



A First-Class Digital Customer Journey with REST Services

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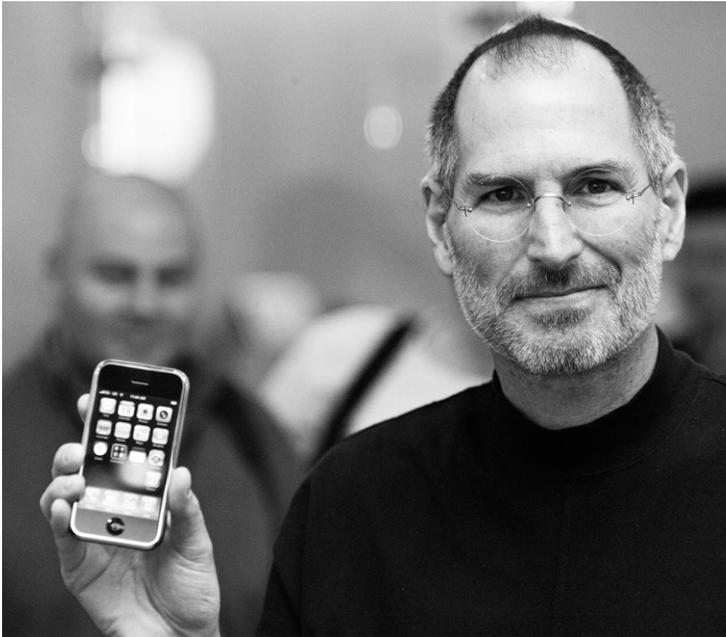
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1. Introduction



iPhone's dead-simple usability put computing and the internet into the pockets of a whole new audience, including technophobes, senior citizens and kids: In 2016, phones outsold PCs by a factor of 1,000.

iPhone's contributions are many: User Experience, Touch, Apps, Mobile Photography... all made possible because Apple carefully and painstakingly integrated hardware, sensors, software and design together to deliver such a groundbreaking product.

But one of iPhone's most profound areas of impact is how it has redefined consumers' expectations in term of App user experience. Reaching that level of quality, necessary for an App to be successful, requires a very close collaboration between product managers and designers and front-end and back-end developers. It requires taking great care in integrating, with the tightest tolerances, a large number of software parts, from different origins and vendors, from front to back.

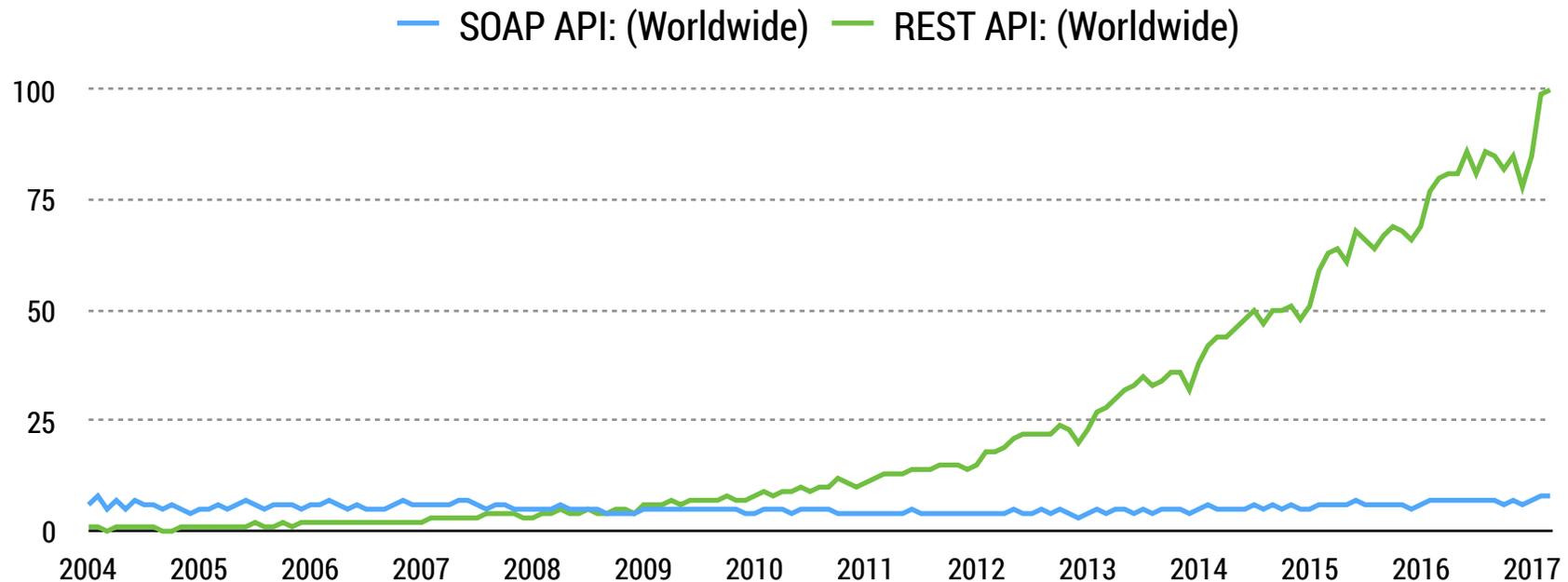
Intended for technology and business stakeholders, this white paper addresses the challenges in building mobile applications using REST services while delivering the experience customers expect, as well as how using Kaazing's REST Accelerator and Montage Studio together simplifies the creation of universal Apps that offers a first-class user experience.

2. REST Services

REST Dominates the API Economy

As the web industry matured, it moved on from monolithic application servers that generate HTML markup combined with data to a clearer separation of roles, with services that abstract proprietary database connections to directly expose data via HTTP. This service-oriented architecture initially adopted the XML-based SOAP (Simple Object Access Protocol) protocol, but is now dominated by the REST protocol.

REST Interest Over Time



As the mobile devices market surpassed the size of the PC market, fueled by the mobile App revolution, the demand for access to data through APIs exploded, accelerating the adoption of REST and supporting the growth of what is now known as the API economy – an enabler for organizations to turn their business into a platform. By allowing business ecosystems, inside and outside of the enterprise, to exchange valuable, differentiated data, APIs multiply value creation and facilitate the creation of new user experiences, exchange of goods, services and value-added information so that all participants are able to capture value.

REST being very close to HTTP, the standard behind the web, makes it easy to understand and learn, both for developers who consume REST APIs, and those who implement REST services. Every server-side programming language offers a variety of open-source and commercial frameworks to implement REST services. Similarly on the client-side, because REST is a thin layer on top of the HTTP protocol, every SDK, whether native or web, can consume REST APIs out of the box. The content returned by REST services is mostly using the JSON format (JavaScript Object Notation), which is native to the JavaScript language used for Web client applications, making it a lot easier to developers than the XML format used by SOAP services. REST services are also designed to be stateless which means, which means they can be scaled with standard web techniques, like caching for example.

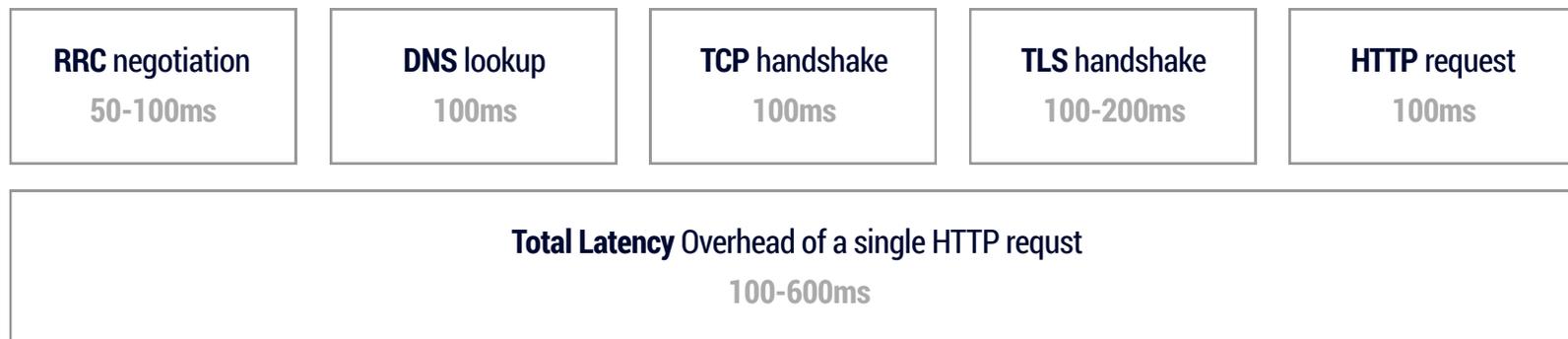
REST services are designed to scale to a large number of users, to use the least amount of computing resources possible and to be fault tolerant, and are judged by these criteria, from the moment a request is received to the moment a response is returned. But an end-user's App experience is one of the whole system, and because client applications and server-side services are built by different teams, with very different skill sets, what happens between the client and the server may not be as carefully analyzed and optimized as it could.

REST Challenges for Mobile Clients

REST services, as part of a system designed to engage and retain customers, need also to be evaluated from a client-side angle, for the quality of experience actually delivered to a client App user, which poses a set of challenges for Mobile clients:

- **Impact on mobile user experience:** As users traverse relationships between different types of data using an application, many small individual requests are sent to REST services to obtain such data. Even on wired connections, many small HTTP requests will lead to slower response time, but this problem is exacerbated on mobile networks that have much higher latencies, less throughput, congestions, and spotty coverage. All these factors compound to significantly degrades the speed at which data flows between a mobile client application and REST services, deteriorating the user experience. The richer and more featured an application is, the bigger the problem becomes, increasing the risk of losing users.

Timing of a “simple” HTTP request’s components on a 4G network



- **Polling side effects are worse on Mobile:** In REST, in order to get data, a client application has to ask for it, and that simplicity is what helped make REST a success. But the data returned is a snapshot in time – not a continuous stream of possible changes that may happen over time. Today more and more systems have interconnected models where data is consumed and created by many users, with high rates of change. The solution for REST to show accurate data to application users is known as polling: at a regular interval, the client will reiterate the same REST request over and over in hope of catching a possible change. But this approach has significant issues:
 - It increases bandwidth usage and cost to users
 - it increases the load on REST servers.
 - It reduces device battery life, without guaranteeing new data
- **Creating rich client applications with REST is a lot of work:** Because REST is a low level API close to HTTP, it leaves a lot of work to be done by developers to organize how data will flow in each application, from the network up to the user interface and back when changes happen. This is often addressed by choosing open source or commercial third party supplemental solutions, but it is rare to find comprehensive solutions that address the problem end-to-end, leaving the developer distracted from focusing on the mission of the application and the business purpose it serves.

REST Services serve Mobile App Users

In today's API economy, REST is ubiquitous and the preferred choice to implement custom, internal APIs, as well as the most likely form of external API that architects and developers will consume from existing vendors and partners over the web. However as phones and tablets are becoming consumers' primary computing devices for many activities, the REST architecture is facing challenges to adapt to this changing environment and keep consumers engaged with a superior user experience they now demand, on all the devices they use.

3. A First-Class Digital Customer Journey

What makes a first-class/superior user experience?

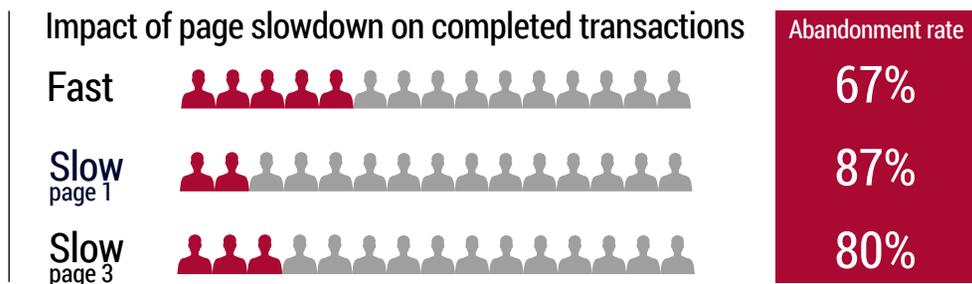
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In general, simplicity leads to a great user experience. Anything that adds friction is a distraction from what a user want to do. If a user is waiting for data, doesn't like colors being used in an App or struggles to understand how to do something, it's not a great user experience. Let's look at some critical aspects that contribute to create a superior user experience:

1. No Waiting

Users/ attention spans are short and regardless of their the level of interest, people don't have the patience to wait. Responding quickly to a user's interactions is critical, from the very beginning and throughout a session. When a user's input doesn't trigger an instant feedback, animations are necessary to help a user understand an App is acting on input, like fetching data from a REST service. But the best loading animation is the one you won't see. If it's visible for too long, users will still leave.

Making each page just 2 seconds faster resulted in more than double the number of completed transactions. it's not enough to lure shoppers in with a speedy first page. Slowing down the third page – for shoppers who are at the halfway point of a transaction – caused the bounce rate to jump from 67% to 80%.¹



2. Intuitive Interaction

Users expect to use an App without having to read a manual. Interaction has to be intuitive with a user knowing what to do in a split second and without “thinking” about it. Any amount of user thinking or hesitation, shows a problem in the user interface, insufficient guiding, product feature definition, or understanding of the user. Using an App has to feel natural, instinctive, to the point that things you want to do fall under your fingers without thinking.

3. Aesthetics

Users are not designers and most people don't analyze an App experience, –they simply experience it, and their impressions are based on emotional connections that form as an App is used. The visual and interaction design of an App can have a huge impact on users' emotions. A sophisticated visual design will convey the attention the company paid to an App and by extension how much it cares about its customers. A consistent color scheme with the company's branding will reinforce it. Consumer Apps tend to use lighter and brighter colors, while darker color schemes are frequently used for professional-grade tools. Subtle animations, like Apple's “Genie Effect” help users understand where minimized windows go, sounds, like the one played when the Mac OS X trash can is emptied –and features like these, can go a long way in reinforcing a user's sense of control and comfort.

4. Consistency

Every new App requires some amount of discovery and learning, but the more consistent, the more predictable an App is, throughout the use of its different features, the faster it will become comfortable for users. This will contribute to creating perception of “ease of use”, and will keep users engaged and coming back. An App is just one channel of communication between one user and one organization, and the number of digital communication channels is growing. It is therefore extremely important, for the same reasons, to offer users a consistent user experience across all these channels available on a variety of devices and platforms: web sites, mobile and wearable Apps, social media and even emails. This is extremely difficult to achieve when so many disparate technologies and vendors are used across channels and an alternative is proposed later in this document

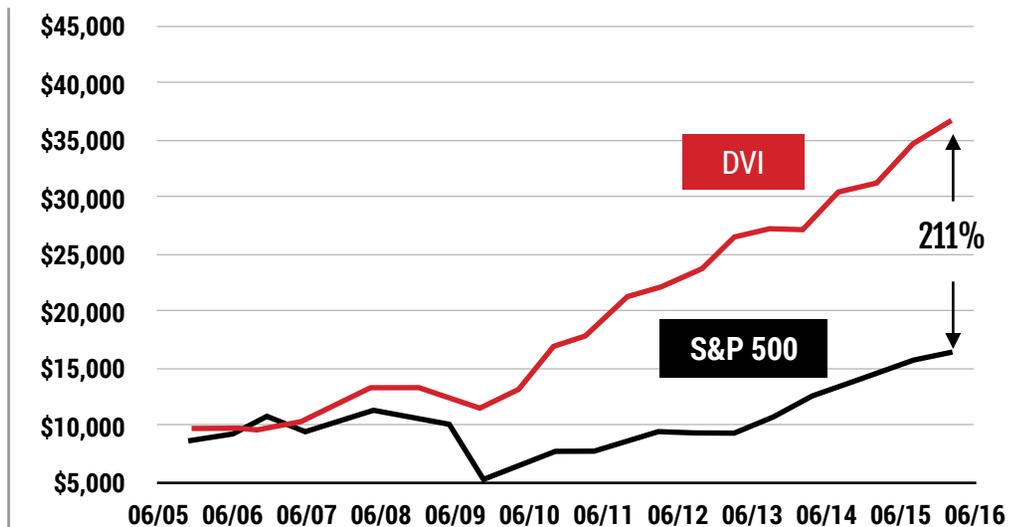
It's All About User Experience

The high quality user experience offered by iPhone has set the standard and people won't adopt nor use products that don't meet such expectations. A study from the Design Management Institute established that companies that invest in design and user experience are rewarded by both their customers and higher market valuations. Companies that don't are at risk of losing ground or becoming irrelevant. Apple, NETFLIX and Starbucks are clear User Experience leaders, while Nokia, Blackberry and Microsoft were all severely disrupted by Apple's iPhone focus on ease of use.

Depending on industry, it can cost anywhere from 5 to 25 times more to attract new customers than it does to keep existing users. It's in a company's best interests to develop apps that promote habitual use—it's not only more effective from a business standpoint, it provides an opportunity to learn about users and improve the way to engage with them.

DESIGN-DRIVEN COMPANIES OUTPERFORM S&P 500 by 211%²

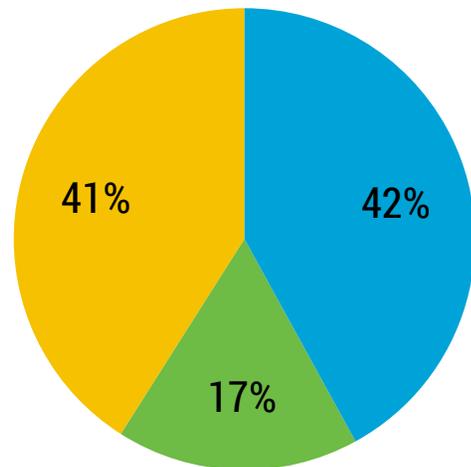
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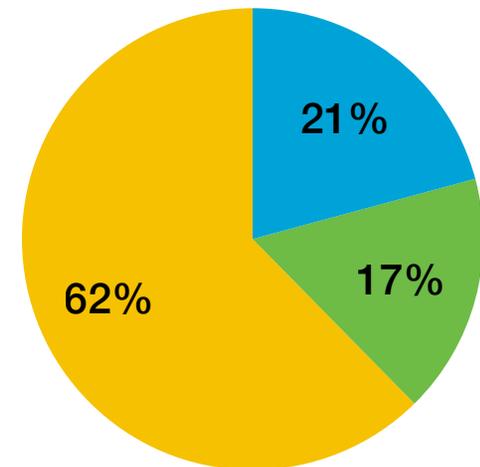
The Omnichannel Digital Customer

As smartphones became more prevalent in consumers' lives, companies began to focus on developing mobile first strategies. But as smartphone adoption matures, a different picture emerges: the real experience people want today is the ability to engage in the same activities on an increasing diversity of computing devices/screens at their disposal: PCs, which are still very much used, tablets, phones and wearables. Such expectations define what is now known as Omnichannel Consumers, leading marketers to rethink their engagement strategies. New research from the second half of 2016 confirms this picture: marketers need to stop thinking of 'mobile users' and 'desktop users' as different people – they're not. A 'mobile user' one minute is a 'desktop user' the next, and the distinction is entirely artificial. A failure to engage, or a poor user experience, on any of these digital channels, put the conversion at risk. The focus has to be on delivering a seamless experience across devices.

Customers Use Multiple Devices from intent to Purchase



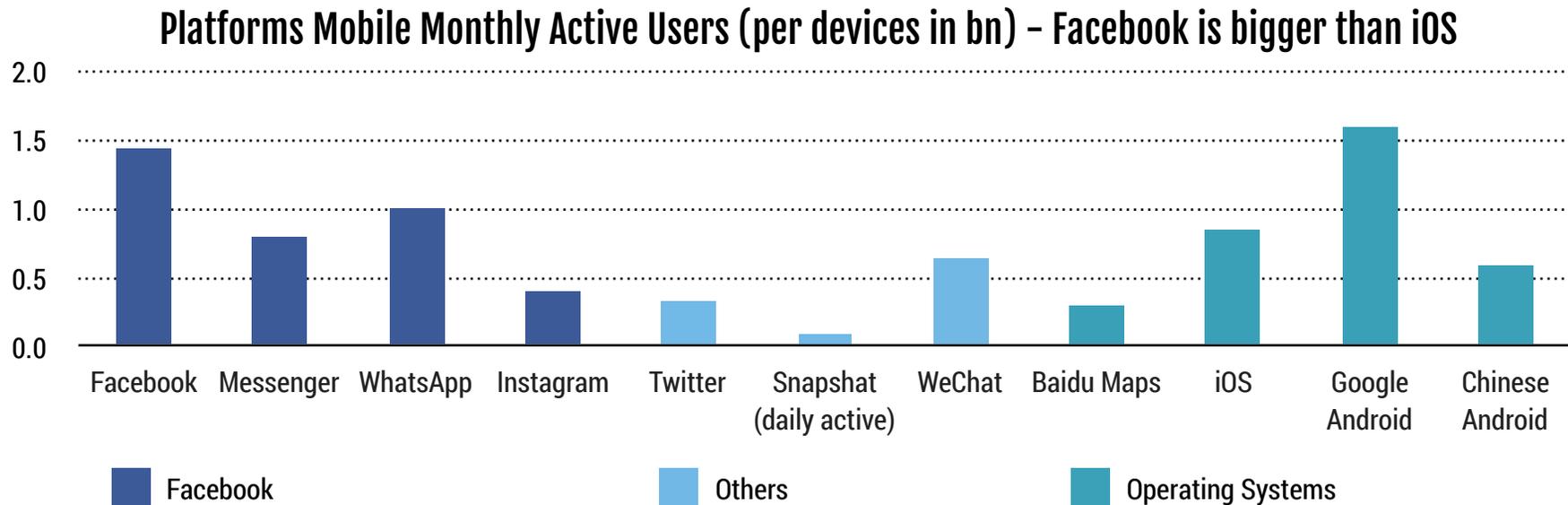
Sessions by Device



Revenues by Device

Innovate by Engaging People with Apps on Social Media

For companies to reach and engage new customers, it is critical to be able to reach people where they are, which is increasingly on social platforms like Facebook, Twitter or WeChat. The time people spend on Facebook is such that it has more monthly active users than the whole iOS platform. While social media platforms offer advertising for native Apps, inviting users to leave the current application to go download another App from Apple or Google App stores won't yield impressive results. Instead companies can engage users with a real App experience instantly, on the spot, without leaving Facebook, using HTML5 . WeChat, the largest HTML5-based platform after the web itself, launched Mini Programs in January 2017 to offer that exact experience. But thanks to the ubiquity of HTML5 and exiting Facebook and Twitter APIs, nothing could stop a company from offering Facebook in-app that would, as long as they offer a great user experience, significantly increase engagement and conversion rates.



Real-Time Expectations

The combination of high speed connectivity, mobile computing and social media has forever reshaped people's expectations regarding access to information. Whether it's someone streaming a live video feed from their cell phone to the world on social media, with the ability to reach and be reached at any time pretty much anywhere, by text, audio, video, or through a notification, people expect to know instantly when something important happens. However, living up to such expectations at scale presents significant technical challenges, especially when using existing systems that may not have been designed for real-time requirements.

Stale Software is Boring Software

To stay engaged, consumers expect a constant evolution of features, usability and visual design:

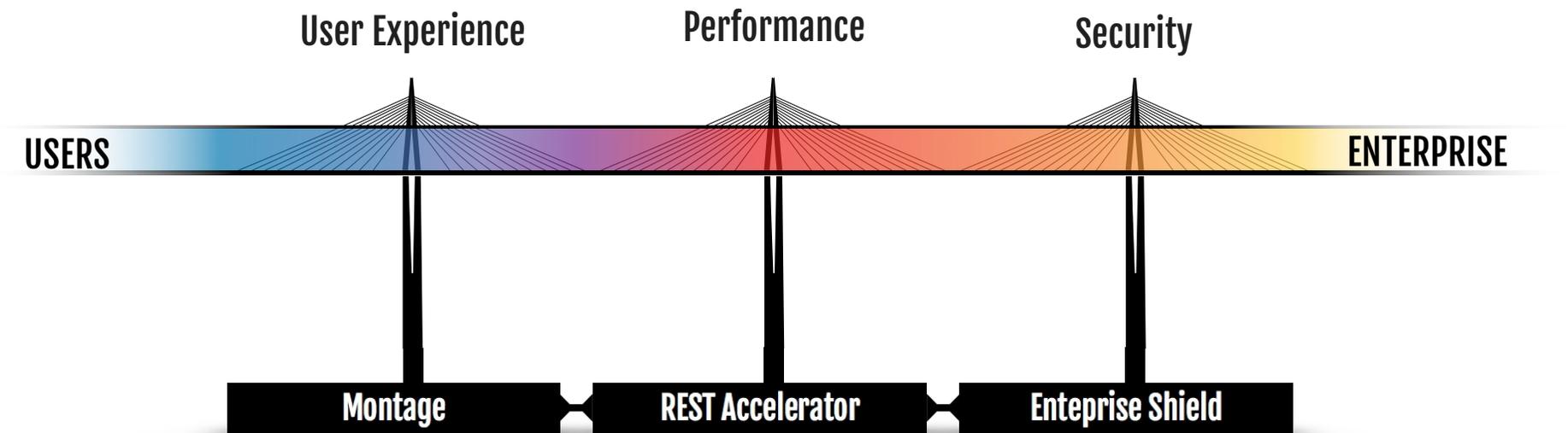
- The internet generation is used to the speed of the web and continuous changes
- Such expectations have been driven by companies like Facebook, Amazon, and Netflix who constantly update, refine, and evolve their user experience to increase engagement
- Other aspects of people's lives, like music or fashion, are continuously changing
- This means that application development time and cost has to align to deliver on such expectations. If a company can't deliver, and a competitor does, it will lose customers.

Integration is Key to Deliver on User Experience

Too often, client-side applications and back-end services are created independently, with different technologies, leaving application developers with the responsibility to integrate disparate technologies, while they are still trying to develop the final solution targeted to the customer. These efforts commonly impact the deliverable itself, in term of time to market, cost, and polish of the finalized version of the solution.

4. Kaazing Comprehensive App Solution

With a clear focus on delivering a user experience that delight users on any screen: high performance data delivery that keep users engaged and the ability to integrate with, and deliver data from existing Enterprise systems and services, Kaazing offers a unique, integrated, standards-based App solution that bridges existing enterprise systems and services to deliver future-proof applications to mobile clients.



REST Accelerator

Kaazing REST Accelerator is a cloud service that addresses REST challenges with mobile data loading speed and freshness:

- By reducing the time it takes to load data following a user interaction, an App user experience is dramatically improved, increasing engagement
- By replacing inefficient data polling by data pushing, network bandwidth and server load are further reduced, and more importantly, data can be updated in real-time as needed.

The REST Accelerator is designed to operate between client Apps and enterprise REST services, without requiring changes to existing infrastructure, as a drop-in “widget”. The Accelerator’s extensible architecture allows it to connect to other sources of data, such as message bus or micro-services, and integrates with different types of authorization and authentication schemes.

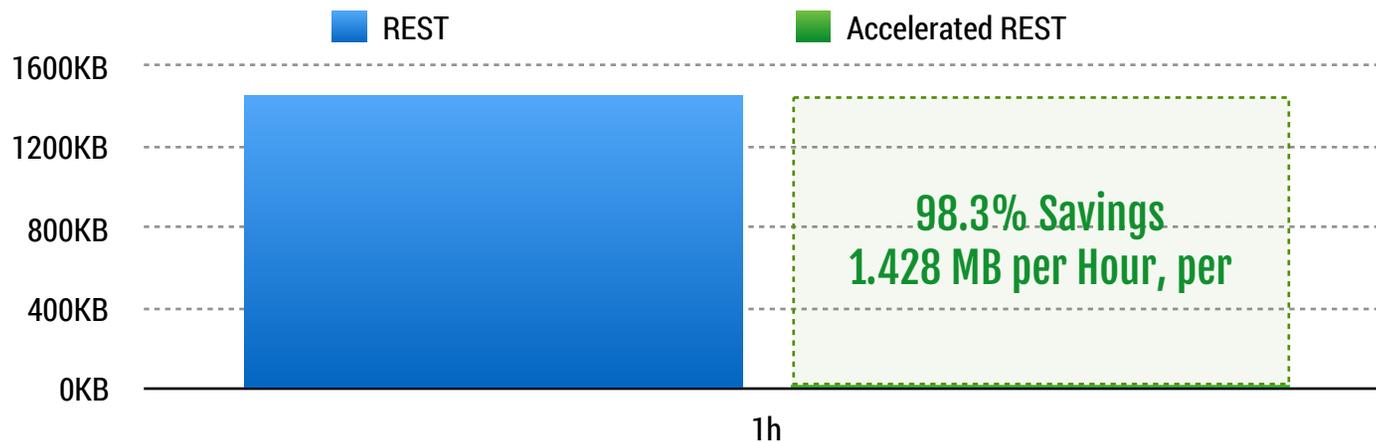


Kaazing REST Accelerator Delivers Data for a First-Class User Experience

Accelerates REST Data Load Time on Mobile and Reduces Per-User Bandwidth Costs

Leveraging Kaazing's class-leading expertise in scaling WebSockets, the REST Accelerator transparently transports HTTP requests coming from a client application over WebSocket, removing the performance degrading side effects of many HTTP request-cumulated latencies. The direct benefits are a better user experience for mobile Apps, with data following user interaction at a much higher rate, and a lower bandwidth usage and costs on end users' data plan.

Per-User Network Efficiency: 1 User Polling REST Server at 5s intervals



Each request (headers) is 1KB, Each response (headers) is 1KB, Each response (body) is 2K when updated, or 0K when unchanged. Changes occur every 10mins.

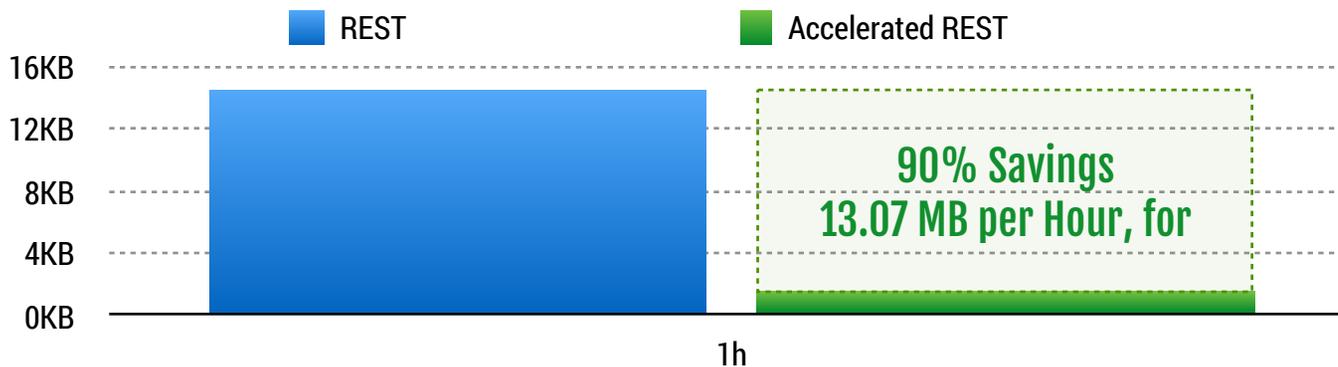
Removes the Negative Side Effects of Polling

When a user expects data in an application to update regularly, the only solution is to poll for updates since the REST architecture wasn't designed for real-time push of data. A key feature of Kaazing's REST Accelerator is its ability to automatically convert HTTP polling requests behavior from an application to a server push over WebSocket. Instead of mobile client application constantly polling REST services, which increases bandwidth use and decreases battery life, the Accelerator polls existing REST services, server to server, where high bandwidth network connections have near-zero latencies.

This polling from the Accelerator can be done once on behalf of many end-users when a consistent security profile allows sharing, which directly improves the load on REST servers resources. When changes are detected from the last known state sent to clients, changes are pushed to the right client applications, eventually ahead of a polling cycle, effectively transforming REST services into real-time services.

As the number of users of a REST service increases, so do server side savings in bandwidth and server load costs.

Server-side Load: 10 Users Concurrently Polling REST Server at 5s intervals



10 users with a consistent security profile, Each request (headers) is 1KB, Each response (headers) is 1KB, Each response (body) is 2K when updated, or 0K when unchanged. Changes occur every 10mins.

New Opportunities Open with Real-Time Push Capabilities to Users

As the number of services available to consumers grows it is critical to differentiate. Most applications today are entirely user driven and a lot of work is done through push notifications and emails to bring users back into Apps. Why not instead keep them in Apps longer while they are actually using it, and change the monologue into a conversation? With push capabilities, a company has the opportunity to proactively propose to a user something relevant, intriguing and uncalled for, and see how a user responds. Millennials, for examples, want to know the brand they're buying from and feel that the brand knows them, so push is a great opportunity to build this relationship. Push also open the doors to explore variable rewards and Fear Of Missing Out (FOMO) which are known to be drivers of user engagement.

Slot machines are so addictive because they give intermittent variable rewards, and social networks are addictive for the same reason. Pokemon Go uses the same reward model. Clearly, variable rewards are one of the most powerful tools to 'hook' users. Research shows that our "feel good" hormone, dopamine, surges when the brain anticipates a reward. Introducing variability multiplies the effect, creating a hunting state that activates the parts of the brain associated with want and desire.

Coined in 1996 by Dan Herman, "FOMO", describes the psychological stress induced when one feels excluded from something enjoyable that others are experiencing. Pushing users' informations relative to what others users may be doing with live streaming, pushing exclusives or limited flash sales offers, creates a sense of urgency, taking advantage of FOMO and getting users to engage.

Any information brought to a user's attention while in-App is more likely to be acted upon than when a user is interrupted by a push notification doing something else.



Summary

The Kaazing REST Accelerator augments the capabilities and performance of REST services, without requiring changes to such services. This solution benefits both mobile Apps users as well as REST data providers.

The first benefit to mobile users is a significantly improved in-app data refresh rate. As users interact with an application, navigating lists, the interface refreshes in sync with their interactions, without the lags so many users typically see in data-driven applications. Not only is data loaded faster, it can be pushed in real-time by the Accelerator to connected client applications that will present it instantly to users. These major improvements bring two other benefits: lower bandwidth usage on a user's carrier data plans, and improved mobile device battery life.

The most important benefit for data and application providers is increased user satisfaction, which drives engagement, loyalty and ultimately revenues. But there are also significant savings in terms of bandwidth and server resources costs, savings that scale with the number of users.

The Montage Universal App Platform

The Customer Experience People Want

The high quality user experience offered by iPhone has set the standard and people won't adopt or use products that are not well designed and intuitive to use. These expectations apply to any digital experience on the devices used by most people today, phone, PC and tablet. But more importantly, people expect to perform the same activity, use the same application, consume the same media on any of their devices, and at different time during the day. And the companies that invest to offer this seamless experience to their customers will win people over from companies that don't.



The First-Class Customer Digital Journey –Any Screen, Any Time

The Mission-Critical App Platform Enterprise Needs

Creating one high quality App is already difficult, and the approach to creating an iOS, an Android and a web App is not only expensive, but extremely difficult to sustain over time, and out of reach for most companies. Plus, it still doesn't deliver the ultimate first-class experience: the same, familiar, experience on any screen. Thanks to open source web engines, the HTML5 platform is available on virtually every device on the market, continuously supported and improved by device/OS vendors. HTML5 has won distribution. But web standards were created for documents, not for Apps. An additional layer of software is needed to help build Apps with web standards, but unfortunately neither vendors nor a continuously changing scene of open source JavaScript framework have managed to make HTML5 a competitive alternative to the decade-tested App platforms from Microsoft and Apple when it comes to developing mission-critical applications. What enterprises needs is a standards-based App platform that delivers the user experience people demand, with faster and less expensive development times.



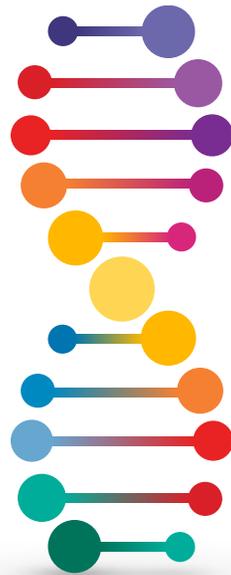
Open Source Frameworks are Not Products –Enterprise Projects cannot be Guinea Pigs

The Montage HTML5 Universal App Platform

The Montage Platform was born and open-sourced at Motorola Mobility, out of a vision first experimented with at Apple, to infuse App genes from the market-proven Apple Cocoa SDK into HTML5 and to turn the web into the most sophisticated App platform ever built. The strength of Native SDKs meets the ubiquity of the web.

The Montage Platform has two clear goals:

1. Delight users with Apps that rivals the native experience and surpass it in terms of distribution
2. Create Apps faster and cheaper with a platform designed from the ground up to maximize the development team's productivity



Montage Bring Apple App Genes to HTML5 –First-Class User Experience at Web Scale

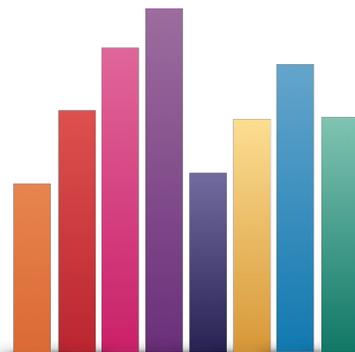
Montage HTML5 Framework

Montage is an elegant, comprehensive solution that simplifies the development of sophisticated, consumer-grade applications. It brings to HTML5 key engineering design patterns from Apple's App SDK that have successfully helped built millions of Apps over the past 25 years, on desktop, mobile and wearables.

- Montage Components are inspired by Apple's WebObjects WOComponents. They encapsulate in a folder all resources needed, opening the door to building large scale applications faster, with more people, that are maintainable.
- Montage Templates are valid HTML5 documents, using web standards separation of concerns to improve software quality, maximize reuse of web developers' know-how, and finally offering a workflow that optimizes the team's output throughout a project
- Montage's Draw Loop automatically maximizes an App's frame rate on any device, guaranteeing responsive Apps and the best user experience possible on diverse device's capabilities.



Templates



Draw Loop



Components

Montage Data

Montage Data extends to data management the Montage mission to make complex problems simpler. Most applications today needs data coming from one or more internal or external API providers, most of the time REST services. Quickly developing quickly a complex application that needs to integrate disparate data structures, authentication and network dependencies, while focusing on performance and delivering a great user experience across many type of devices, represents significant challenges.

Inspired by Apple's powerful yet simple Object-Relational Mapping (ORM) framework, Montage Data offers developers an object-oriented, set of API's that unify and simplify how an application creates, reads, updates and deletes data. The application data model aggregates data from many distinct endpoint REST services, simplifying the navigation through relationships between different types of objects.

The close integration between Montage UI Components, Montage Data and the REST Accelerator allows the kind of an end-to-end, user-driven optimization that is needed to deliver the kind of user experience people demand.

Montage Studio

An App platform can't just offer quality frameworks, it has to go further to accelerate the development of common use cases, and facilitate iterations with visual tools. It is especially true when it comes to developing the user experience.

One problem that has plagued App development is the digital disconnect between designers' tools and App software platforms. They live in two parallel universes that require a lot of time, effort and money to bring together, in each project, again and again.

We designed Montage Studio to serve all talents creating Apps, not just developers, and to radically improve how they work with each other. By interactively composing Apps with massive reuse vs coding from scratch, and by solving the time and energy wasted, because designers can't design in the final medium and iterate with developers, we're rewriting the rules of App development, at the scale of the web.

Montage Market Adoption

The Montage platform has been chosen by commercial companies and public-sector entities, across diverse verticals, with a common desire: offering their customers the same delightful, intuitive and future-proof user experience on any device they may choose to use. Montage Apps have been presented by executives at CES and NASDAQ and have won multiple awards.



5. Summary

We live in a hyper-connected, data-driven and experience-first world. Technology is evolving rapidly, leading to accelerating changes in consumer behaviors. More than ever to stay competitive, companies need the ability to be highly efficient in order to innovate and adapt to a continuously changing environment, in a market where competition and customers are global.

Kaazing's App Solution components are built on standards and proven engineering solutions. The Montage platform and the REST Accelerator can be used independently and integrated with other vendors or home-grown solutions. But used together, they offer a comprehensive, integrated solution for companies to engage millions of simultaneous connected users. The superior, future-proof user experience made possible by the Montage HTML5 Platform, and further improved with the REST Accelerator, helps companies focus on their mission.

With the ability to continuously and efficiently improve consumer-grade universal Apps, rather than spending time on one-off, custom technical solutions, companies can engage users on any screen, within social media platforms, and at the moment of interest, turning any screen moment into an invaluable brand interaction.

References

1. [Case Study: How a 2-Second Improvement in Page Load Time More Than Doubled Conversions](#)
2. [2015 dmi:Design Value Index Results and Commentary](#)



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