example, sentiment analysis across the Web) will be sourced by marketing professionals and others (such as the legal department, product development and customer support). In those cases, IT needs to play a leadership role in orchestrating a coordinated set of activities across departments to, for example, minimize duplication of effort, ensure coordination between efforts and standardize taxonomies.

Business Impact: Social analytics is useful for organizations that want to uncover predictive trends based on the collective intelligence laid open by the Internet. For example, a biopharma researcher could examine medical research databases for the most important researchers, first filtering for the search terms and then generating the social network of the researchers publishing in the biopharma's field of study. Similarly, social analytics could be used by marketers who want to measure the impact of their advertising campaigns or uncover a new target market for their products. They could look for behaviors among current customers or among prospects that could enable them to spot trends (deterioration in customer satisfaction or loyalty) or behaviors (demonstrated interest in specific topics or ideas).

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Attensity; BuzzLogic; galaxyadvisors; IBM; News Patterns; salesforce.com; SAS; Trampoline Systems; Visible

Recommended Reading: "Turn Information into Insight With Social Analytics"

"Marketing Essentials: How to Build a Social Analytics Strategy to Mine Customer Insights"

"Competitive Landscape: Social Analytics"

Private Cloud Computing

Analysis By: Thomas J. Bittman

Definition: Private cloud computing is a form of cloud computing that is used by only one organization, or that ensures that an organization is completely isolated from others.

Position and Adoption Speed Justification: Cloud computing is a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service to customers using Internet technologies. Private cloud contrasts with public cloud computing, where access to the service is open to any customer willing to pay (unless the service is subsidized, for example, by advertising).

Private and public cloud computing are extremes. There are a number of variations that fit somewhere between those two, such as community cloud computing (shared, but with limited users), virtual private cloud computing (less than full isolation between multiple users), and hybrid cloud computing (a service federated between private and public cloud services). For our purposes here, the focus will be on private cloud computing that is fully private to an organization — usually on-premises, but could be hosted by a third-party.

Organizations building a private cloud service are trying to emulate public cloud computing providers to acquire similar benefits, but within their control and often on-premises. In most cases, this is at an infrastructure level (using virtual machines), but platform as a service (PaaS) and even software as a service (SaaS) private clouds exist. Private cloud computing requires both technology and nontechnology changes to be successfully implemented. Technologies include standardization, automation, self-service tools and service management, metering and chargeback, to name a few. Many of these technologies are still evolving, and early deployments often require custom tools. Regardless, the biggest challenges with private cloud computing tend to be process-related, cultural, political and organizational.

Unlike public cloud providers, which maintain a small number of offered services, enterprises have many complex and interrelated services to deliver. A private cloud computing service can fit within a broader portfolio of services delivered by a real-time infrastructure.

Although some of the technologies required for private cloud computing exist, many do not, or are immature. Many early examples of private cloud computing services are focused on development and test provisioning. However, a growing number of enterprises are now deploying private cloud services in production, and are learning where private cloud computing makes sense and where it does not.

Enterprise interest is already high, with roughly 75% of respondents in Gartner polls saying they plan to pursue a private cloud computing strategy (at least for a small set of services) by 2014. This

trend will move very quickly on the Hype Cycle in the next two years, as private cloud moves from strategy to pilot and production deployments.

User Advice:

- Let service requirements lead your private cloud computing plans, rather than technologies (see "Getting Starting With Private Cloud: Services First").
- Create a business case for developing a full private cloud service versus using public cloud services, or modernizing established architectures.
- Consider the long-term road map for your private cloud service (see "The Road Map From Virtualization to Cloud Computing"). Build with the potential to take advantage of hybrid sourcing (using both your private cloud services and public) at some point in the future.
- Start slowly with development/test lab provisioning; short-term, low service-level agreement computing requests; and simple, non-mission-critical Web services (e.g., self-service requests and dynamic provisioning for Web environments). Pilot a private cloud implementation to gain support for shared services and to build transparency in IT service costing and chargebacks.
- Implement change and configuration management processes and tools prior to implementing private cloud services to ensure that you can standardize on the software stacks to be delivered through self-service provisioning, and adequately maintain them.

Business Impact: Most private cloud implementations will evolve from a virtualization foundation. Virtualization reduces capital costs, but private cloud computing will reduce the cost of operations and (most importantly) enable faster service delivery. It is primarily attractive to the business because it enables agility — self-service ordering of frequently requested services — as well as dynamic provisioning. Private cloud is not the right approach for every service. Test lab provisioning is an early example of a private cloud service that enables testers to improve time-to-market and efficiencies, while labor costs associated with provisioning are reduced.

Private cloud computing also changes the relationship between the business and IT, transforming how IT is consumed. The shift to services (rather than implementation and assets), pay-per-use and chargeback enables the business to focus on rapidly changing service requirements and consuming IT based on variable costs, while IT can focus on efficient implementation and sourcing (including the potential to leverage public cloud services in the future without negatively affecting the business).

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Sample Vendors: Abiquo; Adaptive Computing; BMC Software; CA Technologies; DynamicOps; Eucalyptus; HP; IBM; Joyent; Microsoft; VMware

Recommended Reading: "Private Cloud Computing: Target Services That Need Agility"

"Design Your Private Cloud With Hybrid in Mind"

"Top Five Trends for Private Cloud Computing"

"How to Build an Enterprise Cloud Service Architecture"

Application Stores

Analysis By: Monica Basso; Ian Finley

Definition: Application stores support application discovery and downloads through a local storefront client or browser. Public stores categorize applications in games, travel, productivity, entertainment, books, utilities, education, travel and search, etc., with ratings and comments. Enterprise application stores are private, cloud-based or deployed on-premises, and help organizations deploy applications for employees and partners.

Position and Adoption Speed Justification: Consumer application stores are at the heart of the success of modern smartphones and media tablets. Apple boosted the application store concept in 2008 with its App Store and free, advertisement-based or priced applications, which drove the success of the iPhone and iPad, and reached over 500,000 apps by May 2012. Other handset and OS manufacturers own application stores as part of their value propositions (e.g., Google's Android Market, Research In Motion's BlackBerry App World, Microsoft Windows' Marketplace for Mobile). Carriers own application stores for feature phones, focusing on billing, location and messaging, e.g., Orange App Shop and Vodafone 360. Third parties such as Handmark, GetJar and Qualcomm offer white-label solutions to carriers.

Public application stores are relevant for enterprises, because consumerization and bring your own device (BYOD) models drive adoption in the mobile workforce, and mobile business-to-consumer (B2C) application initiatives targeting end customers must leverage public application stores for application distribution and discovery by target users.

Enterprise app stores are the enterprise analog, but they are private and implemented on internal servers, or delivered in the cloud. They often offer native, Web and cloud apps for mobile devices, desktops or both. Unlike consumer app stories, enterprise stores offer selected applications that meet enterprise standards. An increasing number of enterprise portals promote applications that employees should, or are recommended to, download by pass-through to the store or local download. Private mobile application stores are critical for organizations to support easy discovery and distribution of applications to the mobile workforce, as well as end customers. Mobile device management vendors such as MobileIron, AirWatch, Zenprise, Fiberlink and BoxTone offer app store capabilities enriched with management and security in their mobile data management (MDM) offerings. Application management vendors such as Partnerpedia, Nukona (now Symantec), Apperian and AppCentral offer similar capabilities. Mobile application development platform vendors such as Kony offer them integrated with their development platform. Citrix Systems and VMware offer private store capabilities across a range of client and mobile devices.

The hype around enterprise app stores continues to build, with enterprise implementations in the initial stages, and it may take up to five years before large numbers of enterprises adopt them as the

standard software distribution mechanism. Many factors will limit the broad adoption of enterprise app stores in the short term, including lack of market maturity, ROI data and app-store-friendly applications in legacy portfolios. However, as employees increasingly rely on mobile, Web and cloud apps to do their work, and as enterprises appreciate the risk of employees sourcing apps from consumer websites and app stores, the pressure to implement a safe, enterprise alternative will grow. Hence, we expect a growing number of organizations to implement limited enterprise app stores during the next few years.

While we anticipate the number and types of enterprise app store options to expand dramatically during the next few years, the current market is immature. Consumer app stores continue to multiply and innovate, redefining what it means to be an app store. Basic enterprise app store functionality is available from a few software vendors and cloud providers, but no single vendor provides a comprehensive solution for all scenarios. In addition to pure-play vendors, some device management, application platform and software as a service (SaaS) vendors offer overlapping functionality. We expect system integrators and other service providers to enter the market with outsourced enterprise app store services. As a result, the market is likely to remain noisy (hyped, with announcements from vendors, but no clear signal about where it is headed) and immature for several years.

Overall, we expect the use of public and private mobile application stores to accelerate rapidly to the Plateau of Productivity in two to five years, given the rapid adoption of smart devices, both as individual and corporate tools. Application stores for PC and desktop Web applications may take much longer to mature.

User Advice: Enterprises should evaluate opportunities that originate from application stores to target end customers with mobile applications, e.g., to engage them in community-based activities to implement market campaigns, collect customer feedback and preferences, and provide new services. Enterprises can help improve the modularity, user experience, standards compliance, platform compatibility, provisioning, security and deployability of the application portfolio.

Application providers and developers should look for application stores that are associated with popular handsets and can create a good user experience, and should weigh these against the difficulty of developing and porting applications with their potential popularity. It is important to choose application stores with good distribution outlets and service from the application development community. Other features of application stores that benefit developers include advertisement support (like the Google model, to allow vendors to be "top of deck"), user reviews, rankings and recommendations (as with Amazon), and good billing and reporting features.

Application stores are a scale game, and those offering applications need to create unique selling points that bring developers to their stores, rather than to their competitors. An ecosystem needs to be created in which developers have the tools to easily write and port applications; individuals can easily access, download and use applications; and all sides have visibility into the accounting of application sales, and an efficient billing system that allows everyone to get paid in a timely manner.

Business Impact: Reduce the risks: Enterprise app stores can help security leaders reduce risk through better management of application and data assets. Employees are increasingly comfortable

using mobile and cloud apps they source from public consumer app stores on enterprise devices with enterprise data. However, these apps can be security threats to the enterprise. The situation is particularly acute for mobile devices, because enterprises often don't control the device or provide many mobile apps to employees, leaving them to fend for themselves. Security leaders can reduce enterprise system and asset risks by discouraging the use of unsafe app sources, and providing an enterprise app store as a safe alternative.

Lower the costs: Enterprise app stores can help software asset managers lower administration overhead and drive cost accountability. An app store can help manage traditional software licensing models, SaaS subscriptions and other, more elastic, on-demand cloud provisioning models by automating the capture of license, subscription and cost assignment data during check-out. More mature enterprises can use app store data to manage ongoing maintenance and support costs, and drive better accountability through more sophisticated and accurate chargeback models.

Increase productivity: Enterprise app stores can help application strategists increase business productivity and application innovation through application choices and competition. Consumer app stores did not just simplify software distribution; they improved consumer productivity by letting people choose the best app for their needs, and triggered a sustained wave of innovation by creating a new, highly competitive market for applications. Properly managed, enterprise app stores can produce the same results for enterprises.

Application stores are likely to have an impact on brands that can advertise and segment customers based on applications, and on application providers, giving them access to additional customers in a well-organized ecosystem.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: AppCentral; Apple; Citrix Systems; Embarcadero; Google; Microsoft; MobileIron; Nukona; O2; Orange; Partnerpedia; Research In Motion; SAP; Vodafone; Zenprise

Recommended Reading: "Marketing Essentials: How to Decide Whether to Start a Mobile Application Store"

"Dataquest Insight: Application Stores; The Revenue Opportunity Beyond the Hype"

"Enterprise App Stores Reduce Risk and Improve Business Results"

"The Impact of App Stores on your Application Strategy"

"Enterprises Can Apply an App Store Approach to Support Employees' Smartphones and Tablets"

"Best Practice for Software Asset Management: Take an App Store Approach to Help Manage and Chargeback Software Costs"

Augmented Reality

Analysis By: Tuong Huy Nguyen; CK Lu

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. 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: The maturity of a number of mobile technologies — such as GPS, digital cameras, accelerometers, digital compasses, broadband, image processing and face/object recognition software — has made AR a viable technology on mobile devices. As all these technologies converge in maturity, AR has also benefited from a growing number of open OSs (promoting native development), the increasing popularity of application stores (increasing awareness and availability of applications), and the rising availability of overlay data, such as databases, online maps and Wikipedia. The combination of these features and technologies also allows AR to be used in a number of different applications, including enhancing user interfaces (UIs), providing consumers with information and education, offering potential for marketing and advertising, and augmenting games and entertainment applications. We also believe that AR will play a role in mobile contextual interactions, and will be particularly powerful for:

- Discovering things in the vicinity
- Presenting real-world objects of potential special interest
- Showing a user where to go or what to do
- Providing additional information about an object of interest

Most current efforts in AR do not fully leverage the potential of this technology, but given the extended adoption curve, they are moving in the right direction.

There are currently two approaches with regard to the content displayed within the AR application and the underlying delivery technologies and processes: object-specific/private data and shared/public data. Marketing and branding are the most prevalent applications for AR and fall into the former category. They focus primarily on logos, product images, bar codes and quick-response codes. Examples include Tesco's price drop campaign, Yoplait gamification to promote charitable giving, and Weetabix's cereal box AR game. AR has also been trialed in sales-oriented environments, such as Macy's Backstage Pass program and Zugara's Webcam Social Shopper. Most recently, Google's Project Glass announcement increased the hype for AR but at nowhere near the level seen in 2010. We expect efforts and adoption in this type of AR to continue steadily, as brands, marketers and advertisers look to inspire engagement with their user base.

On the other hand, we expect a number of factors will slow adoption of the more advanced form of AR, which relies more on shared/public data. These issues include:

- Device requirements for AR in mobile devices are rigorous; so, although mobile services provide a great use case for this technology, it will be restricted to higher-end devices. Mobile devices

have smaller screens than other consumer electronics devices such as laptops and even handheld gaming consoles, restricting the information that can be conveyed to the end user. Tablets have good potential to overcome some of these challenges — providing a good mix of portability and screen real estate. The interface (a small handheld device that needs to be held in front of you) limits use to bursts, rather than continued interaction with the real world. GPS technology also lacks the precision to provide perfect location data, but can be enhanced by hardware such as accelerometers, gyroscopes or magnetometers.

- As with other location-based services (LBSs), privacy is a potential concern and a hindrance to adoption.
- Always-on connectivity is required — data cost and battery drain are concerns of users.
- As a newer solution, there are also issues with compatibility: Competing AR browsers are using proprietary application programming interfaces and data structure, making the AR information from one vendor's browser incompatible with that of other browsers.

User Advice:

- **Communications service providers:** Examine whether AR would enhance the user experience of your existing services. Compile a list of AR developers with which you could partner, rather than building your own AR from the ground up. Provide end-to-end professional services for specific vertical markets, including schools, healthcare institutions and real estate agencies, in which AR could offer significant value. A controlled hardware and software stack from database to device will ensure a quality user experience for these groups. Educate consumers about the impact of AR on their bandwidth, to avoid being blamed for users going over their data allowance.
- **Mobile device manufacturers:** Recognize that AR provides an innovative interface for your mobile devices. Open discussions with developers about the possibility of preinstalling application clients on your devices and document how developers can access device features. Build up alliances with AR database owners and game developers to provide exclusive AR applications and services for your devices. Secure preloading agreements and examine how you could integrate AR into your UIs or OSs.
- **AR developers:** Take a close look at whether your business model is sustainable, and consider working with CSPs or device manufacturers to expand your user base; perhaps by offering white-label versions of your products. Integrate AR with existing tools, such as browsers or maps, to provide an uninterrupted user experience. Build up your own databases to provide exclusive services through AR applications. Extend your AR application as a platform that individual users and third-party providers can use to create their own content. Explore how to apply AR, through different applications and services, to improve the user experience — with the aim of predicting what information users need in different contexts.
- **Providers of search engines and other Web services:** Get into AR as an extension of your search business. AR is a natural way to display search results in many contexts.
- **Mapping vendors:** Add AR to your 3D map visualizations.

- **Early adopters:** Examine how AR can bring value to your organization and your customers by offering branded information overlays. For workers who are mobile (including factory, warehousing, maintenance, emergency response, queue-busting or medical staff), identify how AR could deliver context-specific information at the point of need or decision.
- **Brands, marketers and advertisers:** Use AR to drive increased engagement with your user base.

Business Impact: AR browsers, applications and seamless integration will be the focus of innovation and differentiation for players in the mobile device market in 2012. There are interesting branding opportunities for companies and businesses. Points of interest can be branded with a "favicon" (that is, a favorites or website icon) that appears when the point of interest is selected. Companies such as Mobilizy are offering white-label solutions that allow core Wikitude functionality to be customized. AR products such as Wikitude can lead to numerous LBS advertising opportunities.

CSPs and their brand partners can leverage AR's ability to enhance the user experience within their LBS offerings. This can provide revenue via set charges, recurring subscription fees or advertising. Handset vendors can incorporate AR to enhance UIs, and use it as a competitive differentiator in their device portfolio. The growing popularity of AR opens up a market opportunity for application developers, Web services providers and mapping vendors to provide value and content to partners in the value chain, as well as an opportunity for CSPs, handset vendors, brands and advertisers.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: GeoVector; Google; Layar; Metaio; Mobilizy; Nokia; Research In Motion; Tonchidot; Total Immersion; Zugara

Recommended Reading: "Emerging Technology Analysis: Augmented Reality Shows What Mobile Devices Can Do"

"Contextual Smartphone Applications Will Exploit Augmented Reality"

"Innovation Insight: Augmented Reality Innovations Add Business Value"

In-Memory Database Management Systems

Analysis By: Roxane Edjlali; Donald Feinberg

Definition: An in-memory database management system (IMDBMS) is a DBMS that stores the entire database structure in memory and accesses all the data directly, without the use of input/output instructions to store and retrieve data from disks, allowing applications to run completely in-memory. This should not be confused with a caching mechanism, which stores and manages disk

blocks in memory cache for speed. IMDBMSs are available in both row-store and column-store models.

Position and Adoption Speed Justification: IMDBMS has been around for many years (for example, IBM solidDB and Oracle TimesTen), but many available now are new within the past two or three years: VoltDB and SAP Sybase ASE were new in 2010, SAP Hana was released in mid-2011, and new vendors such as ParStream continue to emerge While several IMDBMSs are mature, many are new or have limited adoption, and so we have retained its position on the Hype Cycle from last year. However, we expect adoption to accelerate in the next two years, based on client interactions demonstrating a high level of interest and growing adoption of these technologies.

Many use cases are supported by IMDBMS: solidDB, StreamBase and TimesTen were originally developed for high-speed processing of streaming data for applications such as fraud detection, with the data then written to a standard DBMS for further processing. Others such as Altibase, SAP Sybase ASE and VoltDB focus on high-intensity transactional processing. Some IMDBMSs, such as Exasol, ParStream or Kognitio are dedicated for in-memory analytical use cases. SAP Hana, although primarily for analytics and data warehousing, has begun to support both online transaction processing (OLTP) and analytics in the same database (with the general availability [GA] of BusinessOne powered by Hana).

Given the different maturity levels across the various vendors, the level of support for high availability and disaster recovery can vary. The perceived risk involved with memory failures and lack of reliable high-availability disaster recovery, and sufficiently fast backup and recovery techniques continue to be an issue when selecting an in-memory DBMS. As this functionality is added often through a combined software and hardware offering including clustering, this inhibitor will decrease in importance. The other limiting factor in terms of adoption is the availability of skills and practices.

User Advice: Continue to use IMDBMS as a DBMS for temporary storage of streaming data where real-time analysis is necessary, followed by persistence in a disk-based DBMS.

For the next several years, IMDBMS can be used for OLTP with the understanding that extra care must be exercised to assure a high-performance environment and logging to a persistent store, such as disk, solid-state drive and Flash.

IMDBMS for analytic acceleration is an effective means to achieve increased performance. However, given the diverse level of maturity of the vendors, organizations should verify references and run a thorough proof of concept to ensure the technology meets their expectations.

The single most important advancement will come as IMDBMS matures as a column-store, combined OLTP and online analytical processing model as a basis for new, previously unavailable applications; taking advantage of real-time data availability, with IMDBMS for increased performance and reduced maintenance.

Organizations should evaluate the business innovation opportunities from new IMDBMSs as they mature — to address OLTP and real-time analytical use cases.

Organizations evaluating the IMDBMS should revisit data governance and data warehouse practices and design in order to take advantage of the increased performance without losing in data quality or data consistency.

Business Impact: Once these IMDBMSs become mature and proven — especially for reliability and fault tolerance — and as the price of memory continues to decrease, the potential to the business is transformational:

These systems utilize hardware systems that require far less power (as low as 1% of the power of an equivalent disk-based system, according to several hardware vendors) and cooling — leading to huge cost savings.

The high performance implies that smaller systems will do the same work as much larger servers, again with major cost savings.

Column-store IMDBMS has the potential for a combined OLTP and data warehouse (DW) single database model that will enable an entire set of new applications that were not possible before because of the latency of data moving from the OLTP system to the DW.

The speed of IMDBMS for analytics has the potential to simplify the DW model by removing development, maintenance and testing of aggregates, summaries and cubes. This will lead to saving in terms of administration and increased flexibility for meeting diverse workloads.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Exasol; IBM; Kognitio; McObject; Oracle; ParStream; QuartetFS; SAP; VoltDB

Recommended Reading: "Cool Vendors in Advancing Data Management Maturity, 2012"

"What CIOs Need to Know About In-Memory Database Management Systems"

"SAP Throws Down the Next-Generation Architecture Gauntlet With HANA"

Activity Streams

Analysis By: Nikos Drakos

Definition: An activity stream is a publish-and-subscribe notification mechanism and conversation space typically found in social networking. It lists activities or events relevant to a person, group, topic or everything in the environment. A participant subscribes to, or "follows" entities (e.g., other participants or business application objects) to track their related activities. For example, a project management application may add status information, while a physical object connected to the Internet may report its state (e.g., tunnel lane closure).

Position and Adoption Speed Justification: Activity streams are available and popular on consumer social networking sites, such as Facebook, as well as in business social software products used within an organization. Users can usually control how much of their activity stream is visible to other users. Activity streams in business environments may also contain information about business events that are "injected" into a stream from business applications, as well as individual user activities. Activity streams have the potential to become a general-purpose mechanism for personalized dashboards, and general information dissemination and filtering. Beyond notifications and conversations, it is also possible to embed "live widgets" or gadgets — for example, a simple browser interactive application — through which someone will not only be notified about an event, but also will interact with the notification. For example, a notification about a survey may contain a live survey, or a notification about an expense report may contain action buttons that can open the report or allow the user to approve it.

In addition, many people are reluctant to participate within social network sites when they are limited to posting simple status messages. This inhibition is to be expected, yet participation is essential for information sharing, collaboration and community building. Activity streams populated with automated notifications enables a low overhead mechanism that can stimulate conversation and broaden community participation.

Activity streams can be surfaced within many contexts, including various places within a social network site (for example, a profile, a group or topic page) as well as embedded within an application (for example, an email sidebar or beside a business application record).

Activity streams can provide a conversation space populated with intersecting discussions that are sparked by activities or events.

User Advice: Tools that help individuals expand their "peripheral vision" with little effort can be useful. Being able to choose to be notified about the ideas, comments or activities of others on the basis of who they are, or the strength of a relationship, is a powerful mechanism for managing information from an end user's perspective. Unlike email, with which the sender may miss interested potential recipients or overload uninterested ones, publish-and-subscribe notification mechanisms such as activity streams enable recipients to fine-tune and manage more effectively the information they receive.

Activity streams should be assessed in terms of their relevance as general-purpose, information access and distribution mechanisms. Most established enterprise software vendors, as well as many specialist ones, have introduced activity streams in their products and it is important to be ready to understand their implications in terms of business value, cost and risk. There are several aspects of enterprise implementations that will require particular caution. They include: the richness of privacy controls that enable users to manage who sees what information about their activities; the ability to organize information that has been arbitrarily gathered through an activity stream and to determine its authoritativeness; the ability to mitigate compliance and e-discovery risks; the ability to cope with information overload with over-popular activity streams; and increasingly, the possibility of multiple, overlapping activity streams in the same organization as each internal or external system introduces its own activity stream.

Business Impact: There is an obvious application of activity streams in managing dispersed teams or in overseeing multiparty projects. Regular updates of status changes that are collected automatically as individuals interact with various systems can keep those responsible up to date, as well as keep different participants aware of the activities of their peers. Activity streams can help a newcomer to a team or to an activity understand who does what and, in general, how things are done. Activity streams are extremely popular with users of consumer social networks such as Facebook, Twitter or Google+, and their popularity will drive interest and usage of activity streams in business environments. Activity streams are likely to become key mechanisms in business information aggregation, distribution and filtering.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: BroadVision; Cisco; Citrix Systems; Facebook; IBM; Jive; Moxie Software; NewsGator; Oracle; Qontext; salesforce.com; SAP; Socialtext; Tibco Software; VMware; Yammer

NFC Payment

Analysis By: Sandy Shen

Definition: Near Field Communication (NFC) allows users to make payments by waving their mobile phone within 10 cm of a compatible reader. Users can use their bank card or mobile wallet as a payment instrument and can view account activities or top up from their phone.

Position and Adoption Speed Justification: NFC payment hasn't taken off as quickly as many technology and service providers expected. The much slower than expected adoption of Google Wallet has even forced Google into looking to share revenue with its competitor, Isis. Meanwhile, in the U.K., Barclaycard has begun to offer NFC stickers (which attach to handsets) to its cardholders, while working in partnership with Orange for a SIM-based solution. These moves highlight how the slow adoption of NFC payment has pushed providers to seek alternative solutions. Industry players are coming to realize that NFC payment isn't gaining the market traction that they expected. In addition, Project Oscar (a joint venture comprising the U.K.'s three major mobile operators), which aims to offer NFC services and which excluded the smallest player, is being investigated by European regulators. This is something else that could potentially slow down the deployment of NFC payment services in the country. We think the main challenges that NFC payment face are:

- Lack of NFC mobile phones and the contactless reader infrastructure. It will take time for both to reach penetration levels of at least 20%, and thus make the service appeal to consumers and merchants.
- Lack of coordinated efforts among stakeholders, with many working on their own projects with no plans for interoperability. Here we use France as a best practice example where coordinated efforts are guiding all players to move in the same direction.

- Lack of value proposition to consumers. Payment alone won't be enough to persuade users to give up their existing behavior and adopt NFC payment. The industry needs a comprehensive set of applications to make NFC appeal to consumers.
- Security concerns among consumers. Consumers need to be educated about the security features of the service before they are comfortable using it. Security is a top concern for consumers when it comes to using mobile phones for payment.

Some good news is that major mobile phone vendors are including NFC in their new products, and this will see NFC included in about 50% of smartphone shipments in 2015. A number of cities in the U.S. and Western Europe are migrating public transportation to the open-loop systems that can support contactless bank card payment. This will help lay the infrastructure for NFC ticketing. Nevertheless, these efforts will not be enough to combat the challenges mentioned above, and the industry will need a coordinated effort to get NFC payment adopted by the mass market.

User Advice: Service providers should form industry alliances with other players that include standard bodies, technology providers, application providers such as banks, transportation providers, universities and governments. They should agree on a common set of specifications to ensure interoperability and a rich ecosystem that supports various applications ranging from ticketing, couponing, loyalty to personal ID, campus and government services.

Vertical industries such as public transportation, airlines, retail and healthcare should explore areas in which NFC technology can improve efficiency and customer services. Look for areas where NFC can reduce costs and improve efficiency.

Business Impact: NFC payment will have a low impact on service providers' business because of low adoption in the early years. Also there is not much money to be made from payment service alone. Service providers will have to seek revenue from non-payment services such as loyalty programs, proximity marketing and social networking. Enterprises can use NFC for authentication, data recording and monitoring to improve efficiency. Examples include over-the-air ticket purchase to reduce the investment in ticketing machines and commissions paid to agents.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Apple; Cassis; Gemalto; Giesecke & Devrient; Google; Inside Secure; MasterCard PayPass; NXP Semiconductors; VeriFone; Visa payWave; ViVOtech

Recommended Reading: "Japanese Contactless and Mobile Payment Systems: Beyond the Hype, the Lessons You Must Learn"

"Near Field Communication is a Long-Term Opportunity"

"Forecast: Mobile Payment, Worldwide, 2009-2016"

"Competitive Landscape: NFC Semiconductor Vendors, 2011"

Sliding Into the Trough

Internet TV

Analysis By: Andrew Frank; Mike McGuire

Definition: Internet TV is the video streaming of licensed professional content (typically TV shows, live events and movies). "TV" here refers to the nature and status of the content. It drives the key requirement that access be selectively controlled, based on licensing arrangements, which place restrictions on who may see the content (that is, subscribers only), and where and when the content may be seen. Broadband connected TVs, game consoles, open set-top boxes, PCs, smartphones and media tablets are all considered receivers of Internet TV.

Position and Adoption Speed Justification: "Internet TV" is sometimes used interchangeably with "over-the-top (OTT) TV." Gartner is using "Internet TV" to refer exclusively to licensed content delivered to any screen, while OTT often focuses on the use of Internet as an alternate method of video delivery to TV sets, putting emphasis on its bypassing of legacy closed TV delivery architectures.

As doubts fade about the technical viability of Internet streaming for high-quality video (both linear and on demand), incumbent TV service providers are facing off against online video distributors in a complex contest to win content licenses, subscribers and advertisers for the growing portion of TV programming consumed over the Internet. Since the legacy television business is highly regulated on a national level, this contest is playing out differently in different regions around the world. In countries with high levels of publicly funded programming, such as the U.K., national public broadcasters are using Internet delivery to extend programming and add social features as private distributors follow suit with little external competitive threat. In regions with less regulation, Internet video delivery is often associated with content piracy, and broadcasters face major challenges with copyright enforcement. Many regions still look to the U.S. as the historical pioneer of the television business and the epicenter of digital disruption for direction.

In the U.S., incumbent TV distributors are leveraging their existing distribution relationships through the strategy called "TV Everywhere," which seeks to extend subscriber access to licensed content to any device at any time and place by developing a universal login capability with suitable authentication. Meanwhile, online video distributors, such as Netflix, Hulu and Apple, have largely allayed earlier fears that it might be impossible to monetize or secure online video streams. Netflix, in particular, having weathered a customer rebellion and now facing sharply increasing licensing fees and friction with ISPs, continues to attract customers to its streaming service, both in the U.S. and worldwide.

Such competition can be expected to favor both consumers and content providers, although both can be threatened if the ecosystem becomes too unstable to support the production of high-quality programming, which has been an increasingly risky business since well before the current wave of digital disruption. The question of whether the TV industry can avoid the kind of Internet-based disruption that has diminished the music and newspaper publishing industries is still at issue. In the case of television, the stakes are in some ways higher due to the regulatory framework that has

historically protected broadcasting and discouraged the unbundling of content. These regulations are increasingly difficult to reconcile with online distribution, contributing to the instability of the situation. Meanwhile, recognizing the weakness of the position of being a pure distributor in the TV value chain, most online video services have announced plans to create original content, following the model of pay-TV cable networks, like HBO and Showtime, which have sought to increase their brand appeal to consumers with exclusive original programming. Whether the economics of online distribution are sufficient to support the production of content of sufficiently high quality to make a difference remains to be seen.

In any case, the transition to increasing Internet TV consumption patterns among consumers is unlikely to be a zero-sum game, and the ubiquity and efficiency of Internet delivery are bound to produce significant winners and losers over the next five years.

User Advice:

- Content owners should keep a close watch on the evolving business models and get intellectual property rights management (IPRM) to maximize syndication opportunities.
- Broadcasters and other content licensees should negotiate for complete rights packages, rather than distinguish among Internet, TV and mobile rights distinctions.
- TV, Internet and triple-play communication service providers should actively pursue multichannel conditional access models and bundles that elevate the role of ISP operator affiliation in TV service delivery.
- All parties, as well as regulators, should recognize the significance of the net neutrality debate, as consumer demand for Internet video quality grows and strains existing Internet delivery infrastructures.

Business Impact: It appears increasingly unlikely that the impact of Internet TV can be constrained by concerted efforts. Although winners and losers remain unclear, Internet TV will ultimately redefine TV distribution services and overtake the DVD market for premium content distribution. Cable networks and other broadcasters that rely on current cable licensing arrangements (such as retransmission consent rules) will need to rethink their positions in light of Internet TV delivery possibilities.

For many broadcasters, content providers and advertisers, Internet TV opens new opportunities and markets. It also has the potential to drive interest in new devices that can leverage the growing demand for Internet TV, while limiting the potential of proprietary STB-based interactive standards to achieve ubiquity. Last, but not least, it offers marketing organizations the possibility of a more efficient and effective advertising and communication channel that combines the impact of video with the targeting, interactivity and cost-benefits of the Internet.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Amazon; Apple; BBC; Comcast; Google; HBO; Hulu; Netflix; NeuLion

Recommended Reading: "The Blocking of Broadband-Connected TV Content by a South Korean CSP Provides Lessons for the Consumer Industry"

"New Television Meets Context-Aware Computing"

"A Scenario for the Future of Television in the Cloud"

Audio Mining/Speech Analytics

Analysis By: Jim Davies

Definition: Audio mining/speech analytics embrace keyword, phonetic or transcription technologies to extract insights from prerecorded voice streams. This insight can then be used to classify calls, trigger alerts/workflows, and drive operational and employee performance across the enterprise.

Position and Adoption Speed Justification: Although the technologies are more accurate and scalable than they were a few years ago, speech analytics solutions have not yet become widely adopted. Due to the potential to uncover insights that can enhance operational efficiency, understand the customer experience and reduce churn, organizational interest is high. The availability of software as a service (SaaS)-based solutions is reducing the barrier to entry for what is commonly viewed as a luxury contact center technology investment, due to its traditionally high cost and deployment complexity. Technological advancement will provide further improvements to accuracy and scalability. Organizational investment will gradually increase, as part of a holistic corporate analytics strategy.

User Advice: Organizations should use pilot projects to evaluate whether this technology can provide significant business value. Focus on call classification, the impact on quality management, and the hypothetical value of insights that can be fed back to sales (such as pricing sensitivity), marketing (such as campaign awareness and competitive deals) and product development (such as current issues/needs and competitive products). Determine the technology stack (keyword/phrase, phonetic or transcription) that best suits your organizational needs, because each has its own strengths and weaknesses. Choose a deployment model (SaaS, in-house or managed service) that best aligns with your short- and long-term financial plans, as well as your internal resource availability/expertise.

Business Impact: Audio-mining/speech analytics solutions:

- Improve call center agent performance and compliance
- Increase customer satisfaction by identifying issues and taking the appropriate actions
- Enable better understanding of customer needs and issues
- Provide insights into product feedback, pricing issues and market campaign effects

- Improve access to previously unsearchable audio information and assets, such as analyst calls or educational materials

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Autonomy; Avaya (Aurix); CallMiner; Nexidia; Nice Systems; Raytheon BBN Technologies; StreamSage; Utopy; Verint Systems

NFC

Analysis By: Mark Hung

Definition: Near Field Communication (NFC) is a wireless technology that enables a variety of contactless applications, such as payments, information retrieval, mobile marketing and device pairing. It has an operating range of 10 cm or less using the 13.56MHz frequency band. Three user modes are defined for NFC operation:

- Card emulation
- Tag reading
- Peer-to-peer (P2P)

These modes are based on several ISO/IEC standards, including ISO14443 A/B, ISO15693 and ISO18092. The NFC Forum is the industry group that specifies the use of these standards.

Position and Adoption Speed Justification: For the past decade, NFC has been a technology looking for a solution. Originally intended as the foundation for next-generation payment systems using smart cards, it never caught on due to the lack of a compelling value proposition. As mobile phones became more prevalent globally in the mid-2000s, Nokia tried to push the technology in this new platform. However, the ROI was still unclear for financial institutions, payment processors, credit card issuers and most importantly, merchants. Nokia introduced it on only one feature phone, the 6131.

In November 2010, Google breathed new life into NFC by embedding it into its latest smartphone, the Google Nexus S. This became the first widely available smartphone with built-in NFC. During the next several months, Google enhanced the Android OS to eventually support all three modes specified by the NFC Forum — another first. During 1H11, all the major smartphone OS vendors, with the notable exception of Apple, announced support for NFC by the end of 2011:

- Android: Samsung, HTC, LG, ZTE, Huawei
- RIM: BlackBerry Bold and Curve
- Symbian: Nokia

- Windows Phone 7: Nokia

By embedding NFC into the smartphone platform, the hardware and software companies hope to move beyond payments and provide the developer community with another tool to foster innovative applications, such as:

- Gaming: Rovio has introduced a version of "Angry Birds" that will allow NFC-enabled phones to unlock unique levels of play.
- Social networking: Poken has pioneered the use of NFC to allow people to not only exchange contact information, but also profiles from various social networking sites, to build out their social network. This network can then be used to share coupons, offers and virtual goods.
- Information retrieval: NFC tags can provide a richer experience at museums by providing the user with more information about the display. Additional use cases include real-time schedule information at transit stops and smart advertising.
- Device pairing: NFC can serve as the setup channel for connecting two devices together, such as a Bluetooth headset with a phone or a wireless printer with a PC.
- Access control: Instead of providing a guest with a key card, a hotel can download the key to the guest's handset at check-in and deactivate it upon check-out. Similarly, enterprises can use NFC-based devices to replace existing badges for physical access control.
- Location-based services: Foursquare has started an NFC pilot by installing NFC tags at local merchants to facilitate the check-in process.

Progress has also been made in the NFC payment segment. ISIS, a consortium of mobile carriers in the United States that includes Verizon Wireless, AT&T and T-Mobile, decided to drop its initial plans for forming a new payment network and to instead work cooperatively with the existing financial institutions. Google, on the other hand, introduced the Google Wallet, which has the support of some of the leading players in the mobile payment ecosystem, including Citi, MasterCard, First Data and Sprint. Most notably, Google is not sharing in the transaction fee structure that's been established between the existing players, opting instead to monetize this platform via offers and advertising. The Google Offers product that was introduced with Google Wallet allows users to transfer online coupons into the wallet to be used in brick-and-mortar stores. Similar progress has been made in the U.K. (Orange UK/Barclaycard), France (expansion of the Nice Cityzi trials to other cities), Korea (KT), and Japan (FeliCa going dual mode with support for NFC).

NFC payment, however, with multiple parties that have differing interests and agendas, remains the most complex and time-consuming application to implement. For the next few years, growth of NFC will be primarily in smartphones and the surrounding digital ecosystem devices, such as tablets, PCs, printers and TVs. For NFC to take off in payments, a compelling case must be made for the merchants and the financial ecosystem to invest in the necessary infrastructure.

User Advice:

- Electronic equipment manufacturers should carefully examine NFC's possible use cases and determine which of their mobile, computing, communications, and consumer electronics devices can benefit from its inclusion.
- Software developers should explore the combination of NFC with a smartphone's other capabilities to bring about innovative applications to bridge the online and physical worlds.
- Wireless connectivity semiconductor vendors should re-examine their product road map and decide how to offer this capability to their customers, whether through a partnership, acquisition or organic development. This will become a checkbox item for connectivity on smartphones within two to three years.

Business Impact: NFC can bring about unrealized applications by embedding identity into a multifunction computing and communications platform, such as the smartphone. Although this will have the most impact at the consumer level at first, it may eventually have a strong influence on context-aware computing and security control in many different industries and enterprises.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Broadcom; Google; Inside Secure; Nokia; NXP Semiconductors; Research In Motion (RIM); Samsung

Cloud Computing

Analysis By: David Mitchell Smith

Definition: Cloud computing is a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies.

Position and Adoption Speed Justification: Cloud computing is still a visible and hyped term, but, at this point, it has clearly passed the Peak of Inflated Expectations. There are signs of fatigue, rampant cloudwashing and signs of disillusionment (e.g., highly visible failures). Although cloud computing is approaching the Trough of Disillusionment, it remains a major force in IT. Users are changing their buying behaviors, and, although they are unlikely to completely abandon on-premises models or buy complex, mission-critical processes as services through the cloud in the near future, there is a movement toward consuming services in a more cost-effective way and toward enabling capabilities not easily done elsewhere.

Although the hype has peaked, there is still a great deal of hype surrounding cloud computing. Every IT vendor has a cloud strategy, although many aren't cloud-centric. Variations, such as private cloud computing and hybrid approaches, compound the hype and demonstrate that one dot on a Hype Cycle cannot adequately represent all that is cloud computing.

User Advice: User organizations must demand road maps for the cloud from their vendors. Users should look at specific usage scenarios and workloads, and map their view of the cloud to that of potential providers, and focus more on specifics than on general cloud ideas.

Vendor organizations must begin to focus their cloud strategies on more-specific scenarios, and unify them into high-level messages that encompass the breadth of their offerings.

Cloud computing involves many components, and some aspects are immature. Care must be taken to assess maturity and assess the risks of deployment. Tools such as cloud services brokerages can help.

Business Impact: The cloud computing model is changing the way the IT industry looks at user and vendor relationships. As service provisioning (a critical aspect of cloud computing) grows, vendors must become provider or partners with, service providers to deliver technologies indirectly to users. User organizations will watch portfolios of owned technologies decline, as service portfolios grow. The key activity will be to determine which cloud services will be viable, and when.

Benefit Rating: Transformational

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Amazon; Google; Microsoft; salesforce.com; VMware

Recommended Reading: "Agenda for Cloud Computing, 2012"

"The What, Why and When of Cloud Computing"

Machine-to-Machine Communication Services

Analysis By: Tina Tian; Nick Jones; Leif-Olof Wallin

Definition: Machine-to-machine (M2M) communications is used for automated data transmission and measurement between mechanical or electronic devices. The key components of an M2M system are:

- Field-deployed wireless devices with embedded sensors or RFID
- Wireless communication networks with complementary wireline access includes, but is not limited to cellular communication, Wi-Fi, ZigBee, WiMAX, wireless LAN (WLAN), generic DSL (xDSL) and fiber to the x (FTTx)

Position and Adoption Speed Justification: M2M technology continues to fuel new business offerings and supports a wide range of initiatives, such as smart metering, road tolls, "smart cities," "smart buildings" and geofencing assets, to name a few. Revenue growth is now back to 30% to 40% per year after a slowdown during 2008 and 2009. Communication service providers (CSPs),

business development managers and architects in many industries should take a closer look at how M2M can help grow the business.

M2M services are currently provided by three types of service providers:

- **M2M service providers.** Mobile virtual network operators and companies associated with an operator that can piggyback on the operator's roaming agreements (for example, Wyless, Kore and Jasper Wireless).
- **CSPs.** Some CSPs, such as Orange in Europe and AT&T in North America, have supplied M2M services for several years, but have not publicized them widely. However, CSPs are now marketing M2M more vigorously and those that haven't had a strong M2M presence are treating it more seriously by increasing marketing, or creating dedicated M2M divisions (for example, T-Mobile, Telenor Group and Vodafone).
- **More organizations with different M2M strengths are combining to enter the market.** For example, Jasper Wireless signed an agreement with AT&T to support M2M devices created jointly.

All three of these types of players will be viable, and can be customized to meet M2M requirements currently awaiting verification.

Besides the service providers mentioned above, there are companies with certain skills in strategy and rollout that can manage the daunting value chain needed to implement M2M solutions. Examples of such companies are:

- Ventyx, an ABB Company
- Walsh Vision, which rolled out an M2M-based pay-as-you-drive insurance solution
- Capgemini, which is a leader in smart grid and advanced metering infrastructure solutions
- Integron, which is a logistics and integration partner for M2M solutions.

There is also progress toward M2M in emerging markets. Russia's leading CSP, VimpelCom, announced a partnership with Jasper Wireless and joined the M2M community (of AT&T, KPN, Telcel, Rogers and Jasper Wireless) in 2009. The government of China, meanwhile, has announced its intention to put M2M into its 12th five-year plan (from 2011 to 2015) as a major development and investment focus.

Wireless access is one of the many important links in an M2M deployment chain. CSPs have to be well positioned for their role in the M2M market, based on the evaluation of their own strengths — in terms of multinational network coverage, application development skills and IT management ability — and their choice of a suitable business model and partner. CSPs also have to be in a position to sell a series of new data plans (that accommodate an M2M solution's business requirements) as well as providing some form of second- or third-tier support. These demands are being placed on CSPs whose core expertise lies in providing mass-market voice and data services to consumers.

One of the key technology factors that may affect M2M deployment is mobile network supporting capability. Early M2M services were smart meters, telematics and e-health monitors, which are

expected to be widely used in the future. In Release 10, 3GPP has been working on the study of M2M to enhance network systems to better support machine-type communications (MTC) applications. 3GPP's TS 22.368 specification describes common and specific service requirements for MTC. The main functionality specified in 3GPP Release 10 are overload and congestion control. Other MTC features will continue to be investigated in Release 11 by architecture, core network and radio access network (RAN) workgroups. End-to-end real-time security will also become an important factor when more critical vertical applications are brought into cellular networks.

Another key factor from the technology side that may impact M2M mass deployment is standardization. Parts of the key M2M technology components — such as RFID, location awareness, short-range communication and mobile communication — have been in the market for quite a long time. However, there remains a lack of the standardization necessary to put the pieces of the puzzle together to make M2M cost-effective and easy to deploy, and to allow this market to take off. M2M standardization may involve many technologies (like Efficient XML Interchange Standard [EXI], Constrained Application Protocol [CoAP] and IPv6/6LoWPAN [IPv6 over Low-power Wireless Personal Area Networks]) and stakeholders (including CSPs, RFID makers, telecom network equipment vendors and terminal providers). The European Telecommunications Standards Institute currently has a group working on the definition, smart metering use cases, functional architecture and service requirements for M2M.

User Advice: As M2M grows in importance, regulators should pay more attention to standards, prices, terms and conditions. For example, the difficulty of changing operators during the life of equipment with embedded M2M might be seen by regulators as a potential monopoly. Regulators in France and Spain already require operators to report on M2M connections, and we expect to see increased regulatory interest elsewhere.

For the end user, the M2M market is very fragmented because no single end-to-end M2M provider exists. A number of suppliers will offer monitoring services, hardware development, wireless access services and hardware interface design and other functions to the user. As a result, an M2M customer has to do a lot of work to integrate the many vendors' offerings, on top of which, business processes may need redefining. M2M will speed up IT/operational technology alignment and convergence, as IT and communications solutions will come closer to users' operations and control through M2M.

An enterprise's M2M technology strategy needs to consider the following issues:

- Scope of deployment
- System integration method
- Hardware budget
- Application development and implementation
- Wireless service options
- Wireless access costs

Business Impact: M2M communications bring many benefits to its users, government and CSPs. It will dramatically improve the efficiency of device and machine management.

It is expected to be the enabler for many smart initiatives that fall under the smart city umbrella. For example, smart grid with connected smart grid sensors, to monitor the distribution network in real-time; and smart transportation with embedded telematics devices in cars to track and control the traffic. It will also connect billions of devices and machines, causing further transformation of communications networks.

M2M communications should be seen as an important set of facilitating technologies for use in operational technologies (OT). Particular care should be taken at an architectural level when choosing M2M solutions to see that they facilitate the alignment, convergence or integration of OT with IT.

Benefit Rating: Transformational

Market Penetration: Less than 1% of target audience

Maturity: Adolescent

Sample Vendors: AT&T; France Telecom; Qualcomm; Sprint Nextel; Telenor Group; Verizon; Vodafone

Recommended Reading: "The Shifting Sands of the Cellular Machine-to-Machine Market"

"The M2M Market Evolution: Growth Attracts Everyone"

"Technology Overview: Mobile M2M Network in Japan"

"nPhase Alliance With Carriers Simplifies Global M2M Deployment"

"IT and Operational Technology: Convergence, Alignment and Integration"

Mesh Networks: Sensor

Analysis By: Nick Jones

Definition: Sensor networks consist of dynamic meshes of peer nodes, each of which includes simple networking, computing and sensing capabilities. Some variants offer low-power operation and multiyear battery life. Sensor networks are typically self-organizing using distributed routing algorithms and are capable of ad hoc operation with nodes joining and leaving dynamically. We use the term "sensor network" to mean an entire system, consisting of multiple sensors connected in a mesh network possibly with gateways to connect the network to the Internet.

Position and Adoption Speed Justification: Small-to-midsize implementations (that is, tens to hundreds of nodes) are being deployed using technology from several vendors for applications such as remote sensing, environmental monitoring and building management/automation. The market is commercially and technologically fragmented, and topics such as middleware and power-efficient routing are still areas of active academic research. Some vendors use proprietary protocols;

however, standards such as IPv6 over Low-Power Wireless Personal Area Networks (6LoWPAN) are making sensor environments more accessible by extending mainstream Internet Protocol version 6 (IPv6) networking to sensor nodes.

Sensor networks will use a wide range of wireless bearer technologies. These include ZigBee, 802.15.6 for body area networks, low energy (LE) Bluetooth, WirelessHart for industrial networks, and proprietary protocols such as Z-Wave for home automation. The long-term market potential is enormous, with likely scenarios of tens of billions of installed units. However, although the wireless bearer technologies are maturing rapidly, other aspects of sensor networks such as business models and the slower pace at which silicon chips evolve means that it will take at least a decade before the market reaches its full potential.

User Advice: Sensor networks will be a key component of the Internet of Things. Organizations looking for low-cost sensing and robust self-organizing networks with small data transmission volumes should explore sensor networking. Because it is an immature technology and market, vendor and equipment decisions could become obsolete relatively rapidly (perhaps in less than three years); therefore, this area should be viewed as a tactical investment. Despite these challenges, there have been successful early deployments in such areas as building automation, agricultural sensing, automated meter reading and industrial sensing.

Business Impact: This technology will affect a wide range of business areas, including low-cost industrial sensing and networking; low-cost, zero-management networking; resilient networking; military sensing; product tagging; healthcare; building automation; infrastructure monitoring (e.g., railways or bridges); home automation; and environmental management.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Cisco; Dust Networks; Intel; Memsic; Millennial Net; Sigma Designs; Silicon Laboratories

Recommended Reading: "Innovation Insight: The 'Internet of Everything' Innovation Will Transform Business"

Gesture Control

Analysis By: Stephen Prentice

Definition: Gesture control is the ability to recognize and interpret movements of the human body in order to interact with and control a computer system without direct physical contact. The term "natural user interface" is becoming commonly used to describe these interface systems, reflecting the general lack of any intermediate devices between the user and the system.

Position and Adoption Speed Justification: The initial commercial phase of gesture control began with handheld devices that detect motion, such as the Nintendo Wii's 3D controller, as well as 3D mice and high-end mobile phones with accelerometers. We now recognize these as a distinct subcategory — "assisted gesture control" — which makes use of additional physical objects (such as gloves and inertial sensors) to enhance the interpretation and/or resolution of detectable movements.

The overall technology is now advancing rapidly, as camera-based systems (which usually obviate the need for assistive devices) have entered the market strongly. The most visible and easily accessible is the Microsoft Kinect gaming controller, and the decision by Microsoft to release the Kinect for Windows SDK provided a huge boost for the platform, opening the way to a wide range of potential applications in multiple areas, including business and healthcare, as well as gaming. Microsoft Kinect combines camera-based, full-body gesture and movement recognition with face and voice recognition to provide a rich interface. Such composite interfaces are likely to become more commonplace, especially in the consumer environment. Indeed, a sustained period of competitive feature enhancement looks likely among Nintendo, Sony and Microsoft, leading to ever-improving capabilities, including improved facial recognition and greater resolution. The inclusion of these capabilities on increasingly powerful handheld devices and mobile platforms offers interesting possibilities, which will drive further developments in areas such as augmented reality. Most recently, Microsoft Research revealed an alternative sensing approach using high-frequency sound waves and detecting the Doppler effect, which appears to work satisfactorily over short distances and may open up new options for desktop and handheld devices. The announcement of a new low-cost device from Leap Motion promising submillimeter discrimination within a limited (desktop-sized) zone is likely to drive further possibilities for desktop devices.

A more limited subset of gesture recognition and control (in 2D only) has become common with the recent development of multitouch interfaces (such as the Apple iPhone or Microsoft Surface), in which multiple finger touches — pinch and squeeze, flicks, and swipe-type gestures — are used to provide a richer and more intuitive touch-based interface.

Gesture recognition involves the effective use of a variety of input devices (to provide either 2D movements or full 3D information) and considerable data processing — to recreate wire frame models of body positions and vector-based dynamics (for speed and direction of movement), followed by the interpretation of these gestures into meaningful commands to an application. The conceptual design of a user interface based on gestures is a considerable task — both from a technical standpoint and from a cultural and anthropological perspective, especially in a global market where cultural sensitivity must be taken into account. Nevertheless, this is an area that is attracting considerable interest from researchers, and the ability to create mashup-style interfaces from readily available components makes experimentation accessible. The SixthSense project at MIT is a good example, linking the use of gesture recognition with augmented reality to explore a new generation of interactions. Business applications are already starting to emerge; a good example being the use of Kinect to track and record shopper behavior to provide retail analytics (see www.shopperception.com); although this does not directly involve "gestures," it exploits the ability to recognize and interpret body movements and is more accurately in the field of video analytics.

While the benefits of gestural interfaces in gaming applications are clear, the creation of intuitive and logical natural user interfaces for business applications will take several years. The logical mapping of intuitive and standardized gestures into meaningful commands with which to control a business application is a significant challenge. The rapid adoption of media tablet devices and the continuing growth of smartphones have significantly increased the use of multitouch-based interfaces in recent years, and this is in no small part due to the widely accepted "standard" touch and multitouch actions like pinch, rotate and flick. The establishment of well-understood standard touch gestures is now spilling over to larger devices, and a number of developers are creating solutions designed for a variety of platforms from handheld devices to large wall-mounted displays, although a consistent set of standard gestures has yet to emerge. For example, business-oriented solutions (such as those from iNUI Studio) are already appearing and are targeted at specific vertical business markets, using camera-based gesture recognition as part of portfolios of natural user interface solutions for handheld devices and wall-mounted displays. We anticipate the following:

- The growing availability of devices and the rapidly increasing accuracy, combined with the growing number of devices requiring control, many of which are becoming embedded into the fabric of our environment, means that the traditional control paradigms are no longer appropriate. Gesture control allows control from the distant "lean-back zone" to the immediate "lean-in zone" and is looking increasingly significant as a primary interaction paradigm with the ability to transform the way humans interact with computers. We have therefore increased the benefit rating from moderate to transformational.
- With mainstream products in the gaming market now well-established, gesture control is moving quickly through the Hype Cycle, and the growing availability of options advances it from "emerging" to "adolescent" in terms of maturity.
- While mainstream adoption in gaming is happening quickly, the time to plateau in the enterprise space will be longer.

User Advice: Gesture control is just one element of a collection of technologies (including voice recognition, location awareness, 3D displays and augmented reality) that combine well to reinvent human-computer interaction. Enterprises should:

- Evaluate handheld and camera-based gesture recognition for potential business applications involving controlling screen displays from a distance (the "lean-back" operating zone). Consider business-oriented toolkits, as well as those targeted at the gaming sector.
- Evaluate the new generation of desktop-oriented devices and consider what role they may play in the "lean-in" operating zone.
- Consider how these may be combined with location-based information and augmented-reality displays.
- Look carefully at developments in the gaming sector; these will form the basis for a variety of early prototypes for business applications.

Even the simplest use of gesture, movement or touch can be introduced to existing products (especially in the handheld space) to enhance the user experience. Even almost-novelty items (such as the Kymera Magic Wand, which can control devices at a distance with learned infrared commands — www.thewandcompany.com) can create engaging user experiences in an otherwise keyboard-dominated world.

Business Impact: The primary application for gestural interfaces at present remains the gaming and home entertainment market. However, the potential of hands-free control of devices and the ability for several people to interact with large datasets are opening up a wide range of business applications — including data visualization and analytics, design, retail, teaching, and medical investigation and therapy.

As computing power moves from a single device to an "on-demand" resource, the ability to interact and control without physical contact frees the user and opens up a range of intuitive interaction opportunities, including the ability to control devices and large screens from a distance. For smaller desktop and handheld devices, the ability to control the device without physical contact opens up interesting possibilities in healthcare applications (where physical contact may result in transfer of bacterial material) as well as the design aesthetics of avoiding unsightly finger marks on touch-based devices.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: eyeSight; GestureTek; Gyration; iNUI Studio; Leap Motion; Microsoft; Nintendo; Oblong; PrimeSense; SoftKinetic; Sony

In-Memory Analytics

Analysis By: James Richardson

Definition: In-memory analytics is an alternative business intelligence (BI) performance layer in which detailed data is loaded into memory for fast query and calculation performance against large volumes of data. This approach obviates the need to manually build relational aggregates and generate precalculated cubes to ensure analytics run fast enough for users' needs.

Position and Adoption Speed Justification: Declining memory prices, coupled with widespread adoption of 64-bit computing, continue to prime the market for in-memory analytics. Most BI vendors are now positioning in-memory analytics as a key component of their BI offerings — and the use of RAM-based processing to speed up analytics will soon be ubiquitous as part of vendor platforms. Hype is running ahead of uptake however, with most organizations still relying on traditional approaches, such as summary tables, to improve performance. This is because, in the main, these are the techniques most familiar to them. While the speed gains are undeniable when using this style of processing, it's evident that a note of realism is becoming apparent about how in-memory analytics is best used and its cost-benefit ratio — although RAM is cheaper than it used to be, it's still many times more expensive than disk.

User Advice: For response-time issues and bottlenecks, IT organizations should consider the performance improvement that in-memory analytics can deliver, especially when run on 64-bit infrastructure. Users should be careful to use in-memory analytics as a performance layer, not as a substitute for a data warehouse. In fact, users considering utilizing in-memory analytics should also be aware of how their requirement for speedier query processing and analysis could be addressed by the use of in-memory processing in the underlying databases feeding BI or via in-memory databases or data grids.

BI leaders need to be aware that in-memory analytics technology has the potential to subvert enterprise-standard information management efforts through the creation of in-memory analytic silos. Where it is used in a stand-alone manner, organizations need to ensure they have the means to govern its usage and that there is an unbroken chain of data lineage from the report to the original source system, particularly for system-of-record reporting.

Finally, it is becoming apparent as the scale of in-memory analytics deployments grow that there is still a need for performance tuning either by the return of some aggregation at data load, or by managing application design against user concurrency requirements and the sizing of hardware and available RAM.

Business Impact: BI programs can benefit broadly from the fast response times delivered by memory-based processing, and this in turn can improve the end-user adoption of BI. The reduced need for database indexing and aggregation enables database administrators to focus less on the optimization of database performance and more on value-added activities. Additionally, in-memory analytics by itself will enable better self-service analysis because there will be less dependence on aggregates and cubes built in advance by IT. However, from an analyst user perspective, faster queries alone are not enough to drive higher adoption. In-memory analytics is of maximum value to users when coupled with interactive visualization capabilities or used within data discovery tools for the highly intuitive, unfettered and fast exploration of data.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Board International; IBM; Microsoft; MicroStrategy; Oracle; QlikTech; Tibco Software

Recommended Reading: "Need for Speed Powers In-Memory Business Intelligence"

Text Analytics

Analysis By: Gareth Herschel; Hanns Koehler-Kruener

Definition: Text analytics is the process of deriving information from text sources. It is used for several purposes, such as: summarization (trying to find the key content across a larger body of information or a single document), sentiment analysis (what is the nature of commentary on an

issue), explicative (what is driving that commentary), investigative (what are the particular cases of a specific issue) and classification (what subject or what key content pieces does the text talk about).

Position and Adoption Speed Justification: Often, interest in text analytics has been cyclical, with several false starts for the technology moving toward mass adoption. However, interest in the application of text analytics in three areas has resulted in accelerating interest among users and more serious vendor support. These three areas are: voice of the customer, which looks at direct (for example, surveys) and indirect (for example, blog commentary, Facebook and Twitter) customer feedback; fraud and public security (identifying patterns that require further investigation); and categorization and classification, which involves trying to understand how a particular text objects fit into an existing structure, or creating structures from scratch. Although it is unlikely that text analytics will be the panacea that many organizations hope for, it is past the unsubstantiated hype phase of its evolution, and eventually will become a ubiquitous tool for organizations.

User Advice: Text analytics will be an increasingly important tool for organizations, as exhaustive analysis of structured data yields increasingly little competitive advantage. However, the text analytics solutions market is slowly maturing (the vendors with the longest track records have software-as-a-service offerings), though some of the underlying capabilities are not as robust as the attractive user interface may suggest (for example, dealing with non-English-language documents and documents with many domain-specific terms can still be a challenge for some vendors). The lack of understanding on the part of most users about the subtleties of information extraction theory makes most selection processes dependent on a proof of concept and careful evaluation of the resulting insights. Organizations considering investing in this space should do so incrementally. They should consider limited pilots to ensure that the application will work effectively in the chosen domain, and to establish business processes for dealing with the results before investing in a full-scale deployment.

Business Impact: The impact of text analysis varies depending on the use case. When providing a summary of the nature of commentary on an issue, the benefits are usually seen in better resource allocation, or in identifying areas of concern or opportunity so that action can be taken. When providing explicative analysis, the benefits usually come from faster and more accurate identification of the underlying issue. For example, customer dissatisfaction with a product may be traced to misrepresentation of its capabilities by marketing, to a design flaw that makes it unsuitable for a specific purpose or open to misuse by an untrained customer. The benefits of investigative analysis may be easily quantified (detecting fraudulent insurance claims) or more difficult to quantify (preventing a crime or identifying dissatisfied customers). In many cases, the largest impact of text analytics will come from allowing it to combine extracted unstructured data with traditional structured data to provide a more complete view of the issue that can then be analyzed using traditional data-mining or business intelligence tools.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Attensity; Autonomy; Clarabridge; IBM; IxReveal; Megaputer; Microsoft; Nice Systems; OpenText; Oracle; SAP BusinessObjects; SAS; Temis

Home Health Monitoring

Analysis By: Barry Runyon; Angela McIntyre

Definition: Home health monitoring is the use of IT and telecommunications to monitor the health of patients in their homes and to help ensure that appropriate action is taken. Patients are provided devices that measure vital signs, such as blood pressure, glucose level, pulse, blood oxygen level and weight, and then transmit the data to clinicians. Other devices are used for messaging — gathering information from patients on their symptoms, cognitive state and behavior, and sending them information and advice.

Position and Adoption Speed Justification: Home health monitoring involves sending data through wired or wireless connections to a hub or gateway system in the home, which transmits the data to an external server where software can be used to analyze the data and issue alerts to clinicians as needed. Most often, data from hubs is transmitted through a regular telephone line, although some hubs require broadband connections. In some developing countries, where mobile phone service is easier to obtain than landlines, the data is transmitted through mobile phone networks.

Home health monitoring is appropriate for certain groups of chronically ill, homebound patients and others who need frequent monitoring. If implemented correctly, it can improve health, assist in keeping patients at home, reduce the need to travel, reduce emergency room visits and delay inpatient admission. It has the potential to allow patients to live at home longer before being admitted to a long-term care facility and to support remote monitoring by the adult children of homebound patients. Home health monitoring appeals to patients, and a successfully implemented home health monitoring program could enhance the reputation of a healthcare delivery organization (HDO).

Technical barriers to adoption include the problem of exchanging data between monitoring devices and electronic medical record (EMR) applications. These barriers are gradually being reduced through the work of the Continua Health Alliance and other groups. The nontechnical barriers include legal and licensing restrictions, inconsistent reimbursement by healthcare payers, and the fact that home health monitoring requires new protocols for dealing with large volumes of information and new ways of staffing and information sharing (in particular, greatly enhanced care coordination). For family caregivers, barriers include the perceived high cost and a belief that the care recipient will resist using the technology. The training and support of patients in the use of home health technology is necessary to overcome the reluctance and fear that some patients experience.

Many deployments of home health monitoring have been pilot projects. However, there are few examples of standardized ongoing services. The U.S. Department of Veterans Affairs (VA), has deployed home health monitoring to more than 50,000 patients with high-cost chronic conditions, such as chronic heart failure, chronic obstructive pulmonary disease, diabetes, depression and

post-traumatic stress disorder. The VA has recorded a 25% reduction in numbers of bed days of care, a 19% reduction in numbers of hospital admissions and mean patient satisfaction scores of 86% after enrollment in its home health monitoring program.

Other adopters of home health monitoring have been home health agencies in the United States, which receive a fixed fee per patient for one to two months after a hospital episode from the federal U.S. Medicare program and, therefore, have a financial interest in using technology to reduce the cost of delivering care. There is strong interest among hospital-owned home health agencies, because hospitals do not receive Medicare reimbursement for rehospitalizations and emergency room visits during the one-to-two-month period. A limitation of these deployments is that they are short-lived, whereas the patients they are serving have chronic conditions.

U.S. attention to home health monitoring has been boosted by initiatives created and expanded under healthcare reform laws. Key initiatives in this regard include patient-centered medical homes and accountable care organizations.

In Canada, the Canada Health Infoway program and the Ontario Telemedicine Network (OTN) are making significant investments in home health monitoring, and the Canadian Home Care Association pilot in British Columbia has found that 5% more patients are released to home care due to the availability of telemedicine in the home. In Europe, home health monitoring received a boost from the 2008 European Commission (EC) Communication on Telemedicine, in which the commission addressed the problems of confidence, evidence, regulation, reimbursement and interoperability. Since then, the EC has launched Renewing Health, which will evaluate nine regional home health monitoring deployments across Europe, and will help them scale up to become national deployments. In England a number of primary care trusts have added home health monitoring to existing programs of telecare (technologies for safety at home). Most of the English deployments are pilots, but a few have become mainstream services. Other European countries with mainstream services include Italy, Germany and Spain.

In the Asia/Pacific region, home health monitoring is mostly characterized by pilot projects; however, the Australian state of New South Wales has an initiative called Connecting Care to deploy home health monitoring to 43,000 patients between 2011 and 2015.

Despite the enthusiasm and undeniable potential of home health monitoring, it will remain squarely in the Trough of Disillusionment during 2012. Clinical and financial results from existing pilot programs need to be better understood by healthcare providers along with regulatory implications. Existing operational home health monitoring programs need to lead to best practices so HDOs can determine how and when to introduce home health monitoring into their business plans and workflows.

User Advice: HDOs should identify ways to make home health monitoring economically viable for them to deliver, and attractive for healthcare payers to fund. The ability to care for patients at home and keep them out of skilled nursing facilities has great appeal to patients and their families. In competitive healthcare markets, this visibility will be an important factor in building up an HDO's brand value and attractiveness. Therefore, it makes sense for HDOs to promote their home health monitoring programs through their enterprise/consumer portal or patient portal. Home health monitoring is particularly well-suited for closed health systems, with tight links between the

providers and payers of healthcare, and in situations where the healthcare provider takes on financial risk for the costs of patient care. Clinicians should be encouraged to incorporate home health monitoring in cases where the adoption will improve care and reduce inconvenience to the patients.

HDOs should recognize that home health monitoring devices will eventually become commodities. What will differentiate a home health monitoring deployment will be the software and associated decision support, as well as the infrastructure of care coordination that includes individuals available to intervene in the case of alerts, and who are trained in standard procedures for referral, assessment and patient education. HDOs should deploy home health monitoring as part of a program of chronic disease management and as a tool to help patients better manage their medical conditions. HDOs, research centers and trade associations must continue to demonstrate to healthcare payers the positive outcomes of home monitoring to get them to reimburse it more widely. Whereas patient satisfaction and clinical outcomes have proven relatively easy to measure, financial outcomes — meaning the ROI from deploying a home health monitoring program — are much harder to measure.

Manufacturers of consumer electronics considering providing symptom monitors for home health monitoring should make their devices compatible with open standards for interoperability, for connectivity and data formats. Manufacturers should provide a product that has a wireless interface for mature market countries, and offer a wired option that adheres to the USB Personal Healthcare Device Class (PHDC) specification. They should choose the Bluetooth wireless standard for devices that may be used with smartphones. Manufacturers must ensure the widest range of potential partners for data tracking and analysis applications, software tools, and other connected consumer electronics and home health monitoring service providers by using the Continua Health Alliance standards.

Business Impact: The potential impact of home health monitoring remains high. It can enable improvements in the quality and timeliness of care, improve the accessibility of care, reduce patients' and clinicians' travel time (as well as cost and environmental impact), and permit elderly patients to remain at home longer before entering a skilled nursing facility. It can also reduce the number of hospital admissions, readmissions and bed days.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Aerotel Medical Systems; Alcatel-Lucent; American TeleCare; AMD Global Telemedicine; A&D Medical; Bosch Healthcare; Broomwell Healthwatch; Cardiocom; Docobo; Entra Health Systems; Honeywell HomMed; Ideal Life; Intel; Intel-GE Care Innovations; McKesson; Medgate; Medic4All; Nonin Medical; Numera; Omron; Philips Healthcare; Samsung; SHL Telemedicine; TaiDoc; Telbios; TeleMedCare; Tunstall Healthcare Group; Viterion Telehealthcare; Wipro

Recommended Reading: "A Quick Look at Cloud Computing in Healthcare Payers and Providers, 2012"

"Market Trends: Mobility Solutions in Vertical Markets"

"Cool Vendors in Healthcare Providers, 2012"

Hosted Virtual Desktops

Analysis By: Mark A. Margevicius; Ronni J. Colville; Terrence Cosgrove

Definition: A hosted virtual desktop (HVD) is a full, thick-client user environment run as a virtual machine (VM) on a server and accessed remotely. HVD implementations comprise server virtualization software to host desktop software (as a server workload), brokering/session management software to connect users to their desktop environments, and tools for managing the provisioning and maintenance (e.g., updates and patches) of the virtual desktop software stack.

Position and Adoption Speed Justification: An HVD involves the use of server virtualization to support the disaggregation of a thick-client desktop stack that can be accessed remotely by its user. By combining server virtualization software with a brokering/session manager that connects users to their desktop instances (that is, the OS, applications and data), enterprises can centralize and secure user data and applications, and manage personalized desktop instances centrally. Because only the presentation layer is sent to the accessing device, a thin-client terminal can be used. For most early adopters, the appeal of HVDs has been the ability to thin the accessing device without significant re-engineering at the application level (usually required for server-based computing).

While customers implementing HVDs cite many reasons for deployments, three important factors have contributed to the increased focus on HVD: the desire to implement new client computing capabilities in conjunction with Windows 7 migrations, the desire for device choices (particularly iPads), and the uptick in customers focused on security and compliance issues. During the past few years, the adoption of virtual infrastructures in enterprise data centers has increased, making HVDs easier to deploy. With this increase comes a level of maturity and an understanding of how to better utilize the technology. This awareness aids HVD implementations where desktop engineers and data center administrators work together.

Early adoption of this technology has been hindered by several factors, primarily licensing compliance issues for the Windows client OS. This has since been resolved through Microsoft's Windows Virtual Desktop Access (VDA) licensing offerings. This was only one aspect of the higher total cost of ownership (TCO) associated with implementing HVD on a broad scale. While many IT organizations made significant progress in virtualizing their data center server infrastructures, HVD implementations required additional virtual capacity for server and storage (above and beyond what was in place for physical to virtual migrations). Even with Microsoft's reduced license costs for the Windows OS, enabling an HVD image to be accessed from a primary and secondary device for one license fee, other technical issues have hindered mainstream adoption. Improvements in the complexity of brokering software and remote access protocols will occur throughout 2012,

extending the range of desktop user scenarios HVDs can address. Yet, adoption will remain limited to a small percentage of the overall desktop installed base.

Since late 2007, HVD deployments have grown steadily, reaching around 10 million users by the end of 2011. Because of the constraints, the broad applicability of HVDs has been limited to specific scenarios, primarily structured-task workers in call centers, and kiosks, trading floors and secure remote access. About 50 million endpoints remains the target population of the total 700 million desktops. Throughout the second half of 2012 and into 2013, we expect general deployments to continue. Inhibitors to general adoption involve the cost of the data center infrastructure required to host the desktop images (servers and storage in particular) and network constraints. Even with the increased adoption of virtual infrastructures, cost-justifying HVD implementations remains a challenge, because of HVD and PC cost comparisons. Some advancements in leveraging application virtualization make HVD less cumbersome by introducing the ability to layer applications. This makes managing the image and maintaining the HVD easier. Availability of the skills necessary to manage virtual desktops remains a challenge, as is deploying HVDs to mobile/offline users, despite the promises of offline VMs and advanced synchronization technologies.

Through 2012, broader manageability of HVD VMs will improve, as techniques to reduce HVD storage volumes lead to new mechanisms for provisioning and managing HVD images by segmenting them into more isolated components (including OSs, applications, persistent personalization and data). These subsequent manageability improvements will extend the viability of HVD deployments beyond the structured-task worker community — first to desk-based knowledge workers, then to new use cases, such as improved provisioning and deprovisioning, contractors and offshore developers. The virtual graphics processing units (GPUs) introduced in 2012 will eventually allow a broader audience, but will not have much impact until the end of 2013.

HVD marketing has promised to deliver diminishing marginal, per-user costs, due to the high level of standardization and automation required for successful implementations. However, this is currently only achievable for persistent users where images remain intact — a small use case of the overall user population. As other virtualization technologies mature (e.g., brokers and persistent personalization), this restraint will decrease. This will create a business case for organizations that adopt HVDs to expand their deployments, once the technology permits more users to be viably addressed. Enterprises that adopt HVDs aggressively will see later adopters achieve superior results for lower costs. However, these enterprises will need to migrate to new broker and complementary management software as products mature and standards emerge. This phenomenon is set to further push HVDs into the Trough of Disillusionment in late 2012.

User Advice: Unless your organization has an urgent requirement to deploy HVDs immediately for securing the environment or centralizing data management, wait until late 2012 before initiating deployments for broader (mainstream) desktop user scenarios. Through 2012 and 2013, all organizations should carefully assess the user types for which this technology is best-suited. Clients that make strategic HVD investments will gradually build institutional knowledge. These investments will allow them to refine technical architecture and organizational processes, and to grow internal IT staff expertise before IT is expected to support the technology on a larger scale through 2016. Balance the benefits of centralized management with the additional overhead of infrastructure and

resource costs. Customers should recognize that HVDs may resolve some management issues, but will not become panaceas for unmanaged desktops. In most cases, the promised TCO reductions will not be significant, and will require initial capital expenditures to achieve. The best-case scenario for HVDs remains securing and centralizing data management, and structured-task users.

Organizations must optimize desktop processes, IT staff responsibilities and best practices to fit HVDs, just as organizations did with traditional PCs. Leverage desktop management processes for the lessons learned. The range of users and applications that can be viably addressed through HVDs will grow steadily through 2012. Although the user population is narrow, it will eventually include mobile/offline users. Organizations that deploy HVDs should plan for growing viability across their user populations, but should be wary of rolling out deployments too quickly. Employ diligence in testing to ensure a good fit of HVD capabilities with management infrastructure and processes, and integration with newer management techniques (such as application virtualization and software streaming). Visibility into future product road maps from suppliers is essential.

Business Impact: HVDs provide mechanisms for centralizing a thick-client desktop PC without re-engineering each application for centralized execution. This appeals to enterprises on the basis of manageability and data security.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Citrix Systems; Desktone; Microsoft; Quest Software; Red Hat; Virtual Bridges; VMware

Virtual Worlds

Analysis By: Stephen Prentice

Definition: A virtual world is an online networked virtual environment in which participants are immersed in a 3D representation of a virtual space, and interact with other participants and the environment through an avatar (a representation of themselves in the virtual space).

Position and Adoption Speed Justification: The publicity and hype that surrounded virtual worlds over the past few years has now dissipated, and growth has stalled. The expectation that these environments would become the new online social space for a digital generation has long evaporated, as social websites like Facebook grew explosively and overwhelmed all alternatives. Interest from early and preteen users has held up more strongly, but recent issues with "grooming" of vulnerable users on Habbo (owned by Finnish company Sulake) will do little to boost confidence and have already caused some investors to pull out. Niche application areas including education, virtual events and simulation/training (particularly in hazardous environments) remain the only significant growth areas. There is ongoing interest from public-sector organizations and federal users (in the U.S.), but engagement by private-sector enterprises remains muted outside the specific niches listed above.

Second Life (owned by Linden Lab) drove the hype in this sector some years ago, and remains a player today — but ongoing management changes and uncertainty over future directions remain. Nevertheless, with its rich tools and relatively uncontrolled environment, Second Life remains a viable option at this point in time for enterprises and educators looking to trial 3D environments for a wide variety of purposes, although training and simulations are still the primary applications. However, the focus of much attention for the thick-client rich 3D virtual worlds has realigned to OpenSimulator as an open-source platform for those wishing to explore this route. The majority of attention has moved toward simpler browser-based environments which compensate for a less realistic environment with a simpler and more easily accessible user interface.

Without a clear audience value proposition across multiple age groups and sectors, early interest in social worlds has declined. Early ideas of "virtual campuses" for education have largely been abandoned or scaled down to very specific learning scenarios, and the majority of early commercial entrants have now scaled down or closed down their activities as the e-commerce opportunities failed to materialize. In the consumer space, the massive growth in social networking platforms such as Facebook and the rise of addictive browser-based games (such as FarmVille) consume the attention and interest of the potential audience, to the detriment of those operators hoping to create social networking sites built around a 3D immersive environment. The continued growth of gaming environments (that is, massively multiplayer online role-playing games [MMORPGs]) with a strong social and planning element (such as World of Warcraft and Eve Online) has further undermined the less-focused social elements of virtual worlds around which the original hype developed.

User Advice: The value of virtual worlds to enterprise and educational users resides primarily in the ability to deliver a rich and immersive environment for collaboration and interaction. Security issues remain, forcing the focus of attention for many enterprises toward alternative solutions hosted inside the firewall (previously described by Gartner as "private virtual worlds" to distinguish them from the publicly accessible environments like Second Life). Current business conditions continue to encourage enterprises to examine a wide range of alternatives to face-to-face meetings and public events, but simpler solutions (such as Web conferencing) appear to be gaining more traction with users. Travel restrictions, natural disasters and cost constraints have created a growing opportunity for virtual events (or, more frequently, hybrid events with both real-world elements and those participating through a virtual environment, which is a specific niche that is gaining credibility and acceptance). Outside this niche, business models and compelling business cases remain problematic, while effective metrics are still under development. Enterprises should avoid heavy investments and focus on delivering clear business value for identified and prioritized needs.

Enterprises looking to host online events (either independently or as hybrids in support of conventional on-site events) should evaluate the role that browser-based virtual worlds can play in this application.

Business Impact: In the short term, virtual worlds remain a "sandbox" environment for experimentation in training, community outreach and collaboration, but the buzz has died, and enterprise interest remains static. In the longer term, virtual environments still represent useful media channels to support and engage with communities in an immersive fashion, but they appear unlikely to induce transformational change.

Benefit Rating: Low

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: 3DXplorer; Altadyn; Avaya (Nortel); Linden Lab; ON24; OpenSimulator; Unisfair; VastPark

Recommended Reading: "How to Justify Enterprise Investment in Virtual Worlds"

"Virtual Worlds: What to Expect in 2009"

"Learning Simulations Equip People to Face Crises"

"Cool Vendors in Social Software and Collaboration, 2010"

Mobile OTA Payment

Analysis By: Sandy Shen

Definition: Over the air (OTA) payment refers to remote payment as opposed to proximity-based payment using technologies such as Near Field Communication (NFC). OTA payment often uses SMS, Unstructured Supplementary Service Data, Wireless Application Protocol or downloadable client, but not NFC. Gartner defines mobile payments as transactions conducted using a mobile phone and payment instruments, such as bank accounts, bank cards or prepaid accounts.

Position and Adoption Speed Justification: Mobile OTA payment can be used for money transfers, bill payments, merchandise purchases and so forth. It is used in emerging markets where mobile payment services have been launched to target the unbanked and underbanked population. Money transfer, bill payment and mobile account top-up are the top three use cases in emerging markets. For example, we expect the three use cases to account for 92.5% of the transaction volume in Africa in 2012.

Despite the success of M-Pesa in Kenya, not all services in emerging markets have been a success. Nokia recently decided to withdraw its mobile money service from India due to difficulties in ramping up the scale. This, along with many other not-so-successful services, highlights the challenges in developing a mobile payment ecosystem that works for local markets, and there is no standard formula that can be applied to all markets.

In developed markets, mobile OTA payment is often related to online shopping and mobile banking transactions. We expect online shopping via mobile phone to experience accelerating growth, driven by services from electronic commerce (e-commerce) providers, banks, communications service providers (CSPs) and alternative payment providers, such as PayPal. These many services will help increase user awareness and make users feel more comfortable using mobile devices to make payments. At the same time, there are new initiatives led by banks that could potentially be disruptive to card-based payments. In May 2011, three U.S. banks announced a service called "clearXchange," which allows anyone with a bank account to send money to another person using

the recipient's mobile phone number or email address. The service will launch in mid-2012. In February 2012, Barclays launched a money transfer application called "Pingit" that allows banked users to transfer money for free to any bank account in the U.K., using the recipient's mobile phone number. These services can become new alternative methods for online shopping and business payments among small or midsize businesses.

User Advice:

- Banks in emerging markets should consider working with CSPs to make use of their brand and distribution networks to reach out to new customers. Banks in developed markets should monitor the progress of clearXchange and Pingit, and they should consider launching competing offers.
- CSPs should focus on the top use cases for OTA payment and partner with related companies to enrich the service offering.

Business Impact: CSPs can expect to see increased revenue and reduced churn from mobile OTA payment. Banks have the potential to reach more users, attract users from competitors and cross-sell more bank products.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Barclays; Comviva; Fundamo; Gemalto; mChek; Monitise; Obopay; Sybase; Utiba

Recommended Reading: "Forecast: Mobile Payment, Worldwide, 2009-2016"

"Market Trends: Mobile Payment, Worldwide, 2012"

"New Barclays Mobile Payment App May Upset Bank/Telco Status Quo"

Climbing the Slope

Media Tablets

Analysis By: Angela McIntyre; Roberta Cozza; Van L. Baker

Definition: A media tablet is a device based on a touchscreen display, typically multitouch, that facilitates content entry via an on-screen keyboard. The device has a screen with a diagonal dimension that is a minimum of five inches. Media tablets feature connectivity via Wi-Fi or via 3G/4G cellular networks. Tablets typically offer day-long battery life and lengthy standby times, with instant-on access from a suspended state. Examples of media tablets are the Apple iPad, Asus Eee Pad Transformer, Motorola Xyboard and Samsung Galaxy Tab.

Position and Adoption Speed Justification: It is tempting to assume, with the success of the iPad, that the media tablet is at or near maturity, but this is not the case. While competitive tablets have not enjoyed much success to date, we believe that other manufacturers are committed to this hardware platform and will continue to improve their offerings. Future iterations may also incorporate control by gesture and voice. The success of the tablet form factor has been primarily in the consumer market, and it is just beginning to capture the attention of the business market. This alone will contribute to sustained hype for some time to come.

Media tablets include screens that are five inches and larger and come with a supplementary input device, such as a keyboard or pen. The primary focus for media tablets has been content consumption, but media tablets with screens 10 inches or larger are increasingly used for light content creation.

This device category has disrupted the consumer PC market, with the greatest impact being on the mini-notebook (netbook) segment. The media tablet offers an attractive alternative to mini-notebooks and ultra-thin and light notebooks for consumers who are focused on content consumption. The content creation capability of media tablets is improving. Its instant-on capability and long battery life give it a convenience that appeals to consumers, and a wireless keyboard can be added for extended periods of typing.

Media tablets may have "open source" OSs, such as Android, under the control of the OS vendor with modifications from the device maker, or an open OS under the control of the OS vendor, such as Apple's iOS 4 or Windows 8. The OSs offer open programming APIs and development environments for third-party developers to create applications that can be downloaded from online stores, such as the Apple App Store, Google Play and the Amazon Appstore.

The rapid growth of tablet-optimized applications has contributed to the success of the tablet market, while the success of the e-book and magazine reader applications for tablets has significantly altered the e-book reader market. Media tablet capabilities for content creation, such as photo and video editing, as well as productivity applications, have improved dramatically in the last year, making the device more practical as a general-purpose tool. This trend is expected to continue. Given the high profile of the tablet category in the press and the resultant hype, the media tablet may move through the Hype Cycle quickly. Although more than 60 million tablets were shipped worldwide in 2011, they have been adopted by less than 5% of their potential users. Gartner's forecast model shows that tablet penetration will not plateau until after 2020 in mature markets and later than that in some emerging markets.

User Advice: Enterprise IT architects should prepare for media tablets to continue to gain traction in their employee base as the devices increase in popularity with consumers. In many cases, these devices have already entered the enterprise as employees use their own media tablets for work. IT managers should apply the managed diversity model for these devices. For tablets with the Android OS, IT managers should select device makers on the strength of their security road maps and adherence to OS updates. Apple iOS 5 has improved security features for iPad. Windows RT tablets are likely to need different management and security products than future x86-based Windows 8 tablets. IT should decide whether the security features of tablets are sufficient to address the risks associated with the job roles and application needs of mobile users.

Media tablets should also be considered for business-to-consumer applications for delivering content, providing high-quality graphics in sales situations and/or driving customer engagement where it is required for navigating through marketing materials. During the next three years, media tablets will be used in business for customer-facing roles — for example, by sales (to give presentations to clients), by realtors and by executives. The adoption of tablets by businesses will depend on the development of software that incorporates touch in ways that significantly enhances the user experience or improves productivity because there is a lack of multitouch-centric user interfaces in mainstream productivity applications.

Business Impact: The adoption of multitouch technology in both the smartphone and media tablet categories has elevated multitouch use models to mainstream devices that consumers carry every day. Additionally, the availability of instant-on access has driven strong adoption as consumers have come to place a high value on this feature. The proliferation of multitouch and instant-on capabilities in media tablets and smartphones has put additional pressure on the PC industry to offer multitouch and instant-on functionality in notebooks. The Ultrabook PC designs incorporate media tablet features popular with consumers, such as long battery life and instant-on access. This disruption of tablets in the market has put an emphasis on industrial design that was lacking in the market before the arrival of the media tablet.

Manufacturers of consumer electronics need to broaden their efforts to address the full user experience and avoid focusing on hardware features as they develop tablets for the market. Consumers have shown that they are much more concerned with usability and software that is well-designed for use with a multitouch tablet environment than they are with hardware features. Manufacturers should avoid products designed on existing mainstream OSs that are ill-suited for use on a multitouch system.

PC manufacturers will increase experimentation with controls, such as gesture and voice, in addition to multitouch. Media tablets, in conjunction with smartphones and cloud-based services, have the potential to fundamentally change PC use models in the longer term. This impact extends beyond the user interface to application design and product design, with increased expectations for additional performance and a more appealing industrial design aligned with consumer aesthetics.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Early mainstream

Sample Vendors: Acer; Apple; Asus; Lenovo; Motorola; Samsung Electronics

Recommended Reading: "Market Definitions and Methodology Guide: Consumer Devices"

"Apple iOS 5 Enterprise Improvements for Tablets and Smartphones"

"iPhone and iPad Security Assessment"

"Android Smartphone and Tablet Security Assessment"

"Quarterly Statistics: Personal Computers, All Countries Forecast Database, 2Q12 Update"

"Windows on ARM May Not Be What Many Enterprises Expect"

Consumerization

Analysis By: Tom Austin

Definition: Consumerization is the specific impact that consumer-originated technologies can have on enterprises. It reflects how enterprises will be affected by, and can take advantage of, new technologies and models that originate and develop in the consumer space, rather than in the enterprise IT sector. Consumerization is not a strategy or something to be "adopted." Consumerization can be embraced and it must be dealt with, but it cannot be stopped.

Position and Adoption Speed Justification: At some level, there are already consumerization effects in place in the vast majority of enterprises. However, few organizations have comprehensive policies that deal systematically with the different aspects of consumerization. (Too often, they still rely on a "don't-ask, don't-tell" style of policy.) For that reason, we rate the market penetration of consumerization at only 5% to 20%.

The majority of employees in our target enterprise population already have relatively unfettered access to a broad (and unvetted) range of Internet-based information and applications. Most enterprises block socially unacceptable sites, but this blacklisting is far different from the blanket Internet blockages that were fashionable at the dawn of the Internet era. Other examples of consumerization are still in an emerging phase — for example, "bring your own computer" (to work) and employee self-provisioning of mobile phones.

More importantly, a governance model that actively embraces consumerization has not been clearly articulated and broadly defined in most organizations. Tacit behavior (what is allowed) says that some forms of consumerization are already spreading (and growing) across many venues. Explicit governance models, with clear definitions and a separation of responsibilities, are clearly lacking. The void is caused by inertia; it is easier to take a passive stand toward consumerization, even while tacitly allowing it. The void is also caused by specific concerns around risk factors, such as security, privacy, intellectual property (IP) protection, industry regulation, work rules, contingent liabilities and legal discovery proceedings. These risks cannot be completely controlled, and certainly are not controlled when employees are tacitly allowed to act with discretion and exploit consumerization.

In addition, most of the personal content associated with many of the Internet information sources and applications "boggles the minds" of professionals who have spent their careers trying to ensure data cleanliness, provide a "single version of the truth," reduce data redundancy and otherwise employ good data hygiene principles.

IT usually does big projects well. The risk factors cited are important to the enterprise. Managing large-scale projects, the related processes, risks and concerns are all in the domain of the IT organization. However, IT organizations are not conceptually designed, chartered, funded or expected to be as responsive as the diversity of the Internet (and consumer markets). The use of IT is increasingly being regulated by end users, because more use of IT is creative, volitional,

collaborative, emergent, chaotic and truly "human." There is rarely a single version of the truth, complete control over IP, guaranteed locked-down security everywhere, or consistent labeling and tagging. The future of IT will, therefore, be one where content and process will increasingly be human-centered and not under the control of IT systems. The more traditional IT engineering values, while still very important, will no longer be treated as sacrosanct and universally applicable. The tensions this creates have led to an IT "civil war" in some organizations.

User Advice: Consumerization drives and inspires new enterprise governance models, that redefine the split of responsibilities between consumers and providers among associates in the enterprise (consumers of services from the IT organization) and the IT organization.

There will continue to be many critical areas where the IT organization, acting on behalf of the enterprise, assumes responsibility for what is done with information and IT. However, there is increasing awareness that, in many cases, individuals and non-IT organizations are assuming (and should assume) ever-increasing levels of responsibility for some aspects of IT. There are some places where the enterprise IT organization should take responsibility, and other places where users should take responsibility. Asserting that either should take complete control is naive in most cases.

The single best example of consumerization is the fact that most enterprises, at least tacitly, allow many individuals to use untested information sources and applications available from the Internet. Most enterprises only blacklist a small subset of content from the Web. Some of this untested use is for business reasons:

- Salespeople searching for information on a new prospect they have been assigned to.
- Marketing people exploring the attitudes of key influencers in social media.
- Engineers and product managers seeking user opinions about competitive products.
- Security officers seeking additional information on potential security exploits.
- Finance staff seeking to better understand relevant financial trends as due diligence.

This is not limited to generalized or specialized searches for information. People are also exploiting externally available business applications. For example, board members using external electronic deal rooms to evaluate potential merger and acquisition opportunities and threats, and programmers in the IT department jumping outside of approved processes to use salesforce.com (and other cloud-based platforms) to prototype or build lightweight applications for someone in the business. The forces of consumerization are as applicable to individuals within the IT organization as to anyone else.

Some of this use of consumerization is for personal reasons: for example, checking a personal calendar for after-work commitments or looking at personal emails or a Facebook page. IT pervades a broad range of normal activities: from task-related through professional, personal, social and familial activities, including serving as a pseudoautomatic adjunct facilitating communications, sharing, socializing, finding a restaurant or a date, and links to an upcoming business contact's associates. Therefore, the need to separate business and personal activities must be defined by the individual's job responsibilities, the enterprise's code of conduct, the person's sense of duty to their

employer, and the likelihood that the enterprise would allow the employee to receive and make personal phone calls while "on the job." Many (but not all) employees qualify for personal use.

Recommendations:

- User (and system) segmentation is critical to success; proceed carefully and record successes and failures.
- Create a governance council to evolve the enterprise's consumerization governance model. Involve the business, IT, legal, risk and selected others.

Business Impact: Establishing a governance model for consumerization can improve business ROI and the IT organization's ability to do what it does best.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Recommended Reading: "Consumerization Gains Momentum: The IT Civil War"

"The Next Big Impact of Consumerization Will Be Consumer Editions of Windows"

"Using Consumer Versions of Windows in the Enterprise"

"Hype Cycle for Web and User Interaction Technologies, 2009"

Biometric Authentication Methods

Analysis By: Ant Allan

Definition: Biometric authentication methods use biometric characteristics or traits to verify users' claimed identities when users access endpoint devices, networks, networked applications or Web applications. Across a wide range of use cases, any biometric authentication method may be used in one-to-one comparison mode (when the user enters a user ID), or one-to-many search mode (when the user simply presents his or her biometric characteristic, with no explicit claim of identity, and the system determines his or her user ID from a range of candidates).

Position and Adoption Speed Justification: Biometric authentication methods embrace a variety of discrete technologies, differentiated by the biometric characteristic used and, in some cases, further differentiated by sensor types. In addition, biometric authentication methods are used in a wide range of use cases, such as for workforce local access (such as logins to Windows PCs and networks or downstream applications), external users (such as logins to Web applications), and less often, workforce remote access (such as logins to VPNs), each of which makes different demands. The position and time to plateau of this technology represent the optimal cases; individual technologies in particular use cases may be less advanced and may never reach the plateau.

Often, the main driver for adoption of biometric authentication methods is improved user experience (UX), rather than increased assurance or accountability, especially for users who have particular problems with passwords because of irregular working patterns (for example, factory workers and firefighters). However, the potential for increased UX is not always fully realized. Fingerprint has been the most popular choice of biometric characteristic, but at least some users (a few in a thousand) will be unable to reliably use biometric authentication methods, and many users have problems some of the time. For some enterprises in a few vertical industries, the driver has been a need for a higher level of individual accountability, typically among small constituencies within larger populations (for example, traders in investment banks). Here again, fingerprint has been the most popular choice, with some interest in vein structure in the hand.

Over all these use cases, biometric authentication methods have remained relatively niche, limited by the need for specialist capture devices (sensors) and the cost and complexity of deployments. However, during the past few years, we have seen the emergence of server- and cloud-based biometric authentication method offerings that can exploit the existing microphones, user-facing cameras and keyboards (including touchscreen keyboards) on various endpoint devices as capture devices for voice recognition, face topography (and possibly iris structure) and typing rhythm. While microphones and cameras are less common on PCs than on tablets and smartphones, which would seem to limit the utility of the corresponding biometric authentication modes, some solutions can co-opt these capture devices on users' phones in this case. The lower cost and improved convenience of these approaches are driving increased adoption. Gartner has seen increasing interest in typing rhythm over the past few years globally, and solutions that incorporate voice recognition, face topography and palm prints are now used in a small number of major enterprises, including some top 10 U.S. banks.

Gartner projects that mobile technologies, rather, will drive the biggest growth in the adoption of biometric authentication methods, and will be the biggest driver toward the Plateau of Productivity. Enterprises are increasingly seeking to support workforce and customer access to their networks and applications from smartphones and tablets, but this breaks many traditional authentication methods, either because UX is unsatisfactory, or because the level of assurance can be eroded. With these endpoint devices, biometric authentication methods can provide better trade-offs between assurance and UX. The UX considerations are particularly important in mobile banking, where clients tell us that they are seeking transparent or frictionless user authentication. UX considerations are also relevant to enterprise use cases, such as mobile access to Microsoft Exchange, where the default PIN lock policy can vex users. Thus, we expect to see significantly increased interest in biometric authentication methods for workforce and external users accessing corporate networks and Web applications from mobile devices during the next two years (see "Predicts 2012: A Maturing Competitive Landscape Brings New IAM Opportunities").

In the long term, it seems likely that enterprises will be unwilling to support (and users unwilling to put up with) different authentication methods for use with different endpoints, so the best solution for use with smartphones is likely one that can most easily be adopted for use with PCs and tablets as well. Thus, while adoption of biometric authentication methods for access from PCs will likely lag adoption for access from mobile devices in the short term, it will be even in the long term.

Some devices embed biometric authentication methods, which impacts usage and business value. We treat this as a special case — "device-embedded biometric authentication" methods — with a different position on the "Hype Cycle for Identity and Access Management Technologies, 2012."

User Advice: Enterprises should evaluate the potential benefits of biometric authentication methods against the needs of each use case, and choose among the broad range of biometric technologies on the same basis (see "How to Choose New Authentication Methods"). Costs arising from user enrollment — which, depending on which technology is used, may involve special equipment, have to be done in person and under supervision, and involve significant preparation and user guidance or assistance — can be a significant part of the total cost of ownership (TCO).

Biometric authentication methods can provide medium to high levels of assurance (although biometric authentication methods are absent from NIST SP 800-63-1 Electronic Authentication Guidelines, so comparison with other methods is tricky). On the other hand, established, nonbiometric alternatives are available at a similar price point.

Biometric authentication methods can provide a higher level of accountability than alternatives. Favor biometric authentication methods, alone or in conjunction with other technologies, when individual accountability is paramount. When biometric authentication methods are used in combination with smart cards, the comparison of the probe biometric sample with the biometric reference can be performed onboard the card. Evaluate the benefits of such "match on card" technology in addressing privacy, legal, scalability and integration issues regarding biometric authentication methods. Of course, this clearly increases the cost and complexity of authentication, so enterprises might consider alternative approaches. For example, one European investment bank chose vein structure over fingerprint, partly to avoid the need to use "match on card" to comply with local legislation, which at that time precluded centralized storage of fingerprint (but not vein structure) data and, thus, to reduce costs.

Evaluate biometric authentication methods as the sole method if UX is a primary consideration. However, bear in mind that, while these methods can free users from the need to remember passwords or carry some kind of token, established fingerprint technologies cannot be used reliably by every user: At least some users (a few in a thousand) will be unable to reliably use biometric authentication methods because of physiological reasons (such as poorly defined ridges) or simply because they find it difficult to properly interact with the sensor (the biometric industry refers to such users unkindly as "goats"). This necessitates the provision of an alternative at a higher per-user cost. In addition, grease and grime can degrade sensor performance, and facsimile attacks can defeat some kinds of sensors. As a result, evaluate the use of other biometric characteristics, such as vein structure (in a finger or palm, for instance), voice recognition, face topography, iris structure and typing rhythm.

Give particular consideration to biometric authentication methods for user authentication from mobile devices, where solutions can exploit the existing capture devices on a smartphone or tablet. Here, the methods offer the best trade-off between levels of assurance and accountability and UX, avoiding the need for the user to carry and use any kind of authentication token (which can be particularly awkward to use with a mobile device), and the risk of a method based on credentials stored on the device being compromised if the device is compromised (via remote attack, malware or an attacker getting physical possession of the device). Authentication methods (of whatever kind)

should be consistent across endpoints in a given use case, for the benefit of users (consistent UX) and the enterprise (ease of management), so seek a method that can be used with PCs as well as smartphones and tablets, at least in the midterm to long term. In some cases, there may be an asymmetry; biometric authentication from PCs will sometimes need a smartphone to be co-opted for its biometric capture devices if the PCs lack, say, microphones or cameras.

In addition, consider alternative approaches. The comparison score generated by a biometric technology can be used as a variable input to dynamic risk assessment in adaptive access control, rather than as the basis for a clear-cut, binary authentication decision. Biometric technologies, such as face topography and typing rhythm, can also be used as a postlogin preventive or detective control to verify that only the legitimate user is or has been using the PC.

Business Impact: Biometric authentication methods can provide improved UX and, when used as an alternative to passwords, can reduce authentication-related help desk calls by up to 90%. However, usability problems remain, and Tier 2 and Tier 3 support costs will typically be higher than for passwords (as with other new authentication methods). Biometric authentication methods can also provide higher levels of accountability than any other kind of authentication method, since it cannot be shared by coworkers as easily as passwords and tokens can. However, accountability is undermined if the method is susceptible to a facsimile attack; for example, a face topography method implemented in some consumer smartphones can be fooled by a photo of the user. Enterprise-grade systems will use techniques to mitigate this risk.

Some kinds of biometric technologies, such as face topography and typing rhythm, can also mitigate "walk away" risks by providing assurance that only the person who logged into a PC is the person who continues to use it, potentially eliminating the need to enforce timeouts (see "Setting PC and Smartphone Timeouts Is a Blunt Instrument for Mitigating Risks, but an Essential One").

Biometric authentication methods can provide appropriate levels of assurance and accountability for access to corporate networks and Web applications from mobile phones and tablets, where users — especially retail customers, among other external users — will resist having to use any kind of authentication token separate from the device. Some biometric authentication modes (including face topography, voice recognition and user-interface-based behavioral biometrics, such as typing rhythm) offer improved UX, approaching the ideal transparent or frictionless user authentication method that clients tell us they are seeking for mobile banking.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Agnitio; Auraya Systems; AuthenWare; BehavioSec; BioID; Daon; DigitalPersona; Fujitsu; Gemalto; Hitachi; Imprivata; Nuance Communications; Sensible Vision; TM3 Software

Recommended Reading: "A Taxonomy of Authentication Methods, Update"

"How to Choose New Authentication Methods"

"Setting PC and Smartphone Timeouts Is a Blunt Instrument for Mitigating Risks, but an Essential One"

"Q&A: Biometric Authentication Methods"

"Q&A: Phone-Based Authentication Methods"

"Predicts 2012: A Maturing Competitive Landscape Brings New IAM Opportunities"

"Cool Vendors in Security: Identity and Access Management, 2012"

Idea Management

Analysis By: Carol Rozwell

Definition: Idea management is a structured process of generating, capturing, discussing, improving, organizing, evaluating and prioritizing valuable insight or alternative thinking that would otherwise not have emerged through normal processes. Idea management tools are typically used for focused innovation campaigns or events, but most also enable continuous idea generation.

Position and Adoption Speed Justification: Idea management tools provide: support for communities (in originating and fleshing out promising ideas); administrative support (for capturing ideas and enabling innovation leaders to organize and track ideas); and analytical support (for aggregating, refining, scoring, voting, prioritizing and measuring) for the leaders and participants of innovation or ideation programs. These tools offer a wide array of approaches to idea management, such as running innovation events or campaigns, crowdsourcing initiatives (also known as idea marketplaces) and creating prediction markets. Most tools enable participation by internal and external participants and support multiple administrators. Vendors offer owned, hosted and software as a service (SaaS) versions of their tools — and often implementation support and consulting services.

Companies in a wide variety of industries use idea management as a way to bolster innovation that drives sales of existing products, creates new opportunities to increase revenue, or radically changes process or cost structure. Industries that emphasize new product development were the earliest adopters of idea management tools. In addition to tools from vendors specifically designed to support innovation management, collaboration platform vendors provide ideation modules for their offerings. The growth in vendors and success stories for idea management drives interest in innovation and confidence in engaging employees, customers and others in idea generation and evaluation. The market landscape is studded with vendors that offer a common set of functions and features. The Web seems tailor-made to enable idea management marketplaces across enterprise ecosystems, and continually provides access to new sources of ideas and innovations.

User Advice: Organizations generally establish innovation programs with a great fanfare, succeed at generating ample ideas, and then have difficulty sustaining the momentum through implementation. Leaders of innovation initiatives should address the organizational and cultural issues of innovation management. They should also identify the scope, participants and processes envisioned for idea generation programs before attempting to select an idea management tool.

Teams that plan to use idea management tools as a front end to new product or service development should also ensure that these tools can be integrated with community, product life cycle and project management tools. Additionally, they should ensure integration with directory services and other technical and functional features of collaboration.

With the growth and rapid evolution of idea management approaches and technology, buyers should evaluate whether these tools should be internally owned and managed, or whether hosted or SaaS versions are viable options.

Buyers of idea management tools should remember that buying a tool does not on its own lead to a culture of innovation.

Business Impact: Idea management tools were initially used to facilitate an online "suggestion box" (adding the advanced synergy, features and functions made possible by the Web), plus events or campaigns implemented under the auspices of innovation programs. Today, these tools are used in broad organizational programs that include internal and external users; full enterprises or individual departments; and organizations looking for product, process or service innovation.

Idea management tools can also enable organizations to segregate sources of ideas (such as employee versus customer ideas); separate types of ideas (such as product versus process ideas); and even aggregate multiple ideas into one. The proper handling of ideas is one of the most critical aspects of successful innovation programs; users have a large number of choices and therefore need to plan and execute well. Idea management tools also facilitate the process of publicizing campaigns and events (so they get a wide range of participants and input), evaluating and building on the ideas submitted, acknowledging the submissions and archiving valuable information.

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: BrainBank; Brightidea; CorasWorks; Hype; Idea Champions; Imaginatik; Induct; InnoCentive; Inova Software; Jive Software; Kindling; MindMatters; NewsGator; Qmarkets; salesforce.com; Sopheon; Spigit

Recommended Reading: "Revisiting Three Business Approaches to Radical Innovation"

"CEO Survey 2012: CEOs' Views on Innovation Management"

"Who's Who In Innovation Management Technology"

Consumer Telematics

Analysis By: Thilo Koslowski

Definition: Consumer telematics represents end-user-targeted, vehicle-centric information and communication technologies (vehicle ICTs) and services that use embedded technology or mobile

and aftermarket devices. Network-enabled cars for consumers provide in-vehicle services such as emergency assistance, navigation and routing, traffic information, local search (for example, for charging stations or restaurants), financial services (for example, usage-based insurance) and concierge services.

Position and Adoption Speed Justification: As a result of growing consumer demand for telematics and vehicle ICT, automakers are increasingly exploring opportunities to offer cost-effective solutions that ensure sustainable business models without substantial upfront investments. Rather than having to develop the required technology (that is, communications hardware) and resource infrastructure (that is, call centers) in-house, automotive companies are looking to engage third-party providers with comprehensive offerings that will take over the development, management and billing of vehicle-centric services. In addition, companies are looking for automated, Web-based services that leverage online or server-based information and make it accessible in a vehicle.

During the next two years, the supply chain for vehicle ICT offerings will change and will focus on extending existing mobile applications and services (from the mobile and Internet services industries) to vehicles, in addition to creating specific automotive functions (for example, expanding existing application ecosystems, such as those based on Android applications, to the vehicle). Telematics service providers (TSPs) will face competition from new companies that will aggregate other third-party wireless content and develop core technological value propositions from a mobile device perspective. These companies include smaller software, hardware and content providers that target specific aspects of a holistic consumer telematics application and work closely with automakers or system integrators to ensure compatibility and reliability. Consumer telematics is also increasingly developed for the automotive aftermarket by TSPs and insurance providers. In mature automotive markets such as the United States and Western Europe, most manufacturers will offer consumer telematics in virtually all of their models by 2020 due to long product development cycle times. In emerging automotive markets, this milestone may occur slightly later.

User Advice: As telematics services, applications, technology and content providers emerge, vehicle and device manufacturers (for example, consumer electronics companies) will have to choose the providers that best fit their business and technology requirements. Companies wanting to offer connected vehicle services to consumers should take advantage of the emerging offerings in the mobile- and location-based service space. The market is becoming more mature, and vendors have made significant investments in building the expertise, resources and partnerships that can help companies accelerate their vehicle ICT launches. Furthermore, vehicle manufacturers and device manufacturers must differentiate between core, vehicle-centric telematics offerings that are embedded in a vehicle (most safety and security applications) and personal telematics offerings (primarily information and entertainment services), which consumers access by integrating portable devices with the vehicle.

To enable device-to-vehicle and service-to-vehicle integration concepts, vehicle manufacturers must collaborate with consumer electronics companies, service and content providers (regarding interfaces), and connectivity solutions. The introduction of electric vehicles (EVs) will give consumer telematics a boost because seamless EV ownership experiences will greatly benefit from connected data services (for example, finding the next charging station and informing drivers of the available range left).

Consider your choices in a growing vendor supply chain by identifying best-of-breed technology providers instead of a single-solution approach. Both options have their benefits and disadvantages, but with increasing in-house expertise for the connected vehicle, automotive companies can be more selective in their partner choices to better balance innovation and cost objectivity factors (for example, innovation within connected vehicle offerings should reside with the automakers).

Business Impact: Consumer telematics provides an opportunity to differentiate product and brand values (for example, infotainment access and human-machine interface experience), to create new revenue sources (subscriptions and mobile commerce), to collect vehicle-related quality and warranty information via remote diagnostics, and to capture consumer insights.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Adolescent

Sample Vendors: Agero; Airbiquity; Google; Hughes Telematics; Microsoft; Nokia; OnStar; WirelessCar

Recommended Reading: "OnStar Anywhere Brings Telematics Service to All Auto Brands"

"U.S. Consumers Put Vehicle ICT Back on Their Wish Lists, but Feature Priorities Are Changing"

"OnStar Selects Android to Expand Its Ecosystem"

Speech Recognition

Analysis By: Adib Carl Ghubril

Definition: Speech recognition systems interpret human speech and translate it into text or commands. Primary applications are self-service and call routing for contact center applications; converting speech to text for desktop text entry, form filling or voice mail transcription; and user interface control and content navigation for use on mobile devices, PCs and in-car systems. Control of consumer appliances (such as TVs) and toys is also commercially available but not widely used.

Position and Adoption Speed Justification: The cloud-based system introduced on Apple's iPhone in 2011 — Siri — fueled, if not revived, interest and usage of speech recognition systems. Furthermore, Nuance has an agreement with Intel that will see the support of voice-controlled command, content searching and short message dictation of up to 30 seconds on PCs and ultrabooks.

Speech recognition provides tangible benefits for a range of applications but still falls short of its potential — both in performance and in adoption levels. Accuracy can be highly variable, depending on background noise, size of the recognized vocabulary, level of natural-language understanding attempted, clarity of the speaker's voice, quality of the microphone and processing power available.

For text entry in a quiet environment, where some users can achieve impressive accuracy, speech recognition still has not been widely adopted outside of medical and legal dictation, possibly due to the need to learn a new skill (dictation) for most general office workers.

Speech recognition as a whole has been climbing the Slope of Enlightenment for more than a decade. It will likely reach the Plateau of Productivity (that is, the start of mainstream adoption) in two to five years due to a growing number of consumer applications, particularly in the mobile space, including voice mail transcription and speech-to-speech translation. These applications provide useful functionality, even if not perfect, and we anticipate that the broader use of speech recognition embedded in interface and unified communications applications will drive a steadily increasing level of adoption.

Some applications of speech recognition are already further along, with higher levels of adoption; for example, simple self-service dialogues for call center applications are close to the Plateau of Productivity. Others, including desktop dictation and mobile device control, are closer to the Trough of Disillusionment as they struggle to attract broader use. Although speech recognition support in Windows 7 is adept at distinguishing a reasonably wide array of commands in a naturally spoken tone and pitch, it is of limited usefulness; nonetheless, its inclusion in enterprise software is a significant boost in users' access to speech control, which should accelerate its refinement and consequently raise worker productivity. Other interface advances, such as gesture-based gaming and touchscreens for media tablets, may also lead to broader inclusion of speech recognition as an additional (but not sole) means of input and control, and drive more-rapid adoption.

Stochastic models from advances and concepts in natural-language processing will also help speed the maturity of speech recognition.

User Advice: With Siri, speech recognition takes a distinct evolutionary step. Indeed, the speech modality is best utilized for complex tasks — something that would take a lot more steps to describe with typing, pointing or using gestures (namely, dictation and search).

For call center applications, the most critical factors influencing success and reducing risk are designing the application to work within the accuracy constraints of speech recognition, designing the voice user interface, selecting the appropriate speech engine, and having thorough ongoing tuning and evaluation. Professional services that are experienced in speech recognition technology are recommended for a first foray into this space.

For general-purpose office text entry, deploy speech recognition "on demand" for individual users who express interest and motivation (for example, those with repetitive-stress injuries). Users who are already practiced in dictation are likely to be most successful. Also, examine non-mission-critical applications, in which a rough transcription is superior to nothing at all, such as voice mail transcription and searching audio files. In addition, consider speech recognition and its related technology, text to speech, for applications in which users must record notes, as they perform detailed visual inspections — for example, radiology, dentistry and manufacturing quality assurance.

For mobile devices, focus initial applications on selecting from lists of predefined items, such as city names, company names or music artists. This is where speech recognition has the strongest value-add by avoiding scrolling embedded lists, while maintaining a high level of accuracy.

Business Impact: Speech recognition for telephony and contact center applications enables enterprises to automate call center functions, such as travel reservations, order status checking, ticketing, stock trading, call routing, directory services, auto attendants and name dialing. Additionally, it is used to enable workers to access and control communications systems, such as telephony, voice mail, email and calendaring applications, using their voice. Mobile workers with hands-busy applications, such as warehousing, can also benefit from speech data entry.

For some users, speech input can provide faster text entry for office, medical and legal dictation, particularly in applications in which speech shortcuts can be used to insert commonly repeated text segments (for example, standard contract clauses).

For mobile devices, applications include name dialing, controlling personal productivity tools, accessing content (such as MP3 files) and using voice-mail-to-text services. These applications are strongly motivated to use speech to support in-car use and for unified communications among voice, text and email services.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Apple; IBM; Loquendo; LumenVox; Microsoft; Nuance; Sensory; Spansion; telisma

Recommended Reading: "The Three Key Components of Industrial Speech Recognition Solutions"

"Emerging Technology Analysis: Voice-to-Text on Mobile Devices"

"MarketScope for IVR Systems and Enterprise Voice Portals"

Entering the Plateau

Predictive Analytics

Analysis By: Gareth Herschel

Definition: The term "predictive analytics" has become generally used to describe any approach to data mining with four attributes: an emphasis on prediction (rather than description, classification or clustering), rapid time-to-insight (measured in hours or days), an emphasis on the business relevance of the resulting insights, and an increasing emphasis on ease of use, thus making the tools accessible to business users.

Position and Adoption Speed Justification: The algorithms underpinning predictive analytic applications are reasonably mature. Although new techniques continually emerge from research laboratories, the 80/20 rule firmly applies with most of the commonly used algorithms (such as CHAID decision trees and k-means clustering) that have been in existence for more than a decade. The applications are also approaching maturity, although the development of packaged applications to address specific business problems (compared with the generic approach of turning more-traditional data mining workbenches into predictive analytic solutions) is less mature and more diverse in its maturity. When predictive analytic applications have added project and model management capabilities and more enhancements to aid ease of use, they will have achieved maturity.

User Advice: Predictive analytics is a more user-friendly and business-relevant equivalent of data mining that is applied specifically to predictions of future behavior. Although potentially lacking some of the mechanisms to fine-tune the model performance that a traditional data mining workbench might deliver, the benefits of rapid model development and easier maintenance are appealing for most analytical initiatives. The bigger distinction is between predictive analytic solutions and packaged applications built on these solutions for specific business issues. In these cases, the selection decision should be based on the domain expertise that the vendor has been able to package into the application, versus the domain expertise the business analyst can bring to the analysis.

Business Impact: Predictive analytics can bring clarity and consistency to any situation where the likely future behavior or condition is uncertain. Common applications include understanding the future behavior of customers (Will they renew the relationship? Which products or services are they likely to buy?), the future state of customers (What will their lifetime value be to the company?) or to predict the likely performance of equipment (predictive maintenance allows the identification of at-risk components so they can be proactively replaced). By understanding likely future circumstances, organizations are better able to allocate investments to maximize returns.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

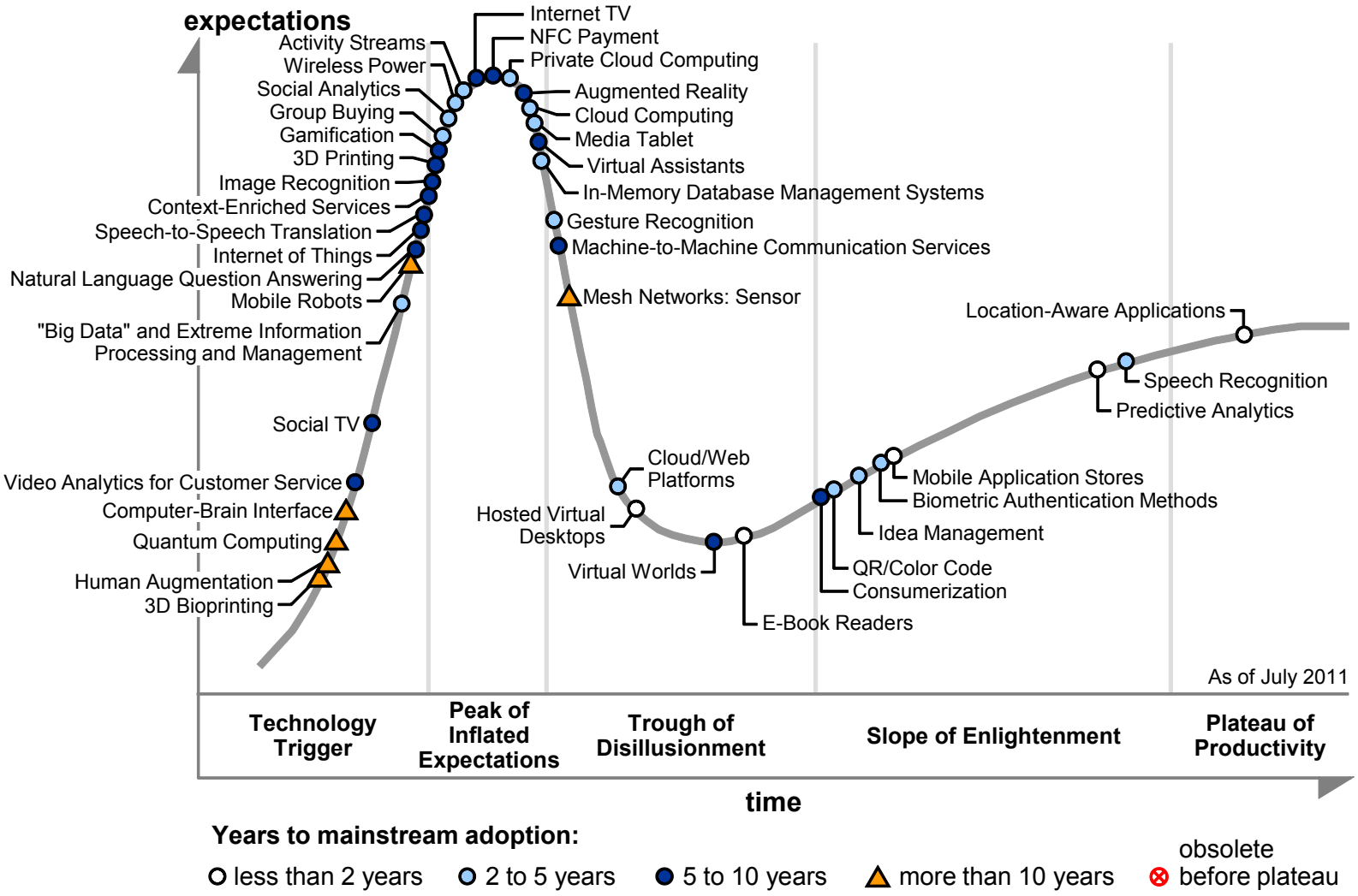
Maturity: Early mainstream

Sample Vendors: Angoss; FICO; IBM (SPSS); KXEN; Pitney Bowes Software; Revolution Analytics; SAS; StatSoft

Recommended Reading: "How to Increase the Volume of Advanced Analytics"

Appendixes

Figure 3. Hype Cycle for Emerging Technologies, 2011



Source: Gartner (July 2011)

Hype Cycle Phases, Benefit Ratings and Maturity Levels

Table 1. Hype Cycle Phases

Phase	Definition
Technology 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.
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 2012)

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 2012)

Table 3. Maturity Levels

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 2012)

Recommended Reading

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

"Understanding Gartner's Hype Cycles, 2012"

"Trends That Matter: Top Trends and Their Business Impact"

"Trends That Matter: 84 Technology, Societal and Business Trends"

"Technology Trends That Matter"

This is part of a set of related research. See the following for an overview:

- Gartner's Hype Cycle Special Report for 2012

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