Applications are the way we put information into action, and shifts in the what, where, how and who of doing this have manifestly shifted the “apps” landscape.

We have seen the movement from general to specific application scopes. In effect, the context of the individual is being brought into the presentation, transaction and securing of information, which is both coming from and flowing through an ever-extending set of channels. From appliances and vehicles to smartphones and TVs, the acceleration of network-attached devices is forcing easy-to-use, easy-to-program, easy-to-integrate strategies, with the Internet taking the dominant position as the network of choice.

Consumerization across this expanding set of endpoint technologies, combined with cloud computing on the Internet as the default service provider, have made technologies like HTML5, JavaScript and HTTP the starting point for consumers and enterprises alike. Employees become “customers” of IT, and IT becomes an information service provider in a landscape where every consumer has the control to tune his or her experience to maximize productivity.

As everyone jumps to “mobile first” as a mantra, and HTTP as the connection, enterprises must shift their service delivery strategies to wrap and extend traditional applications and, moreover, integrate with external services that have become ubiquitous in the landscape. From news feeds to social media, from Google to enterprise knowledge repositories, and from Salesforce to productivity applications, there are Application Programming Interfaces (APIs) for everything. The new disciplines of API management and promotion are becoming critical strategic discussions for businesses.

Another critical discussion is the experience. In the past, the user experience (UX) came very late in the design process, often being “designed” by programmers or engineers. Today, we are seeing a new emphasis on the experience; in fact, the UX is designed, mocked up and built first. The UX designer is a key member of the agile development team. Likewise, the API developer, a somewhat new role, is working to provide a set of programmer interfaces that maximize a correct and complete interface to underlying services and data. These APIs have moved from chatty sequences of messages to a single document that is transacted. These APIs must support constant change, with backward compatibility, to maximize value for the broad new ecosystem of developers.

But who is the developer? With new frameworks and tools, not to mention web technologies, it’s everyone. Do-it-yourself (DIY) apps are starting to flourish. Instead of one fat-client application with hundreds of tabs serving a broad set of jobs and roles, we are seeing function-specific apps created by business people and consumers (in addition to IT). These apps use data not just from one system, but mashed up from news feeds, maps and other services to enable one to make more informed decisions. There are over 1 million apps in the Apple App Store, including over 1,500 calendar apps alone. This creates choice for consumers, and since employees are also consumers, there is a new expectation for IT to become more like the Internet — offering choice, openness, flexibility and speed.

This revolution in technologies and the open passing of information through communities is accelerating a new revolution in applications, explored in the Apps rEvolution report. We are all consumers. We value choice, and we expect enterprise technologies to be as good as their consumer counterparts. With the advance of Internet-connected devices, we expect to constantly create, interact with, and integrate information from everywhere. We are just beginning to see the value that the apps revolution is ushering in as our enterprises continue to embrace the consumerization of IT.

Dan Hushon
Chief Technology Officer
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APPs rEVOLUTION

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Access this report at csc.com/appsrevolution
Apps today are like valets, expected to serve people whenever and wherever they are, on whatever device they have. Successful apps deliver immediate and personalized information and experiences through streamlined digital interactions. Tens of billions are in use today, across an astonishing array of consumer and business activities.

But this is only the beginning. Apps are now becoming critical to product and service leadership in just about every industry sector. They represent the future of how enterprises interact with customers, employees, partners and machines, as we increasingly access the Internet and control our world from the palms of our hands. This report describes the Apps rEvolution: an evolution in technology that is creating revolutionary business and personal change.

From a technology perspective, the apps revolution is redefining how applications are created, distributed and consumed. It is upending the traditional client-server, browser-centric web model and breaking up monolithic applications. The humble Application Programming Interface (API) has moved to center stage. It is no longer just a development tool. In many industries it is a business strategy for spurring external innovation, while also serving as the glue between enterprises, mobile systems and the cloud.

While most of the action thus far has been in consumer markets, the need to improve customer service and increase employee productivity is driving the creation of enterprise app stores and business app management tools, making apps a unifying metaphor for digital system usage. Just about every firm needs to offer engaging app experiences — both internally and externally.

Riding this wave is exciting but not easy. Consumers expect a constantly improving experience across a range of devices that can include phones, tablets, home appliances and, increasingly, cars. Business customers will expect their equipment and machines to be connected to the Internet and managed via an app-like interface. Developers face a confusing and ever-changing technology landscape, as well as complex security requirements. Perhaps most importantly, software architects face a whole new set of end-to-end synchronization, access and software integration challenges. As a result, the underlying DNA of the information technology (IT) industry is changing, as new platforms are required to meet evolving market demands.

In this dynamic environment, the Apps rEvolution is creating a robust and growing apps economy. For the many who do participate, understanding the Apps rEvolution — apps experience, apps everywhere, apps DNA and apps platforms — is essential to planning and competing in this new world.

**APPS EXPERIENCE**

*Engagement and context matter.*

The apps experience — its ease, appeal and speed — is inseparable from its use, effectiveness and popularity. Developers should consider the apps experience from four perspectives:
• **Engagement** — Reimagining the customer relationship and enabling real-time experiences that hold the individual’s attention, often through the use of gamification, loyalty programs, ratings, proximity or other tactics

• **Context** — Increasing app relevancy by leveraging identity, location/geofencing, time, social and physical settings that enable new forms of awareness and intelligence

• **Modalities** — Interacting through touch, gesture, haptics, emotions, biometrics, brain waves, eye movement and wearable sensors

• **Design** — Creating intuitive, easy-to-use, increasingly natural interfaces and aesthetics that suggest both a familiar and interesting user experience (UX)

In short, apps must combine technical flexibility with an artist’s touch. Companies should invest in design and development teams that have both creative and technical skills, can empathize with the user, and can deliver a consistent UX across a diverse set of devices in different contexts, all while keeping business goals at the forefront.

**APPS EVERYWHERE**

*Computers are everywhere and apps run everything.*

As apps infiltrate everything from home heating/cooling to medical devices to jet engines, there will be countless new product and service opportunities. The Internet of Things will lead to both connected industry and connected society. With this comes enormous volumes of new data that will be used for many purposes: reducing costs, automating business processes, increasing revenue through new services, identifying trends, getting marketing feedback, complying with regulations, and enhancing customer efficiency, convenience and satisfaction.

For consumers, app interfaces to cars or home blood pressure systems can still seem expensive novelties, but this will change over time. Increasingly, smartphones are acting as servers, capable of managing a variety of devices in sectors as diverse as health/fitness, television, transportation and payments, blurring many traditional industry boundaries. The long-term challenge is to maintain simplicity so that using an app doesn’t require difficult new learning.

For industry, the use of apps to manage and control systems and machinery is the next great phase of apps expansion, and is a critical part of the Internet of Things — long talked about but now, thanks partly to apps, rapidly emerging. The net effect over time will be longer, more integrated, and more instrumented ecosystems and value chains. New standards will be needed, so that equipment and sensors can more easily communicate with one another.

Enterprises and CIOs should think strategically about the impact of these developments on their future customer relationships and business operations. They must determine what development and integration skills they require, and where these resources should be located in their firms. (A great deal of app development is taking place outside of the enterprise IT organization.) Since few companies can go it alone, app partner selection is also of growing importance.

**APPS DNA**

*New software choices and architectures redefine development.*

Apps for mobile devices and connected things have different DNA than traditional IT systems, altering development and performance choices. New stacks and architectures give developers a wide range of options for designing and creating apps that constantly improve the UX, keep up with the rapid pace of change, and support heterogeneous devices. There has been a resurgence in APIs, which weave the device, cloud and enterprise stacks into an integrated runtime service. By providing well-written and open APIs, an enterprise can spread its applications across a wider ecosystem, reaching a broader audience and spurring innovation by others.

For now, there is no definitive “best choice” among native, web and hybrid app architectures, but this could change. In particular, as HTML5/JavaScript performance keeps on improving, the value of “write once, run anywhere” will become attractive for all but the most specific applications. Over time, it may not be possible to distinguish between a web, hybrid and native app, as these worlds and standards converge, but today these differences matter.

Enterprises need project managers and architects who understand the impact of mobile app and data architectures — especially development standards and languages,
user interface design options, and the power of lightweight interfaces — in order to make informed decisions. Otherwise, outdated architectures will adversely affect the app experience one way or another.

**APPS PLATFORMS**

*Apps platforms simplify development, management and distribution.*

Mobile apps have their own development culture. Design and development are user-centric; the technology spans diverse device environments, multiple cloud services, and lightweight interfaces and standards; and release cycles must be short. The managed desktop is coming to an end, being replaced by dynamic apps, enterprise app stores and bring-your-own (BYO) technologies. Development is taking place outside of IT, where do-it-yourself (DIY) business people leverage both drag-and-drop and more advanced tools to expose APIs, integrate services and create their own apps. Cross-functional challenges like security and governance take on new shape as everyone brings their own apps (not just devices) to work.

Fortunately, new platforms are helping enterprises tame this complexity and transition to more sophisticated environments. However, selecting the best platform requires understanding business needs. If the goal is to enable efficient app development across different departments, put a platform in place for efficiently sharing code. If the goal is to enter new markets or partner with other companies, put a platform in place that promotes the use of APIs. If the goal is to enable non-technical business people to create their own apps, then a DIY business app development platform is probably the right tool for the job.

**APPS ECONOMY**

*Apps are the front end to the digital future.*

Apps are rapidly becoming the main interface to the Internet and the entire digital economy. Industries are blurring, driving deeper integration between things, people, business and society. New markets are forming and customer relationships are changing. Developers are a coveted resource as innovation takes shape by connecting things, people, apps and data to create new services, often with the help of APIs that extend existing services into new realms. Examples in healthcare (RedBrick Health), automotive (RelayRides) and DIY business (Lyft) show the way.

Enterprise IT has a golden opportunity to lead in this new world. However, this requires different thinking (outside-in) and strong relationships with business peers (still a challenge in many firms). Enterprise IT can lead the enterprise to a “mobile first” or even a “mobile only” strategy, but must know when to champion APIs and how to attract developers to build apps leveraging these capabilities. Finally, enterprises can turn what was once seen as a “shadow IT” problem into a competitive advantage by fostering and cultivating a DIY culture for their firm.

The Apps rEvolution is not just about apps. It is about business change: creating new experiences, inventing new products and services, redefining customer service, and improving productivity and efficiency. It is about building new and better ways of using modern technologies, and about applying IT to entirely new realms. The speed, simplicity and appeal of the app experience may have started as smartphone and consumer phenomena, but this is now the model for how information systems will be built and used in the future. The digital economy is no longer just out there on the web; it is literally in the palm of your hand.
Applications are the lifeblood of the organization because they define how work gets done.

Over the past 10 years the application landscape has changed. As mobility and cloud have converged, there has been a pole shift in how applications are designed and delivered and how work gets done. Applications are expected to serve people whenever and wherever they are, on whatever device they happen to interact with. "Apps" is the term used to describe this new breed of flexible, context-aware, ubiquitous applications. (See Figure 1.)

In 2011 the IT industry reached a significant milestone as the number of smartphones sold exceeded the number of PCs sold. Add tablets to the mix, and we are rapidly moving toward a new era of “mobile first.” As a result, apps on mobile devices are coming into their own. Instead of merely porting existing content to the mobile device, companies are creating novel, context-aware transactions and actions on the mobile device that cannot exist in a desktop world. Consider finder apps that locate goods and services based on where you are as you move around, check-in apps, tap-and-pay apps, insurance apps with mobile claims submission, and car-sharing businesses like Uber with its on-demand driver service summoned via an app.

With today’s apps we are witnessing the breakup of monolithic applications and the desktops that supported them. The distinction between client and server is blurring as service roles and devices are decoupled. Apps on personal devices can interact with apps in an organization’s infrastructure as needed, even migrating between different devices as the person moves through different environments. Apps in a flexible, responsive infrastructure will automatically interact with apps in personal devices to allow a person to navigate traffic and pay for tolls in a driverless car, present a train ticket by simply getting on board, and pay for goods by walking out of a store.

Apps everywhere will change the way data is created, shared and used by people and enterprises. A self-healing, dynamic infrastructure will be able to dynamically analyze data on individual app user behaviors, predict future group behaviors, respond to emergencies and provide just-in-time information with a seamless experience for the situation at hand. For example, nearby billboard ads will adapt to an app user’s context based on the person’s characteristics, interact with the person, and guide the person to particular stores and products.
The Apps rEvolution is upending the client-server, browser-centric web model as consumer demand drives app innovation at the (device) edge and suppliers rush to fill this demand. The humble Application Programming Interface (API) has moved front and center as a primary design consideration — a business strategy — for leveraging enterprise content on mobile apps. Spurred on by the consumerization of IT, employee demand for in-house business productivity and customer service apps has grown, followed closely by demand for enterprise app stores and app management tools in enterprises and government agencies. Apps will impact the enterprise everywhere but will be most striking in areas that are purposely designed to engage and empower. User experience is king and the API is queen.

However, not everything in the Apps rEvolution is a bed of roses. Developers face many challenges such as high consumer expectations, multiple types of devices and operating systems, an ever-changing technology landscape, and privacy and security mandates.

While these and other issues need to be addressed, the Apps rEvolution is marching ahead: an evolution in technology that is creating revolutionary business and personal change. The Apps rEvolution gets at the heart of the enterprise: how it conducts business, makes sales, delivers products, serves clients, and interacts with customers and suppliers. Changes to the business of applications — how they are created, distributed and consumed — are fundamentally affecting organizations and consumers. This report explores these changes by examining five areas: apps experience, apps everywhere, apps DNA, apps platforms and the emerging apps economy.
Engagement and context matter.

How a person experiences an app — how easy it is, how fast it is, the quality of its results, the variety of devices it runs on — is driving development in wholly new ways. Client-server may have been about experience to an extent, but it focused on the desktop. In the early days of mobile, devices and networks largely drove applications. But as mobile has evolved, making the promise of “anytime anywhere” computing come true, delivering an excellent experience has become essential.

That is because customer expectations and demands have continued to escalate, and competition from other apps is fierce. If an app doesn’t meet a person’s needs, there are often 10 others that can take its place.

Successful apps must provide an easy, intuitive, “to the point” experience. Most importantly, that experience must be one that continues to improve over time, at minimum staying on par with competing apps. As a result, each new app launch or update attempts to improve experience, raising the bar for all those around it. Through app store ratings, comments and tweets, developers are faced with immediate feedback. Therefore, it is not only that apps are reshaping the user experience; users are demanding new experiences themselves.

To stay ahead, developers must examine the experience through four different lenses: engagement, context, new modalities and interface design. (See Figure 2.)

**ENGAGEMENT: RICH, NOT RIGID**

Apps that engage focus on people, draw them in, and address immediate needs. In contrast to discrete, rigid transactions, engagement encompasses rich end-to-end interactions across an activity and is about relationships and real-time decisions.

For example, a prototype iPad application is working on reimagining the relationship between car buyers and car dealers. The app, developed by CSC, allows consumers to view in-stock vehicles, configure their car, schedule an appointment and arrange financing. Once the car is purchased, a “customer for life” aspect comes into play. The car issues live status reports to the buyer on its health (e.g., oil and tire pressure), gives reminders about scheduled maintenance (e.g., in 4,000 miles or 90 days) and enables the buyer to book service appointments online. (See Figure 3.)
Make It Motivating and Fun. A powerful way to enhance engagement is to make using an app fun. This is the essence of gamification, which applies game strategy and mechanics in non-game environments to appeal to people’s sense of fun and competition, boosting productivity and participation.

Gamification techniques vary depending on the application and desired outcome. Progress bars, comparisons with friends, and community endorsements all use gaming techniques. Techniques that encourage people to improve their ranking (e.g., leaderboards, points, badges) or give them confidence to use an app (e.g., beginner level) also encourage participation. For example, these techniques could motivate call center workers to take online training courses to improve customer satisfaction. One company matched workers’ names to faces at login, in a fun way, to help employees remember each other’s names and, ultimately, help reduce employee turnover.

However, gamification isn’t a be-all and end-all strategy. Gamification pioneer Foursquare has decided to move its points and badges to the background, so the location-based social networking service can focus more on context-driven content. Although the move sparked a storm of debate over the value of gamification, in the end gamification is just another technique to support business strategy, not hijack it.

LEVERAGING CONTEXT

Context makes the app experience more relevant. Context helps determine what a person’s immediate needs will be at a given point in time, enabling a tighter, more personalized integration between the person and the process or service. In a mobile world, context, and thus needs, change frequently. (See Figure 4.) So designing an app with context in mind is integral to making the
app more useful and engaging. Key elements to consider include identity, activity, location, time, social interactions and real-world settings.

Who Are You? Who you are, what role you play and what you are trying to do are often the starting point for context. An example of a context-aware app that adapts based on a person's identity and activity is CSC's ConfidentID Mobile security solution. ConfidentID leverages context — who is using the device, where, for what kind of transaction — and takes advantage of the built-in capabilities of smart devices to put biometrics in the hands of consumers. Built on Daon's IdentityX platform, ConfidentID Mobile uses multi-factor authentication that can be applied in varying levels based on the riskiness of a transaction by leveraging the basic functionality of smart devices — cameras, voice, GPS, network connectivity, etc.

For example, if used with a banking app, withdrawing $50 would require a PIN, but withdrawing $5,000 would require facial verification and a PIN. ConfidentID Mobile combines PIN/password, face, voice and palm recognition, and location data to identify an app user. ConfidentID matches Bob's biometric data to previously collected biometric data on a central identification server to authenticate Bob. This authentication data is linked to the device's unique identification number, which enables ConfidentID to know that it is Bob using Bob's phone. This provides greater identity confidence than using passwords, PINs or public key infrastructure alone.

One CSC customer combines face, voice and PIN in a simple login experience to identify the mobile app user, replacing the traditional username/password login. All of this biometric data, which is collected in the same amount of time it takes to enter a PIN or username/password, identifies the mobile app user and further sets the context of the app session.

Place and Time. Where you are and what is near you are also critical pieces of context. NewAer provides a "proximity platform" for smartphones and tablets that senses nearby devices and takes specific actions. Through the company’s ToothTag app, people configure their mobile device to do a specific activity when a certain "tagged" device or person is in range. This activity could be dropping a pin on a virtual map where you car is parked, or alerting you when a friend is nearby.

Your location can also trigger authorization to perform (or not) an activity. If you are in the San Francisco airport, you can work on your export control project on your laptop, but once you land in China, you no longer have access to the project files. Such "geofencing," or identifying zones that trigger an activity, is commonly
used in mobile ads, such as sending a restaurant coupon to a smartphone when a person is within 2 miles of the restaurant. However, geofencing plus mobile marketing based on time of day, called dayparting, is a more powerful proposition. This emerging strategy would allow organizations to understand your location and send the most appropriate promotion, such as a coffee coupon at 6 a.m. or a sandwich coupon at noon.

**A Sense of Belonging.** Another way to put information in context is to share it with others—hence the proliferation of buttons today for linking digital content to Facebook, Twitter, LinkedIn and other social media. That proliferation extends to the TV, where viewers can connect with others through social apps right from the TV. Or, they can do so from their smartphone or tablet—the “second screen”—while watching TV. These second screens can be used for interactive ads, voting and other engagement. For example, the Shazam app has evolved from a music tagging service to a TV ad and video tagging service on the second screen for high-profile events. During the 2012 U.S. Super Bowl, viewers used Shazam to tag TV ads and events to unlock extra content, get additional statistics about the game, and enter contests, among other things.² A marketing study found that the Shazam app boosted TV ad recall and engagement with the advertiser via the advertiser’s website and Facebook.³

**Real-World Setting.** If information is presented in relation to the real world, people are much more engaged because the information makes more sense than if presented in a vacuum. Augmented reality (AR) presents information in the context of a real-world setting, overlaying digital data onto images or views of the physical world. For example, AR mobile apps can overlay store specials on top of supermarket buildings, navigation markers on roadways, or housing prices on homes for sale.

AR apps, still emerging, can be used on construction sites (see what a finished building or part will look like as shown in Figure 5), in disaster assessments (see what the original setting looked like), for inventory management (view information about an object or a crate of goods) and in healthcare (superimpose an MRI image that shows cancer on a live image to guide a biopsy).

On the horizon for AR: improving the accuracy of augmentations (particularly important for construction and engineering apps) and donning a new form factor, glasses. AR glasses are in the works at Google, Apple and Microsoft. Although they may take time to get used to, they could move AR into the mainstream with their hands-free convenience.

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**FIGURE 5.** A construction worker at BNBuilders uses a tablet equipped with AR software to visualize how a complex set of stairs will fit. AR is in the experimental stage on construction project sites.

*Source BNBuilders*
NEW MODALITIES

AR glasses, a form of wearable computer, emphasize the importance of convenience and ubiquity — a transparent, “always with you” user interface. (See Figure 6.)

Smartwatches are also capturing people’s imagination as a new form of wearable computer. The convenience and immediacy of wearables dovetails with the move toward more natural modes of interaction. Today, new modes of interaction focus on natural user interfaces (NUIs) such as gesture, tactile feedback and human physiology. In addition, “natural” extends to displays such as skin, tables and walls — i.e., ordinary surfaces. As these new modes mature and push the boundaries of how people interact with apps, the new modes will profoundly transform the user experience.

NUIs employ interactions that are effortless, transparent and contextual. A NUI is perceived to be invisible and uses input that is natural or from nature — for example, voice, gesture or eye gaze instead of a typed command. Smartphones are bringing NUls into the mainstream, such as voice via Apple’s Siri and Google Voice, and gesture and eye gaze via Samsung’s Air Gesture and Smart Scroll. Gesture-based interfaces enable people to interact directly with content rather than manipulate menu commands and buttons.

While gesture has been around for some time in video games (e.g., Nintendo Wii and Microsoft Xbox Kinect), it is still early days for non-game environments. The Kinect Accelerator program, for one, aims to change that by seeding entrepreneurial development of Kinect applications for Windows PCs. Examples include facilitating physical therapy, monitoring retail behavior and navigating MRI and CT scans in the operating room. Other burgeoning examples are Samsung’s Smart Interaction TV interface, which incorporates voice and gesture; the Leap Motion controller, which enables people to use hand and finger gestures to interact with a laptop (see Figure 7); and specialized gloves, called Enable Talk, that enable sign language gestures to be translated into speech via a smartphone app.

Further along is gesture in cars, to manipulate apps and controls on the dashboard with hand motions or even open the trunk with a foot motion, such as when carrying groceries. Then there is Myo, an armband that leverages the electrical energy in your muscles to control the digital world through gesture.

In addition to using motion as input from the user, motion can be used as output by the computer. Such tactile feedback, or haptics, includes vibrations and forces. Haptics...
makes a virtual experience seem more physical and real, enhancing context, engagement, understanding — and thus execution — of a task. For example, haptics can aid robotic surgery, providing tactile and resistance feedback to surgeons as they operate. Haptics in car infotainment systems helps drivers keep their eyes on the road. Smartphone users may be less likely to make errors using a haptic keypad and may be more engaged with a game or other app that has haptic features.

For the ultimate in invisible interactions, new modalities are directly tapping human physiology. Consider smart contact lenses that capture pressure-related changes to the circumference of the eye to help diagnose glaucoma (limited commercial availability from Sensimed) or that monitor blood glucose levels for diabetics (in development at Microsoft Research Connections and the University of Washington, and at Rutgers University). The continuous monitoring from the lens is more thorough and less invasive than traditional procedures, improving health and quality of life. (See Figure 8.)

Other areas of research include harnessing emotions (affective computing), brain waves and eye movement to interact with computers. Emotient applies machine learning to facial expression to better understand human emotions and behavior. (One of its first applications was smile detection technology for Sony cameras.) The idea is to have machines learn to understand us rather than us commanding them.

Emotiv has created a headset shown in Figure 9 that reads brain waves, so when you think something (e.g., lift or move), it happens on the screen (e.g., an object elevates or a cursor moves). People could use brain waves to do an Internet search, for example, or to rate a song they are listening to. The headset also detects facial expressions and emotions. Companies such as Seren and NeuroSpire are using the data to understand how customers respond to products and advertisements (e.g., engaged, bored, frustrated, excited).

Besides being able to infer emotional states by sensing physiological traits, apps are able to express and influence human emotions. Apps can express emotion based on context using sound tonality, visual effects, ambient lighting and haptics. For example, Nissan has a prototype vehicle that shows emotions using animatronics and a flexible material that changes shape to emulate a smile or frown. Other vehicle manufacturers use ambient lighting to influence the driver’s mood (e.g., calm, alert), express the state of the vehicle (e.g., unlocked, starting, ready to go, malfunctioning) or define the brand.

FIGURE 8. Smart contact lenses monitor eye pressure-related changes to detect glaucoma. This non-invasive healthcare device takes advantage of the body as a natural user interface.

Source: Sensimed

FIGURE 9. This headset reads brain waves for controlling a computer display, so you can think about moving the cursor and it happens on screen.

Source: Emotiv
However, some challenge the notion of NUIs, saying that an interface that is too simple potentially stunts learning, and that a complex world demands tools that we invest some effort in learning to use, just as we had to learn to read. However, as devices shrink and apps are embedded in all manner of things, from smartphones to sedans to store shelves, natural interfaces will be imperative.

Google Glass is a good example, with its head-mounted display that features voice, video and AR capabilities. The device has captured the public’s imagination about how we will soon interact with the digital world, from navigating through streets to filming and taking photos of memorable occasions. To be clear, head-mounted displays are not new. However, the elegant design and marketing have created an excitement about this new mode of interaction; it’s the same way consumers felt when Apple launched the iPhone with touch screen capability.

As devices shrink and apps are embedded in all manner of things, from smartphones to sedans to store shelves, natural interfaces will be imperative.

USER INTERFACE: DESIGN DOMINATES

The new modalities radically transform how people interact with computers, making user interface (UI) design a critical role in user experience. Encompassing engagement, context and the new modalities, UI design has become a driving force in the uptake of apps. A poor UI ruins the experience quickly, whereas a great UI changes the experience entirely.

Apple showed the world the importance of good UI design, and there has been no stopping UI design since. Today the UI can be a powerful differentiator, if not the primary reason for choosing an app or an enterprise system.

An important though seemingly mundane element influencing UI design is screen size. As the new modalities show, radically different screen sizes require new thinking about design. With a large display such as a table, the trick is to avoid information overload but also design for the possibility of multiple simultaneous users. With a small display such as a smartphone or glasses, the challenge is to decide what functions to leave out or reserve for different form factors, and to set expectations accordingly. These decisions are best made by designers who can walk in the footsteps of the user.

In short, apps must combine technical flexibility with an artist’s touch. Companies should invest in design and development teams that have both creative and technical skills, can empathize with the user, and can deliver a consistent experience across a diverse set of devices in different contexts, all while keeping business goals at the forefront.

These considerations are pushing developers in new directions, changing the very DNA of apps and the platforms used to build them. But before we get to apps DNA and apps platforms, it is important to examine where many of today’s apps are and what things they are connecting to, discussed next.
Computers are everywhere and apps run everything.

Look around: Apps are everywhere. The Internet of Things, long imagined, is taking shape as computers and apps populate cars, TVs, refrigerators, ovens, thermostats, luggage, signs, vending machines and other everyday things. As the physical world “wakes up” and gets online, to paraphrase the Cisco ad: The next big thing isn’t a thing at all but the connection of things, yielding a smarter world. GE calls it the Industrial Internet, born of the Industrial Revolution and the Internet Revolution and ushering in huge potential gains in productivity as machines, computing, connectivity and analytics converge.12

A world of apps everywhere is about changing how businesses operate: cutting costs through automated business processes, increasing revenue by providing new services, and complying with regulations by controlling environmental factors. It is about convenience, efficiency, well-being and innovation. Apps everywhere is about changing everything.

A world of apps everywhere assumes an underlying network unifying everything. In 2013 over 5 billion standards-based wireless connectivity chips will be shipped, connecting all manner of things to other things and to the Internet; there will be over 10 billion Bluetooth-enabled devices in 2013 and over 10 billion WiFi-enabled devices in 2015.13 Chips and apps in objects and things enable interoperability with formerly closed systems, such as in-vehicle information systems in the connected car, entertainment systems and appliances in the connected home, wearable sensors in the connected person, and parts and industrial equipment in connected machines.

CONNECTED CAR

A prime example of the richness and potential of things connecting to both people and other things is the car. The connected car has implications for in-vehicle entertainment and information, safety, diagnostics, stolen vehicle recovery, marketing and sales. Not only does the consumer benefit, but so do the car manufacturer, dealer, financer and insurer.

Today people want personalized access to apps, music, books, news and video from any device at any time. The car is just one more device — some call it “the ultimate mobile device”14 — and the in-vehicle infotainment (IVI) system serves the content to a captive audience, which is why the dashboard has become such a hot property. While dashboard apps for music, navigation, news and nearby restaurants provide enjoyment and convenience for drivers, ads for nearby promotions provide new business opportunities for marketers. Given the increasingly connected consumer, digital services that were once confined to high-end cars will gradually become commonplace.

Several auto manufacturers, including Audi (MMI), Ford (SYNC), Toyota (Entune) and Daimler (COMAND Online), are adopting open standards such as HTML5 to
Digital services that were once confined to high-end cars will gradually become commonplace.

facilitate interoperability between IVIs, the web, mobile devices and app stores. In a move reminiscent of Apple, Ford and General Motors are reaching out to third-party developers to write apps for their vehicles — an automotive first. (See Apps Economy.) Platform provider QNX, a subsidiary of BlackBerry, has developed an open platform for the connected car. QNX CAR Platform 2.0 features interfaces for smartphone integration, 3D navigation, voice, physical and touch control, cloud connectivity and even video conferencing. QNX is working with open-source standards-based development platforms GENIVI, Tizen and webinos to create a vehicle data API W3C specification by the end of 2013. In addition to connecting to people and their apps, cars are connecting to cars and other things on the road. This is the essence of the self-driving car, which senses distance between cars and objects in its path and can operate itself without human intervention. Google, Toyota, Volvo, General Motors and others have been working on self-driving cars in the name of safety and efficiency. Google’s car has been a working prototype for a few years (see Figure 10), and now three U.S. states (Nevada, California and Florida) allow self-driving cars on the road. The vision behind the self-driving car is fewer accidents, higher-capacity use of roads, fuel efficiency and convenience. Many complicated legal and business issues must be settled, however, before driver assistance technology is commercialized. Who is liable in an accident? Should software updates be automatically pushed by the car maker or left to the driver? Can the car legally drive itself without anyone in it?

FIGURE 10. Google reports that its self-driving cars have completed 300,000 miles of test drives without an accident. (On average, U.S. drivers have an accident every 165,000 miles.) Much work still needs to be done, but the reality of the self-driving car is getting closer.

Source: Google

The vision behind the self-driving car is fewer accidents, higher-capacity use of roads, fuel efficiency and convenience.

CONNECTED HOME

The home is chock-full of things being connected to the network. From thermostats to washing machines, ovens, doors and lights, dormant everyday things are being infused with digital life.

While still emerging and somewhat of a novelty, these smart things can enable self-diagnostics without requiring a service call (e.g., LG Smart Range), integrate your photos and allow you to take control of your
entertainment (e.g., smart televisions), and even learn your behaviors and adjust over time (e.g., Nest Learning Thermostat in Figure 11).

The workhorse refrigerator, a centerpiece of home life, is being transformed into a multifaceted thoroughbred. Smart refrigerators from Samsung and LG sport an 8-inch LCD screen with apps including grocery lists, recipes, calendar, weather, memos, photos and more. (See Figure 12.)

Connecting individual things is a first step toward connecting everything to each other, a vision made possible with open standards, cheap sensors, pervasive home WiFi and ubiquitous smartphone apps. Home automation systems that were expensive, proprietary, closed and for the affluent are giving way to inexpensive, standards-based, open systems that target everyday consumers. Companies such as SmartThings, Ube and Microsoft are showing the way.

SmartThings’ system connects things such as doors (open or close), power outlets (on or off), motion sensors and presence detectors. SmartThings uses a wireless hub that links to sensors strewn around the home, and the entire system can be controlled through an Apple or Android smartphone app. (See Figure 13.) Because the platform is open to developers, there are endless possibilities for creating simple apps, such as “when someone’s presence is detected, turn on the light and send me a notification.”

Ube also turns an Apple or Android smartphone into central command, linking any IP-enabled devices in the home. In addition to connecting already-IP-enabled devices like TVs,
Ube has initially announced three IP-enabled devices: power outlets, light dimmers and plugs. (See Figure 14.) Its app incorporates gesture, so you can swipe up or down to change a TV channel or use a dialing motion to adjust volume. But the real power comes from eventually making recommendations based on data from multiple connected things. For example, when your smart scale says you’ve gained weight, it will see that you’ve been watching more TV and spending less time on the treadmill and suggest that you get moving.

Microsoft, with its acquisition of id8 Group R2 Studios, is potentially taking a different approach. Instead of creating a free-standing app, it can integrate at the operating system level and make home automation a core service like location or social, drawing on all the contextual information in the smartphone, for example, to detect patterns and inform home automation activities. Apple is also showing signs of integrating at the operating system level. Integration at the operating system level means smartphones, tablets, desktops, game consoles and more can become hubs, powering the vision of the connected home and the constantly connected consumer.

**CONNECTED (HEALTHY) PERSON**

Apps that monitor health have become popular as a way to promote wellness, detect problems earlier, and take health management literally into our own hands. CSC reported on this trend in “The Future of Healthcare: It’s Health, Then Care” in 2010; as populations age and people seek ways to control healthcare costs and combat a shortage of doctors and nurses, the trend continues in full swing, backed by the proliferation of smartphones and cheap sensors.

Researchers are working on transforming the smartphone into a mobile medical device that can take readings from a patient and ultimately diagnose a condition, akin to the medical tricorder in the *Star Trek* TV series. The best example is Scanadu’s Scout, a device you hold up to your temple that measures your heart rate, blood oxygen level, and

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**FIGURE 13.** In addition to having its own apps, the SmartThings app lets you create your own apps for connecting things in the home.

*Source: CSC*

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**FIGURE 14.** This smart plug, expected to ship in 2014, lets you turn on and off any appliance you plug into it, and monitor energy consumption, from your smartphone.

*Source: Ube*
pulse, electrical heart activity (ECG) and body temperature and communicates this to a smartphone app. (See Figure 15.) The Scout, expected to be released in 2014, may one day be able to tell if you have the flu or strep, as researchers are working on tests that check upper-respiratory conditions (in addition to other tests).

The idea is not to replace doctors but augment them, shifting care to consumers as is practical. Regulation will be an issue, but trends point toward more consumer-controlled care. Other new app devices that attach to smartphones include an ultrasound device (Mobisante), a blood glucose monitoring device (iBGStar), and an otoscope, the device that looks inside the ear (CellScope). (See Figure 16.) There are also apps that leverage the smartphone’s camera to examine, though not officially diagnose, potentially cancerous moles.20

And technology can go deeper than that. The U.S. military is developing implantable nanochips for troops that would report their health status in real time from the battlefield, potentially decreasing preventable illnesses through earlier detection, and one day even treating them.21 On the civilian side, researchers have created a sensor the size of a grain of sand that can be injected in the blood and send alerts to a person’s smartphone when a warning sign is detected, such as being at risk for a heart attack. Describing this, cardiologist and medical visionary Dr. Eric Topol told NBC, “Having your body under continuous surveillance, talking to your phone — that’s the future of medicine.”22

Sensors in wearables are also emerging as effective health detectors. An example is the First Warning System, which uses sensors embedded into a bra to monitor for anomalies that could indicate breast cancer. Clinical trials of 650 women have produced positive results, offering a potential alternative to the mammogram and the ability to detect minor abnormalities far earlier than is possible with current imaging technologies.23

**CONNECTED MACHINES**

In addition to consumer-oriented devices and things, the apps everywhere story is about connecting the commercial enterprise to its machinery, systems and people. The term for this is Machine-to-Machine, or M2M. (See Figure 17.) As industrial things and traditional embedded (closed) systems connect into broader systems, the payoff of this M2M connectivity will be significant. GE
forecasts that the Industrial Internet can cut $150 billion in waste, assuming just a 1 percent improvement in efficiency in major industries such as aviation, rail, energy and healthcare.\textsuperscript{24} With more things instrumented and their data analyzed, the result is improved productivity, efficiency and work experience, magnified significantly across the global economy. This is about replacing parts based on data from the part, not a schedule; about more efficient routing of fleets; about smarter energy production and consumption; about integrated, information-driven healthcare. Among other things, this translates into lower inventories, lower fuel consumption, smarter allocation of resources, and better health outcomes at lower cost. Apps provide the business value between the data and those using it.

The market is big and expected to grow rapidly. IDC predicts that the market for intelligent systems (servers, PCs, smartphones and embedded systems) will double from more than 1.8 billion units and over $1 trillion in revenue in 2011 to nearly 4 billion units and over $2 trillion in revenue in 2015.\textsuperscript{25}

A good example is what GE is doing with jet engine data. In its “Industrial Internet” report, GE says there are 43,000 commercial jet engines in service, each with three major pieces of rotating equipment that, if instrumented, could yield significant efficiencies in engine maintenance, fuel consumption, crew allocation and scheduling. Add to that another 30,000 engines estimated to come into operation in the next 15 years as global demand for air services increases, plus military and non-commercial general aviation fleets, and the potential impact is substantial.\textsuperscript{26}

The U.S. Navy already collects an enormous amount of data from its aircraft, but it needed a better way to analyze the data to detect potential mishaps and avoid them. CSC, in partnership with its Navy client, developed Flightscope, a tool created to handle the big data analytics and visualization needed, providing analysis for individual flights as well as an entire fleet. Flightscope, a 2013 CSC Award for Excellence winner, can load and analyze several thousand files per day, a notable improvement compared to earlier efforts. The U.S. Navy can now make better data-backed decisions about such things as maintenance and pilot training.

Elsewhere, one wind farm company is realizing a 3 percent increase in energy output, which translates to over $1 million in additional revenue a year, from using additional sensors, controls and optimization software with its GE wind turbines. The sensors provide more detailed data than in the past for monitoring the temperature, wind speeds, location and pitch, enabling the turbines to be run more efficiently.\textsuperscript{27}
Mining is another example of how M2M is being used to address the increasing need for automation and the ability to monitor remote operations to improve safety and productivity. Rio Tinto’s Mine of the Future program, which celebrated 100 million metric tons moved using autonomous vehicles in April 2013, has achieved safety improvements and a 10 percent improvement in utilization with 19 haul trucks operating across two mines. The 290-metric-ton driverless trucks use Komatsu’s FrontRunner Autonomous Haulage System to navigate through the mine site, automatically guide themselves to a loading point, avoid obstacles and fellow trucks, and communicate vital data.

Using a combination of advanced sensors, complex control systems, high precision GPS, data analytics and supervisory systems, operators are able to monitor and manage a fleet (or a number of fleets) from a remote operations center in a major city.

In addition to driverless trucks, the industry has leveraged M2M to test and deploy autonomous drills and automated tunneling machines that can detect and self-adjust to the exact type of rock, removing human operator variability.

One challenge in the world of M2M is how to integrate data from sensor networks to apps on the Internet. CSC’s MachinEdge provides a custom development platform for M2M apps that works in all three dimensions shown in Figure 17: machines, enterprise systems and people. For example, CSC has created an app that monitors data center IT process status in real time, including temperature and humidity conditions. It notifies administrators (on their mobile device) when thresholds are reached, shows where the data center is located on a map, and enables administrators to take action (e.g., restart a down system). MachinEdge, which is powered by the ThingWorx application platform, provides a deep level of integration and visibility into operations. MachinEdge apps enable people to make fewer and better business decisions and focus on higher-value activities.

## CONNECTED SOCIETY

M2M and connected things are part of the larger move toward connected society. (See Figure 18.) This includes everything from smart energy grids, smart buildings and smart infrastructure for street lights, highways and signs to smart supermarkets and smart vending machines. China is investing heavily in the Internet of Things and seeks to set, rather than follow, standards. It already has smart vending machines that accept wireless payment from a smartphone (NFC), and innovations in the lab such as health capsules (booths) that link patients to remote doctors, and smart chairs that sense and report a person's health data.

The port city of Santander, Spain, is serving as a prototype connected city for other European cities. (See Figure 19.) About 10,000 sensors have been installed in street lights, trash cans, building walls, buses, pavement and other things to measure light, traffic volume and noise levels, among other things. This information is used by Santander’s government to save energy by regulating lights and watering, and only picking up garbage when a bin is full. Further, a “Pulse of the City” app can be used by residents and visitors to get alerts about traffic jams, stormy weather and street closures. Residents can even use the app to report trouble spots, by taking a picture of a pothole, for example. Future plans include integration with a social media platform to enable citizens to engage with administrators. Being a “smart city” has improved Santander’s economy, not only by cutting costs but also by attracting investors.
interested in smart city planning. Though many questions remain about smart cities, this “living lab” offers a glimpse into the potential of connected society.

**ALL ABOUT APPS**

Realizing the vision of connected society will take time. However, expectations are rapidly maturing as more things are connected; organizations seek apps that integrate with back-end systems (instead of having standalone systems); security between thing, data center and user is a top priority (not secondary); solutions are tailored for specific industries (not one size fits all); and connected things drive new sources of revenue (not just efficiency).

Apps everywhere is the other side of the coin of connected things. For consumers, many of the new connected things are pricey, though that should change over time. The bigger challenge to adoption will likely be behavior change — using apps to perform a function in a new way. For industry, the need for instrumentation, standards, business processes and innovative products is essential.

As headlines such as “Keep your gadgets, give me apps” abound, it’s clear the Internet of Things is really about apps — i.e., what you can do with that connected thing. People crave tools that provide greater efficiency, information to make a decision, and new experiences. So people will keep pushing the envelope on what an app, and a connected thing, can do.

Enterprises and CIOs need to think strategically about the impact of connected things on future business operations and customer relationships. In particular, they must consider what systems integration skills and partners they need to bring together connected things and implement apps and business processes leveraging those things.
New software choices and architectures redefine development.

The influx of devices and things being connected to the Internet, coupled with flexible cloud services, has led to many development options that are changing the DNA of apps. (See Figure 20.) IT leaders face many choices and challenges as the traditional IT stack, which began breaking down with the advent of virtualization and cloud, dissolves and diversifies further.

These changes reflect the fact that mobile apps have expanded from simple web-based apps to more complex apps that leverage local device features such as cameras, GPS, NFC and compass (powerful front end), and enterprise systems for rich data (powerful back end). Apps will expand even further as they interact with all manner of things connected to the Internet.

As apps have increased in relevance (context) and functionality, they have also moved toward a more fluid, real-time experience. This real-time experience is being enabled by lightweight technologies such as JSON, RESTful web services and WebSockets.

This chapter explores three key aspects of the new world of app development: how the morphing of the IT stack into multiple dimensions sets up a plethora of choices; how lightweight interfaces and standards help bring it all together; and how new architectures address different design considerations for native, web and hybrid apps.

MULTIDIMENSIONAL STACK

To support an “any device, anytime, anywhere” world, the traditional app stack — the software components, languages and tools needed to deliver a functional product or service — has morphed from a one-dimensional desktop-centric stack into a mix-and-match of stacks along three dimensions: device, cloud and enterprise. (See Figure 21.) This multidimensional stack is being built on the foundation of a ubiquitous and more powerful communication infrastructure, efficient app and content delivery models, and open web standards. Each dimension is also influenced by the particular stack of the vendors and an increasingly open community in that space.

This new mix-and-match of stacks moves developers from a predictable environment — for example, having a clear understanding of user numbers and device specifications — to developing in a more dynamic and unpre-
dictable environment with varying endpoints, accessing data from services across multiple geographies, and potentially having new app usage patterns. For example, one consideration is the size and number of data queries occurring across the multidimensional stack. In the cloud, there is less control over the distance between the application and the database, so network latency can have a significant impact on performance, especially if multiplied by many unnecessary round trips. Therefore, while poor design and unnecessary data queries may have gone unnoticed in the enterprise stack, there may be noticeable performance issues when developing across the multidimensional stack.

The result: New emphasis must be placed on design decisions that focus on interfaces between the app and back-end systems. Developers must also focus on design criteria for context-aware, flexible apps that are device-agnostic and mutable, crossing traditional boundaries between applications for web, mobile, PC and embedded devices. Figure 22 highlights the implications of this new world of app development.

**Breaking It Down.** The device is the most visible if not important catalyst to changes in the stack and app architecture. In comparison to traditional clients, more processing can occur on the device itself, and features like cameras and GPS can be leveraged in ways never before possible. The new devices include not just smartphones and tablets, but TVs, car infotainment systems, machines, machine parts and appliances.

Although many mobile devices can do substantial processing on their own, most apps extend functionality to applications and data in the cloud. The cloud expands processing power and storage capabilities, enabling data to be stored and accessed anywhere, independent of the device. As the device (client) gains independence from the data, this leads to the rise of responsive clients on the client side and an API economy on the server side. (See Apps Economy.) Applications shift from targeting a single client to adapting for multiple clients, supporting a multichannel delivery strategy that puts data wherever the person is. Underlying this is the need for consistent and adaptable data models to serve as a foundation for the whole system.

Complementing software in the cloud is software in the enterprise, which is evolving to keep up with an employee

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**New emphasis must be placed on design decisions that focus on interfaces between the app and back-end systems.**

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**FIGURE 21.** Today’s multidimensional stack has software components from devices, clouds and enterprise systems that combine to yield a runtime stack. 
*Source: CSC*
workforce that is increasingly reliant on mobile apps. To do this it must support a variety of devices and cloud services and provide access to corporate systems, without compromising security of the underlying data. Thus it is at the intersection of device, cloud and enterprise that the most significant changes in app development are happening.
TYING IT TOGETHER:
LIGHTWEIGHT INTERFACES

Lightweight interfaces are the “glue” holding the device, cloud and enterprise components together. There has been a resurgence in the API, which weaves the distributed device, cloud and enterprise stacks into an integrated runtime service. Used for decades, APIs enable a software application to communicate with one or more applications (or systems). Today, fueled by cloud and mobile, there has been an explosion of APIs (open and proprietary) that are redefining how applications are designed and distributed. (See Figure 23.) The Twitter API, for example, was handling 13 billion calls per day in 2011, up from 3 billion in 2010.14

The excitement around APIs is this: By providing well-written and open APIs, an enterprise can spread its applications across a wider ecosystem, reaching a broader audience and seeding innovation by others. In addition to sharing APIs externally, organizations can share them internally as part of an overall application modernization effort to make internal applications “API friendly.” For example, Comcast exposed APIs from its different development groups to speed up content sharing and app development.15 APIs are a key digital strategy that will be discussed further in Apps Economy.

At a technical level, there are a number of considerations, including API use cases, requirements, standards, response times and vulnerabilities. To meet the rise in API demand, platforms are being used to help providers and enterprises manage their various interfaces to the outside world. A properly designed API platform gives developers a choice of implementation options, integration with unstructured databases (e.g., NoSQL), and the ability to scale API services on demand.

Given the multitude of choices afforded by the mix-and-match stack and APIs, an important consideration for developers is: What is the best way to architect an app? The next section discusses some of the new app architectures, previewed in Figure 24.

API growth is exploding. The ProgrammableWeb, an online API directory, reached 10,000 APIs in September 2013, up from 4,000 roughly two years earlier. Top categories for recent APIs are financial, enterprise, science and education.

Source: ProgrammableWeb.com

FIGURE 24. ARCHITECTURAL VIEW OF NATIVE, WEB AND HYBRID

NATIVE

WEB

HYBRID

Source: CSC

FIGURE 23. API TOTALS 2005 - 2013
NEW ARCHITECTURES: NATIVE, WEB OR HYBRID?

The proliferation of devices and operating systems has forced enterprises to either standardize on a select few or embrace everything. The result is three primary choices in how to architect an app: native, web or hybrid. These approaches leverage in varying degrees the capabilities of the device as well as the expanded stack.

Although at first glance users often can’t tell the difference between a native app, a web app or a hybrid app, it is a significant difference for both developers and users. How the app is architected affects performance, functionality, distribution and ease of use.

A native app is downloaded from an app store, stored in the file system of the mobile device, and executed by

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HTML5: THE QUIET REVOLUTION

While APIs enable app-to-app content sharing, HTML5 adapts the app to different device types automatically. It supports the bring-your-own (BYO) technology mantra and taps a large pool of web developers rather than device-specific developers. This is a critical consideration for organizations that need to quickly and cost-effectively develop apps that can run on any device.

Yet HTML5 has been criticized for performance (“write once, run awful”), among other things. Apps can be slow since they are running in the browser. The debate goes deeper, though, because HTML5 sets up the battle between mobile web apps and native apps: Is the Internet the foundation for all apps and services, or are the native platform environments (e.g., iOS, Android, Windows)? Right now there is room for both. The choice depends on business requirements and who is using the app.

HTML5 has been emerging since the mid-2000s as a “quiet revolution” influencing app functionality and development. Successive waves of new devices and form factors have been driving HTML5 adoption. As discussed in Apps Everywhere, the automotive industry has been an early adopter of HTML5 to facilitate interoperability between in-vehicle infotainment systems, the web, mobile devices and app stores. Another early adopter has been the Financial Times, which opted for HTML5 to maintain control over its content and revenue and support diverse devices more easily, at the expense of not being listed in popular app stores.

To support device heterogeneity, the CA Seguros insurance company leveraged HTML5 for its CA CliniCard app. People can use this app to search for local doctors’ offices or medical clinics in Portugal by location, and retrieve a map and directions to the clinic.

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WHY HTML5?

• Supports device heterogeneity (e.g., iOS, Android, Windows, BlackBerry, laptop/desktop, car system)
• Open
• Flexible
• Works offline, supports local storage
• Leverages device features (e.g., camera, GPS, video playback, contacts)
• Replaces some proprietary plug-ins (e.g., Adobe Flash) with vector graphics and video playback
• Supports 2D drawing (e.g., signatures)
• Runs locally in the browser
• Has a large pool of web developers

Using HTML5, organizations can write an app once that will function on iOS, Android, Windows and other device types such as cars (“write once, run anywhere”). HTML5 enables a touch interface and integration with some device features such as camera and GPS. Typical mobile web apps (written in HTML4) do not support this. HTML5 enables working offline, whereas a typical mobile web app requires connectivity to the Internet. HTML5 also enables the ability to store data locally on the device.
Because the CliniCard app is written in HTML5 using the CSC Canvas Framework, it is easy to adapt the app for different screen sizes (same content, different presentations). This often requires complex development, but the Canvas Framework minimizes the development effort. Both screens show a list of health services; the tablet version also includes a list of clinics (search results) and a map of their location.

Source: CSC

Created by CSC, the app was first written for smartphones and then took just three days to write for tablets. Minimal coding was needed to take advantage of the larger screen size thanks to the HTML5 Canvas Framework that CSC created to provide pre-defined components for such things as buttons, rotating lists, animations, drag-and-drop, swipe, page transformations and screen size adaptation.

As HTML5 continues to emerge — it is not expected to be complete until 2014 — it will add functionality such as interoperability with the Internet of Things. All the major browsers support HTML5 features now and add new features as they become available.
A hybrid app is a native app with embedded HTML code. Hybrid apps have some of the benefits of native apps, such as access to all device features and app store distribution. The web portion of a hybrid app executes in the browser, and communicates with the native portion using a library such as PhoneGap-Cordova. Although hybrid apps emulate features of native apps, the extra communication overhead introduces some latency and a few less-than-optimal user experiences, though a hybrid app is cross-device compatible. The look and feel of hybrid and native apps can be very similar thanks to out-of-the-box style sheets. Figure 25 compares native, web and hybrid apps.

**Figure 25. The Great Debate: Native, Web or Hybrid?**

<table>
<thead>
<tr>
<th>Description</th>
<th>Native</th>
<th>Web</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Development Language and Libraries</strong></td>
<td>• App deployed on specific device (operating system)</td>
<td>• Website optimized for mobile devices</td>
<td>• App deployed on any device (operating system agnostic)</td>
</tr>
<tr>
<td></td>
<td>• Android Java, Objective C, C#, C++</td>
<td>• HTML5, CSS and JavaScript</td>
<td>• PhoneGap-Cordova or other code wrapper in front of HTML4/5, CSS and JavaScript</td>
</tr>
<tr>
<td><strong>Pros</strong></td>
<td>• Developed using dedicated languages (Android Java, Objective C) • Rich user experience • Full access to device platform and features • App store or in-company distribution • Works offline</td>
<td>• Runs on multiple operating systems • Leverages existing web development language skills • Shorter delivery lifecycle • No distribution approval process (faster go-to-market) • Lower cost</td>
<td>• Runs on multiple operating systems • Leverages existing web development language skills • Richer user experience than simple mobile websites • Full access to device platform and features • Shorter delivery lifecycle than native • App store or in-company distribution • Works offline • Lower cost</td>
</tr>
<tr>
<td><strong>Concerns</strong></td>
<td>• Some standards ignored • Specific programming language and skills needed • Longer delivery lifecycle • Distribution approval process • Higher cost</td>
<td>• Less rich user experience • Limited access to device platform and features • Requires network connection (though some limited offline capabilities)</td>
<td>• More susceptible to latency than native apps if poorly designed • Distribution approval process</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>• Fly Delta, Instagram, Yelp, contacts, camera</td>
<td>• Financial Times (app.ft.com), Consumer Information (consumer.ftc.gov)</td>
<td>• TripCase, Measure DHS</td>
</tr>
</tbody>
</table>

*Source: CSC*
Whether an app is native, web or hybrid, many factors impact its performance, including good design, connectivity (3G, 4G, WiFi), the performance of back-end systems, and the app’s runtime environment (native, web, hybrid). Deciding on which approach to use can be complex if not confusing.

The best choice depends on factors such as the app’s intended features, context, target audience, maintenance, budget and skills of the development team. If the app is mainly used to display and interact with online content or services, and does not require full access to device platform and features, then a web app is likely the best choice. On the other hand, if the app is intended to be mainly used offline, and requires full access to device platform and features, then a native app will offer a better user experience.\(^{37}\)

**OUTLOOK**

The DNA of apps is changing. What was once a relatively straightforward proposition, a single stack, has become an amalgam of choices — a mix-and-match stack. The client device is forever decoupled from the server, which resides (for the most part) in the cloud. This, in turn, has ignited mobility, connected things, and a wealth of APIs.

It has also introduced new app architectures for dealing with the device and expanded stack, based on app requirements and the developer pool. For now, there is no definitive “best choice” among native, web and hybrid architectures.

That could change, though, as HTML5 continues to converge with native capabilities. In particular, as HTML5/JavaScript performance continues to improve, the value of “write once, run anywhere” becomes very attractive to all but the most specific applications. Over time, it may not be possible to distinguish between a web, hybrid and native app, as the capabilities of web and hybrid apps will be more or less on par with native. However, there will always be some degree of differentiation by native apps that leverage device-specific features not supported by HTML5.

Over time, it may not be possible to distinguish between a web, hybrid and native app, as the capabilities of web and hybrid apps will be more or less on par with native.

In the meantime, enterprises need to have developers with experience in web, hybrid and native development. They also need architects who understand how to design app architectures that integrate with back-end infrastructure and enhance the app experience. Ultimately, the choice of implementing web, hybrid or native architectures depends on available resources and business requirements.

App architectures will continue to evolve as Internet-enabled devices become pervasive in homes, vehicles and infrastructure. Enterprises need project managers and architects who understand the impact of mobile app and data architectures — including changes in mobile app development standards and languages (e.g., HTML5), the need for a flexible UI design, and the power of lightweight interfaces — in order to make informed decisions and adequately allocate resources. Otherwise, the use of an outdated architecture will adversely affect the app experience as well as cost, scalability and customer satisfaction with the end product.

The goal for architects, designers and developers is to create an optimal experience. They must deliver fluid experiences, manage device complexity and keep up with changing technology. The next chapter discusses how new platforms are helping app creators address these and other challenges.
Apps platforms simplify development, management and distribution.

Building today’s mobile apps requires a fundamentally different approach. Design and development are user-centric; technology encompasses diverse device environments, multiple cloud services, and lightweight interfaces and standards; and release cycles are short to keep pace with a fast-moving market. The managed desktop is coming to an end, being replaced by dynamic apps, enterprise app stores and BYO technologies. Development is taking place outside of IT, where do-it-yourself (DIY) business people can leverage both drag-and-drop and more advanced tools to expose APIs, integrate services and create apps. Cross-functional challenges like security take new shape as everyone brings their own apps (not just devices) to work.

Fortunately, new platforms are helping enterprises tame this complexity and transition to larger, more sophisticated mobile apps. Increasingly, platforms are driving toward end-to-end management of the entire app lifecycle so enterprises can form a comprehensive, coherent mobile app strategy that serves business needs, responds to rapid market change and addresses a broad audience. This chapter explores five core challenges app development platforms are addressing: user experience, device heterogeneity, integration with multiple systems, app delivery and DIY. It also explores what’s new in the traditional cross-functional challenges of governance, security and analytics. (See Figure 26.)

The managed desktop is coming to an end, being replaced by dynamic apps, enterprise app stores and BYO technologies.

PROVIDING A CONSISTENT USER EXPERIENCE

In order to meet consumer needs, developers must ensure the design of the app provides an easy-to-use, consistent user experience. Rapid app prototyping platforms like iRise, Justinmind, Proto.io and Codiga help the developer build and execute prototype apps quickly. However, since it is difficult to predict all contexts in which an app will be used, testing and monitoring tools are needed to track the quality, performance and user engagement of the app during testing and production.

Monitoring of application performance is not new. However, in the past a typical application (enterprise or consumer) had a somewhat tolerant and captive audience. Today’s audience is quite the opposite. In a survey conducted by Apigee, an API technology and services company, 99 per-
cent of respondents reported they would take action if an app didn’t perform, either by deleting the app immediately or telling a friend via social media; 38 percent would delete the app if it froze for longer than 30 seconds; and 18 percent would delete the app if it froze for just 5 seconds.

Unfortunately, poor experience from crashes or freezes can be caused by a range of problems: a device issue, poor third-party API, network problems and so on. Enter real-time app monitoring platforms from companies like Flurry Analytics, Crittercism and New Relic. These platforms use a simple dashboard that captures events ranging from where the app is being used (physical location) to where app crashes or slowdowns are occurring and the number of people affected. This helps focus developers on fixing the most important problems first.

While in web apps bugs can be fixed by deploying new code to the server, in native and hybrid apps bugs can persist on the client side until an update is installed. In response, a number of testing platforms such as Switchboard (open source), Swrve, Optimimo and Pathmapp provide an A/B testing framework for mobile apps and staged rollout of new features. With A/B testing, two variants of a feature, A and B, are tested simultaneously. Companies can see almost immediately if people accept or reject the feature. (Facebook is famous for using A/B testing.) In addition, some of these platforms provide real-time analytics about session duration and gender distribution. This allows non-developers (such as marketing personnel) to test app variations and understand engagement, for example by tracking usability and sales from a campaign.

MANAGING DEVICE HETEROGENEITY

How to manage device heterogeneity is a critical challenge impacting the entire app development lifecycle. Platforms address this by providing design tools to create mock-ups of UIs for different device sizes and operating systems, some of which can be dynamically adapted during runtime (e.g., if HTML5 is used). During implementation, development platforms include reusable software development libraries, to enable a developer to reuse code in app builds for different device types and operating systems.

Further, some platforms integrate with app testing tools and device emulators, which enable a developer to build reusable test scripts and run tests for the different device types. When the Brussels Regional Informatics Center (BRIC) needed to embark on mobile apps for citizens (see Figure 27), CSC created a mobile app development platform with a testing service capable of testing 1,500 different device types. The cloud-based Mobile Software Technical Center (MSTC) platform provides mobile and web cross-device development, version control, device testing, mobile SOA, integration with databases and app store distribution. MSTC, which was a 2013 CSC Award for Excellence winner, is based on open-source components and supports Apple, Android, BlackBerry, Symbian, Bada, WebOS and Windows Phone environments. BRIC, the ITC agency for the Brussels region, is using the platform for all mobile development.

![Source: CSC](image-url)
INTEGRATING WITH MULTIPLE SYSTEMS

Behind that simple app icon is a complex network of interfaces to other apps and back-end systems, some of which are not designed for mobile or the web. Bringing them into the mobile fold requires significant work, making back-end system integration one of the most challenging and time-consuming aspects of enterprise app development.

In order to handle integration with other apps and back-end systems, some platforms (e.g., Kony) include lightweight, reusable connectors to enterprise apps, social media and back-end resources like virtual cloud servers and virtual storage. Other platforms (e.g., Apigee, IBM Worklight/Cast Iron, Mashery) provide API publishing tools to enable the creation of custom interfaces to other apps.

An example of a platform for back-end system integration is Catavolt Extender, a cloud middleware platform that connects to existing enterprise systems via native apps. Catavolt uses two layers of integration: A satellite server is deployed in the enterprise’s data center and is used to expose the data from legacy database systems to a second, middleware layer in the Catavolt cloud. (See Figure 28.)

One Catavolt client, a large healthcare provider, needed to make its two electronic medical records (EMR) systems mobile-accessible to meet regulatory requirements. However, faced with the prospect of replacing its EMR systems in the future, the organization needed to minimize the effort and cost of mobile app development, both now and for the future. Using Extender, the organization was able to blur the lines between the two systems (one legacy and one custom), bring in the necessary data from its business intelligence system and deliver a mobile app to meet regulatory requirements. The solution guaranteed the strict level of security required by keeping data where it was, behind the firewall. More importantly, Catavolt’s middleware layer allowed the organization to phase out the older of the two EMR systems and phase in a new one without impacting workers.

In some cases platforms are designed to solve specific industry integration challenges. Ohio Mutual Insurance Group wanted an app that would make it easy for a driver to present proof of car insurance, such as at the scene of an accident. However, to achieve this, complex integration between three systems was required: the agency information system (in Salesforce), a third-party agency management system, and Ohio Mutual’s proprietary agency portal and policy information system.

The solution to the integration challenge was CSC’s Mobile Insurance Framework. (See Figure 29.) The framework was used to integrate barcode scanning of the Vehicle Identification Number and offline data processing from the mobile device with back-end systems on the server side.

![Diagram of Catavolt Extender](image)

**FIGURE 28.** Catavolt Extender uses two layers of integration: a satellite server in the enterprise’s data center and a middleware layer in Catavolt’s cloud. The approach optimizes for the underlying database while requiring minimal transformation of the data for presentation to the person on the end device.

*Source: Catavolt*
stores need to think about how to incorporate these new delivery models into the workplace while taking into account enterprise security issues such as data protection and role-based access control.

For example, Citrix XenMobile is being considered at a large U.S. federal agency for its internal app store, to deliver Windows-based virtual desktops, web apps and mobile apps in a secure container for iPhone, iPad and Android devices. XenMobile provides device management as well as the delivery of virtual desktop apps, web apps, third-party SaaS apps and mobile apps. (See Figure 30.) Data for all applications is secured by keeping it in the data center (for virtualized apps) or in a secure container on the mobile device (for mobile and web apps). Along with this security are two key features: the ability to set up accounts (a bundle of apps, connectivity services and update services), giving people what they need depending on what device they are connecting from, and follow-me data, giving people access to their documents and apps from any device.\textsuperscript{39}

**FIGURE 29. CSC MOBILE INSURANCE FRAMEWORK**

![CSC MOBILE INSURANCE FRAMEWORK](image)

**REINVENTING APP DELIVERY**

App stores highlight the importance of simple, fast app delivery and distribution (e.g., over-the-air delivery in seconds) to all types of devices, including handhelds, TVs, glasses and smartwatches. Enterprises are attempting to copy the mobile app store model made famous by Apple and Google, to deliver apps that are on-demand and dynamic rather than locked down.

An enterprise app store is a privatized development and distribution platform that controls the publishing, distribution and management of approved applications. Unlike consumer app stores, enterprise app stores enable administrators to assign user roles to apps, monitor app usage activity (popular as well as problematic apps can be identified), and apply enterprise security policies to apps (authentication, data protection). Companies including Citrix, BMC/Partnerpedia, Apperian, Good Technology/AppCentral and Symantec/Nukona provide enterprise app store solutions. Enterprise CIOs who want to leverage the benefits of consumer app
Delving into DevOps. App stores underscore the dynamic nature of today’s apps, whose frequent updates are distributed via the stores. As the pace and scale of updates increase (Facebook releases code to Facebook.com twice a day), and technology continues to commoditize, tight integration and collaboration are needed between development and IT operations.

Enter DevOps, an approach that aims to break down silos and reduce finger-pointing between developers (interested in change) and operations (interested in stability), producing higher quality apps that can be released and recovered faster. A survey of 4,000 IT operations professionals found that high-performing DevOps teams were able to deploy code 30 times more frequently, make changes in minutes, recover 30 times faster and have 50 percent fewer failures. DevOps teams increase performance through aggressive automation in areas such as release management, provisioning, configuration man-

Enterprises need to move toward a DevOps approach and culture to keep up with the rapid pace of business change and deliver a continuously evolving apps experience.
Compared to traditional coding, DIY platforms enable extraordinary ease of use through self-authoring tools, visual design techniques, and sample apps that enable just about anyone to quickly build an app. DIY platforms focus on personal empowerment of the new generation of “double deep” employees (those with strong business and IT skills). A DIY strategy lessens issues of cost, security and time-to-market that are associated with third-party-developed apps. In addition, this form of open employee development frees IT from the dreaded “request pipeline.”

For example, July MX, a product of July Systems, focuses on business users and enterprise IT developers by providing a drag-and-drop development platform that includes interconnectivity with back-end systems such as inventory, payments and loyalty systems. Its focus is development speed and user engagement — drag, drop and create an ad campaign, product catalog, search, payment and much more.

DIY apps also encompass building custom application interfaces. Increasingly, technical business users can leverage more advanced tools to expose APIs, integrate services and create apps. For example, Datownia builds a web API from any Excel spreadsheet held in Dropbox or Box. Taking this idea further, Zapier uses simple drag-and-drop operations on the web to build unique integrations and workflows between web services; no coding required. The result: enterprise application integration for web services. Want to integrate a process across Salesforce, Asana, Chatter, Dropbox, Facebook, Google Docs, Jive and NetSuite? Zapier makes it possible.

Another DIY API mashup service is If This Then That. IFTTT enables non-technical people to connect apps using simple rules. The service provides a list of channels, or apps that can be used to provide “triggers” that enable “actions” on other apps. For example, the weather app provides the trigger “If the sun sets” to enable a “turn on the light” action in the WeMo app.

At the cutting edge of DIY apps is STOIC, which automatically turns an offline spreadsheet into an app. A person imports a spreadsheet to STOIC, which creates a database and UI for the data. The app has a variety of views, from maps to calendars to grids, depending on the data and the person’s needs. Results (views) can be easily shared on a website.
The enterprise has seen DIY IT evolve from the advent of the PC to cloud infrastructure services, cloud development platforms, website builders and now app and API builders. Information technology continues to “abstract up” so that more people can do more themselves. The result has been decades of innovation, with no end in sight.

MANAGING END TO END

To fully optimize a mobile strategy, enterprise CIOs need to consider the importance of governance, security and management across the entire app lifecycle, from requirements, design and development to ongoing release, testing, deployment and operations.

Apps are shaking up traditional service industries by enabling consumers to bypass traditional government regulations for established businesses like taxis, hotels and restaurants. For example, the California Public Utilities Commission has rescinded its ban on ride-sharing start-ups like Lyft and is attempting to create new rules for these start-ups, which have been categorized as “Transportation Network Companies.”

Enterprises need to be alert to how governance changes can affect their business and apps.

Imagine if there could be a step change in the productivity of 5,000 field service engineers via a new app. The business case for this app may never come to life without the collective insights of the engineers in the field. By deploying a DIY apps program that includes an idea portal, enterprises can aggregate the business cases of many app requests, leading to decisions to create new apps and supporting services.

In a world of DIY apps, IT is the springboard for innovation, not the overlord. Apps created closer to business people will deliver new levels of usefulness as they reflect dynamic business and customer needs. Will DIY apps reach core business systems like accounting or payroll? Perhaps not, since those serve more static needs and do their job well today. But for highly dynamic requirements and situations, DIY apps make sense. DIY apps represent a new approach to development that leverages employee talent, helps enterprises better serve their customers and turns shadow IT into a competitive advantage.

Enterprises need to be alert to how governance changes can affect their business and apps.
How to manage personal identifying data is a challenge for individuals and organizations. For example, individuals today are required to provide their personal information to a myriad of companies and organizations as proof of their identity. These traditional identity solutions contribute to an uncontrolled scattering of personal information throughout cyberspace, degrading individual privacy and trust. CSC is addressing this problem with the Trusted Identity and Privacy Services (TIPS) platform concept. TIPS seeks to give individuals greater control of their digital identities by de-coupling key aspects of identity management from third-party service providers like banks and government agencies, making the identification experience more convenient, more secure, and consistently privacy-enhancing, as suggested by the U.S. National Strategy for Trusted Identities in Cyberspace (NSTIC). TIPS also seeks to facilitate new, privacy-centric practices for identity assurance and personal data storage.

Preventing unauthorized access to data is yet another security challenge. Fortunately, it is possible to boost security while the app is in development. This approach is used by Veracode. The developer sets a threshold for an acceptable level of vulnerability risk (high, medium, low) and then submits an app build through the Veracode portal. Veracode scans the app binary for known security vulnerabilities and notifies the developer when an app passes or fails the scan. In this way developers can address security problems before the app is put into production.

It is also possible to enforce security of an app after it is put into production. An application wrapper provides a virtual “shield” around an app to protect the app’s data from unauthorized access, regardless of the security posture of the underlying device. Mocana Mobile App Protection (MAP) provides administrators with a tool to automatically inject data security and policy controls into the binary file format of an app. Mocana MAP can add a secure authentication screen to an app, prevent people from cutting and pasting text from an app, encrypt all app data-at-rest, and ensure that an app communicates using its own secure tunnel back to the corporate network. All of this is done in seconds, with no coding required, and does not impact the user experience. (See Figure 32.)

**FIGURE 32. PROTECTING THE ENTERPRISE**

Source: Mocana Corporation
To manage an app comprehensively, an end-to-end mobile app lifecycle development platform is needed that aligns mobility with the enterprise architecture and covers governance, security and management across the app lifecycle. Several platforms including Appcelerator, CSC’s Mobile Insurance Framework, and MSTC are already moving in this direction. CSC’s new M1 service offering is designed around an end-to-end mobile app lifecycle platform, providing governance, security and management across the entire app lifecycle, from requirements, design and development to ongoing release, testing, deployment and operations.

**HOW TO CHOOSE?**

Platforms for app development need to address the user experience (including performance management), device heterogeneity, integration with other applications, app delivery and DIY. In addition, platforms need to deal with cross-functional challenges including security, analytics and scalability. How does one choose the best platform?

Understanding your business needs is essential. If the goal is to enable efficient development across different departments in an organization, put a platform in place for sharing code more efficiently. If the goal is to enter new markets or partner with other companies, put a platform in place that promotes the use of APIs. If the goal is to enable non-technical business people to quickly create their own analytics apps, then a DIY business app development platform is the right tool for the job.

Ultimately, platforms help developers work better, but deploying a platform is not enough. Organizations need to change business processes and culture in tandem with the new platform to effect real change.

The world is increasingly moving toward open information sharing, both within and between organizations. As formerly closed systems (e.g., cars, machines) open up, the challenge is to combine disparate data in new ways to innovate and create new services. This is a powerful force that is sowing the seeds of a new apps economy, discussed next.
The reshaped experience, explosion of apps everywhere, and dramatic changes in app design and development have ushered in a new apps economy. Lower barriers to entry and new apps marketplaces have simplified production, distribution and consumption of apps, with open APIs igniting exciting opportunities for innovation. In just five years, an apps economy has emerged that is now worth over $25 billion in apps store sales alone. \(^1\) Mobile is dominating the landscape. Apple and Google lead the apps marketplace for smartphone and tablet devices, with approximately 1 million apps each in their app stores and over 100 billion downloads total. \(^4\)

These changes are impacting consumers across the globe, from the growth of smart devices in emerging economies to the growth of apps in non-traditional devices like appliances, TVs and cars. \(^4\) Enterprises cannot ignore the apps economy. New markets are forming, customer relationships are changing, the rush to APIs is on, and developers are a coveted resource.

### NEW MARKETS

Apps and connected things, explored in Apps Everywhere, are laying the groundwork for new markets. Ecosystems are building around connected things, which are increasingly connecting to each other and to people. Innovation is being enabled through integrated apps; platforms that connect things, apps and people; and APIs that extend existing services into new realms. Examples in healthcare, automotive and DIY business show the way.

In healthcare and fitness, a new market is forming around wellness and health cost management that ties investment in one’s health to financial incentives by using personal health data and apps. Although apps have been used for personal health monitoring for some time, what’s new is the ecosystem forming around employees, employers and health plan providers to encourage healthy employee behaviors through technology, personalization, socialization and financial rewards.

RedBrick Health has created a wellness solution for organizations that provide self-funded health insurance to employees. RedBrick’s web app helps participants understand their health status, develop new behaviors and reinforce healthy habits. Participants can take a health assessment; track fitness, nutrition and well-being activity; and engage in health improvement programs and competitions. Importantly, the app integrates with Fitbit, RunKeeper, Fitbug and BodyMedia FIT activity tracking devices so people don’t have to log data twice. \(^4\) This ecosystem leverages the personal data people are already collecting, making it easier to track progress and stay motivated to exercise. The real incentive, though, comes from...
financial rewards that are driven by emerging behavioral models. For example, walking over 3,000 steps per day or achieving a healthy cholesterol level might earn you a contribution to your Health Savings Account, an insurance premium reduction, or entry into a prize lottery. (See Figure 33.)

This ecosystem has enormous potential, because now the employee’s personal data is being linked and leveraged for the bottom line, lowering employer and employee healthcare costs while improving employee productivity and health. Apps are making it easier to collect the data, and the broader ecosystem is putting that data to work. Other players in the health-fitness ecosystem include Aetna CarePass and Jiff.47

Another new market is forming around connected cars. Revenues from connected car services such as traffic information, call center support, vehicle diagnostics and in-vehicle infotainment systems are expected to triple between 2012 and 2018 to approximately $52 billion.48 Fueling this market is the projection that most new cars will have some form of Internet connectivity enabled by in-vehicle LTE services.

Internet connectivity and in-car apps are unleashing a host of new car services. For the first time, the car as a platform is opening up. GM, for example, has opened its OnStar Remote and In-Vehicle APIs to third-party app developers, who can create new applications that leverage vehicle diagnostics and commands such as locking and unlocking doors. The first third-party app is RelayRides, which enables people to rent their cars. The RelayRides app integrates with the OnStar Remote API, enabling renters to unlock the OnStar reserved car from their smartphone.49 Being able to access OnStar-enabled vehicles opens up a large market for RelayRides, whose customers otherwise have to exchange a physical key, and enables it to make car sharing safer and more convenient.50 Such personal car rental is an entirely new offering. Similarly, it is expected that the In-Vehicle APIs will spark a whole new range of apps that interact directly with the infotainment

![FIGURE 33](https://www.redbrickhealth.com/consumer/home)

**FIGURE 33.** RedBrick Health teams with employers, health plan providers and device makers to form a new market for health cost management and healthy worker behavior, driven by data and apps. The home screen provides links to healthy activities, rewards and sync options for importing data from activity monitoring devices.

*Source: CSC*
system, its UI and built-in services such as navigation and audio/video playback.\textsuperscript{51} As the ultimate mobile device, the car has unique properties that, combined with digital and connectivity, are sparking a new connected car market that is personal, customized and information rich.

As the ultimate mobile device, the car has unique properties that, combined with digital and connectivity, are sparking a new connected car market that is personal, customized and information rich.

Another new market is DIY business ventures that leverage mobility and just-in-time convenience. RelayRides and other car-sharing services like Uber and Lyft fall into this category. So do apps like TaskRabbit and EasyShift, which match tasks to people with free time.\textsuperscript{52} TaskRabbit is an errand service, so people can respond to a job while on the road and get paid on the spot using a mobile credit card reader. While these kinds of businesses are possible without a mobile app, the mobile app provides speed, efficiency, practicality and ease of use, which translates to more business transacted and (hopefully) more satisfied customers. The reduced pain of adoption and the immediacy of the mobile app make this new DIY market possible. Expect to see many more people running businesses from their phones.

NEW CUSTOMER RELATIONSHIPS

Apps are reshaping customer relationships by enabling companies to get closer to their customers, influence sales at the point of purchase, and extend the customer relationship over the lifetime of the product. This is improving customer service, sales, speed and convenience.

For example, flight attendants armed with tablets and a passenger app can look up passenger information, preferences and connecting gate information to better assist passengers and provide more personalized service. British Airways does this, and plans are in the works at American Airlines.\textsuperscript{53} Nordstrom is arming employees with mobile apps so they can check customers out anywhere in the store. This not only eliminates the bulky infrastructure of cash registers and the inconvenience of checkout lines but boosts sales because shoppers have less time to change their minds, and salespeople have access to the entire store inventory.\textsuperscript{54} If an item is out of stock, the salesperson can look for it at other stores and the online store and close the sale. Although Apple popularized mobile check-out years ago, the concept is still emerging with mainstay retailers, though gaining momentum.

Buying cars could be next. Apps for car dealers, like the app discussed in Apps Experience, would enable customers to buy cars from dealers online and have a life-long relationship with the dealer. Taking this a step further, why go to a dealer if you can buy a car online directly from the manufacturer? That is what Tesla proposes (though it faces a bevy of laws protecting car dealerships).\textsuperscript{55} Direct sales would create a new manufacturer–customer relationship and new efficiencies from being able to buy online and have the car delivered to your doorstep.

As people become increasingly mobile, many companies will take a “mobile first” or even a “mobile only” approach to how they reach customers. Not only is the customer always right; the customer is always mobile.

As people become increasingly mobile, many companies will take a “mobile first” or even a “mobile only” approach to how they reach customers. Not only is the customer always right; the customer is always mobile.

THE RUSH TO APIs

Enterprises are leveraging open and private APIs, enabling an ecosystem of developers to create apps that enhance or extend existing products, services or data sets. This is the API “gold rush,” a subtext to the apps economy.
This trend toward creating and supporting APIs and data sets for third-party developers would have been unthinkable just a few years ago, among high security concerns and “we can do it better” attitudes. Back then, what business in its right mind would allow anonymous developers to build on services or data linked to their brand?

However, an API strategy can lead to innovative apps that enhance a service at a pace far greater than most firms are capable of achieving. By using a model known as ILC (Innovate-Leverage-Commoditize), explored in past CSC Leading Edge Forum (LEF) research, firms can focus on their core product while enabling others to experiment, reducing the firm’s cost of experimentation. More importantly, by providing APIs, an organization is able to further spread and embed the use of its application, product or service across a wider ecosystem.

For example, by publishing its API, popular online music service Spotify has created an ecosystem of applications that integrate and embed Spotify’s services into alarm clocks, event guides and other apps. This broadens Spotify’s exposure and expands its customer base. Following the ILC model, over time Spotify can leverage these apps by commoditizing the best of them (through acquisition) in its core product. (See Figure 34.)

Even traditionally closed industries such as banking are now leveraging APIs and external developers to drive greater innovation in their products. Australia’s Commonwealth Bank has taken on a start-up mentality with its MyWealth Portal, creating an API to allow third-party developers to create new functionality for the bank’s customers. Similarly, ING Group has released its own APIs to encourage developers to create new retail banking applications, and to bring in fresh ideas from outside of the bank. This “outside-in” approach to innovation, defined by the LEF, is essential for success.

Furthermore, with the rise of open data initiatives, particularly in the public sector, APIs are being used to make it easier for government data to be leveraged in applications. With over 1 million data sets already released by governments and agencies around the world, groups such as Fed {API} are creating catalogs of captured and correlated public data that can be easily accessed and integrated.

The use of APIs, open or private, does not have to equate to new and greater risks around core intellectual property (IP).

The use of APIs, open or private, does not have to equate to new and greater risks around core intellectual property.

Take, for example, Netflix. Its IP is content, how it stores and streams content, and its business model. Netflix doesn’t want
to be in the business of developing apps that integrate its service with every possible device or provider in the market. Instead, Netflix exposed its API to enable other developers to build these apps. Netflix’s API strategy enhanced the value of its IP, which remains protected.

The relationship between the API provider and developer can change over time, and developers need to be aware of this. Netflix’s open API program ended in March 2013. Developers using Twitter’s API have faced increasing restrictions as the company attempts to gain more control of its audience; its impending IPO could tighten the reins further.\(^{62}\) If free API providers like Netflix and Twitter decide to stop offering their service, and there is no pre-existing agreement protecting the developer, then developers are left to manage any problems with their apps on their own.

The rush to APIs is being driven by a range of free, paid and revenue-sharing business models. As apps and revenues flourish, there is no doubt why API management products have been at the center of an acquisition spree, with Intel buying Mashery, CA Technologies purchasing Layer 7, and MuleSoft acquiring ProgrammableWeb — all in the span of a few weeks.\(^{63}\)

**DECADE OF THE DEVELOPER**

Given the app frenzy, developers are in high demand. At the same time, barriers to entry have fallen, making it easier for people to create — and profit from — apps. With Apple paying over $10 billion to developers, $5 billion of that in the last year,\(^{64}\) third-party developers from around the world are coming out of the woodwork. This includes the next generation of developers — even 12-year-olds\(^{65}\) — who will grow up developing apps for connected cars, homes or machines. These developers are at the center of the apps ecosystem — strengthening it, attracting others to it and generating greater levels of investment. This is the decade of the developer.

Enterprise IT’s previous role of “keeping the lights on” and maintaining stability is quite different from the new requirement of application-driven growth. Enterprise IT has a unique opportunity to reposition itself at the front of the firm, driving growth in new and existing markets and driving greater levels of customer intimacy.

Unfortunately for developers, a new skills bar has been set. Getting an app running is no longer the only challenge; apps must be resilient, scalable, secure, integrated, visually appealing and, most of all, adaptable. This requires collaboration with designers, an understanding of development across the multi-dimensional stack and the know-how to select the right approach (i.e., architecture, language, toolset). The best developers will have a creative flair and the ability to think like a start-up and take calculated risks. The challenge is that these developers are a scarce resource, often not working in enterprises but instead working independently on their own ventures, uninterested in the corporate life. Luckily, there are approaches to entice these developers without writing blank checks.

**Draw Them In.** Create an opportunity for your product or service to be easily leveraged by developers for their success. This could be via an open API to your service or data (discussed earlier), an event or special funding.

Events such as hackathons or competitions allow organizations to create awareness and focus a community of developers for a short amount of time on a particular product or service. (See Figure 35.) For example, in June 2013 the White House ran an event called “National Day of Civic Hacking at the White House,” with the goal of...
getting citizen developers to generate visualization tools and apps that “unlock government data.” Others events, like Photo Hack Day, brought together developers who had an interest in building apps using photo APIs. The event featured a range of API providers including Walgreens, Getty Images, Fujifilm and Facebook, each offering different prizes for development using their API.

Another way to attract developers to your ecosystem is to set up special funding. For example, Box.net created a $2 million fund and Salesforce.com launched a $6 million fund to support the growth of start-ups building enterprise applications on their respective platforms. The Singapore government subsidizes mobile apps (and other development) by Singapore-based companies through a Productivity and Innovation Credit.

Capturing developer mind share is imperative not only for API providers but device, operating system, platform and development language providers, who leverage these strategies and more to aggressively target developers. Many developers stick with the technology they are familiar with for their entire career, making early education and promotion critical.

**Coding Becomes Common.** The fierce competition for developers may start to lessen when DIY tools simplify and DIY coding starts to take hold. Through organizations such as Codecademy, a start-up aiming to teach the world to code, more individuals will gain exposure to development. One day, coding may become as common as word processing.

To be clear, we do not expect all of society (including enterprises) to be filled with developers, just like studying math doesn’t make everyone a mathematician. However, exposure will reduce the mystery and fear of coding, creating more developers and increasing the adoption of DIY development platforms. It could even result in more non-developers gaining the confidence and expertise to manage the technical resources required to successfully launch an app. You may not be able to create an app yourself, but you can oversee others to do it.

**GOLDEN OPPORTUNITY**

The reshaped experience, explosion of apps everywhere, and dramatic changes in app design and development have ushered in a new apps economy. Industries are blurring, driving deeper coordination between people, things, business and society.

Enterprise IT has a golden opportunity to lead the apps economy. However, this requires different thinking (outside-in) and strong relationships with business peers (still a challenge in many firms). Enterprise IT can lead the enterprise to a “mobile first” or even a “mobile only” strategy, but must know when to champion APIs and how to attract developers to build apps leveraging these capabilities. Finally, enterprises can turn what was once seen as a “shadow IT” problem into a competitive advantage by fostering and cultivating a DIY culture for their firm.

The Apps rEvolution is not just about apps. It is about business change: creating new experiences, inventing new products and services, redefining customer service, and improving productivity and efficiency. It is about building new and better ways of using modern technologies, and about applying IT to entirely new realms. The speed, simplicity and appeal of the app experience may have started as smartphone and consumer phenomena, but this is now the model for how information systems will be built and used in the future. The digital economy is no longer just out there on the web; it is literally in the palm of your hand.
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Erika is the recipient of two CSC grants: “A Lifecycle Model for Developing, Testing and Delivering Mobile Apps in an Enterprise” and “Reference Implementation and Architecture for Cloud Lifecycle Management.” A paper she co-authored on “Enterprise Service Delivery in a Mobility-Enabled Ecosystem: A New Paradigm for Delivering and Consuming IT Services” received a CSC Papers honorable mention in 2013. eolimpiew@csc.com

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