

Understanding Alphabet and Google, 2017

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Google's size, market differentiation, rapid pace of innovation and ambitions can complicate fully understanding the vendor and its fit to current digital business needs. CIOs and IT leaders can use this report to explore in detail selected topics from the Gartner Vendor Rating.

Key Findings

- Two outcomes are apparent more than a year after the creation of the Alphabet-Google structure: Google is beginning to show increased momentum and has made significant investments in its enterprise offerings (most of its 2016 acquisitions were focused on this); and it is applying more discipline in Alphabet's "Other Bets."
- Google is flourishing despite challenging external market factors: adverse publicity, competitors, government regulators and law enforcement.
- Google values data, encourages bold investments in long-term horizons, pivots plans based on results in near real time, and reveres user-oriented engineering excellence.
- Google is fully committed to 100% cloud-based and web-scale infrastructure, massive scaling, the maximum rate of change, and stream-lined business processes for itself and its customers.

Recommendations

CIOs and IT leaders managing vendor risk and performance should:

- Plan for a long-term strategic relationship with Google based on an assumption that "what you see is what you get." Major vendor changes to core culture and fundamental operating principles in response to customer requests usually come slowly, if at all.
- Determine if your culture supports rapid innovation to the degree that will make Google attractive.
- Reduce the tendency to optimize around a single service or technology provider. Decision making should prioritize enterprise and employee needs over IT organization needs.

- Engage and shepherd business leaders to take ownership of the Google relationship, while providing strategic IT perspective and technology assessment (a technique called "leading from behind").

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Analysis

How to Use This Research

This research provides IT leaders with additional analysis of Google's offerings and actions, opportunities and challenges. It follows, in general, the structure of the Gartner 2016 "Vendor Rating: Google" report. Here we selectively drill down into the Vendor Rating's more summary-level topic treatments. Readers can use this more in-depth note to further explore selected topics, such as Google's augmented reality/virtual reality (AR/VR) technology or the evolution of its cloud platform.

This note has two main sections: corporate viability and market offerings (see Table 1).

Table 1. Contents

Section	Service/Technology	Profile
Corporate Viability		
<i>Overview</i>		
<i>Financial</i>		
<i>Marketing</i>		
Market Offerings		
<i>Product/Service</i>	Marketing and Advertising Services	Google Advertising
		Google Analytics 360 Suite
	Developer and IT Services	Application Services
		Google Cloud Platform
		Machine Learning
	Consumer Devices	Android for Consumers
		Android Pay
		AR/VR
		Chromebase
		Chromebit
		Chromebook
		Chromecast
	Enterprise Devices	Android for Enterprise
		Chromebook for Enterprise
		Chromebox
		Internet of Things
	Consumer Apps and Services	Apps
		Identity and Privacy Services

Section	Service/Technology	Profile
	Enterprise Applications and Services	Search
		G Suite
		G Suite: Digital Workplace Perspective
		G Suite: Midsize Enterprise Market Perspective
		UCaaS
<i>Technology</i>	AR/VR	
	Communication Initiatives	Wireless: Project Loon, Project Fi and Google Wi-Fi
		Wireline: Google Fibre
	Data Center Technologies	
	Emerging and Future Technologies	
	Google and the Web	
	Robotics	
	Security	
AV/VR = augmented reality/virtual reality; UCaaS = unified communications as a service		

Source: Gartner (February 2017)

Note: The Table of Contents located along the left sidebar can be used for navigation.

1. Corporate Viability

1.1. Overview: Google Goes Alphabet

Analysis by Tom Austin

In August 2015, Google founders Larry Page and Sergey Brin announced the creation of a new management and governance structure. They created Alphabet, an umbrella company headed by Page as CEO and Brin as president. The company has two main arms:

- *Google* — The bulk of Alphabet's business; headed by CEO Sundar Pichai
- *Other Bets* — Contains a variety of projects that could evolve into stand-alone businesses over the long run (e.g., Google Fiber, Calico, Nest, Verily, GV, CapitalG and X)

The Alphabet structure (see Table 2 below) provides greater transparency and accountability into Google's various businesses. Google and its investors can now track more easily the trends, successes, failures, investments, costs and revenue for each endeavor. Google will be able to more quickly make adjustments to business models as needed, or exit poorly performing businesses that do not fit into the strategic vision.

Table 2. How Alphabet's Structure Splits the Vendor's Businesses and Priorities

Google	Alphabet's Other Bets
Ads	Access/Google Fiber — Communications initiatives
Android	Calico — Biotech to combat aging
Analytics 360 Suite	CapitalG (formerly Google Capital) — Growth equity investment fund
Chrome	DeepMind — AI platform
Commerce	GV (formerly Google Ventures) — Venture capital investment
Domains	Jigsaw — Technology to counter global security threats
G Suite (formerly Google Apps)	Nest — Home automation systems
Google Cloud Platform	Sidewalk Labs — Technology to improve urban infrastructure
Google Cloud Search	Verily (formerly Google Life Sciences) — Focuses on the study of life sciences
Hardware (Cast, Chromebook, Nexus/Pixel, VR)	Waymo — Autonomous vehicles
Maps	X (formerly Google X) — Creates "moonshot" technologies to "make the world a radically better place"
Play	
YouTube	

Source: Gartner (February 2017)

While these changes are important, the real significance of the new structure is that it reveals the positive forward path that the two founders are pursuing:

- **Page and Brin are trying to launch a second big winner.** This is the main reason for Alphabet's creation, rather than attempting to recover the agility and flexibility of a startup. When they started Google, they had no idea what they were going to do other than implement their original PageRank Algorithm. Both men have a passion for the "heroic engineering myth," which celebrates the idea that a brilliant engineer can go off on his or her own on a weekend, come up with a world-changing insight and make it happen. That's how they succeeded before. Alphabet is the attempt to repeat that approach.
- **Both men are proudly unconventional.** In the 2015 blogpost announcing Alphabet, Page wrote, "As Sergey and I wrote in the original founder's letter 11 years ago, 'Google is not a conventional company. We do not intend to become one.' As part of that, we also said that you could expect us to make 'smaller bets in areas that might seem very speculative or even strange when compared to our current businesses.'" Their leadership model is unique. (For more color on these executives, see The Mission, ["20 Things I've Learned From Larry Page."](#))
- **Page and Brin are impatient with bureaucracy.** Page has always bristled at the notion of being an administrator, a bureaucrat. Yet that's what he had become as Google CEO. At heart, he's an innovator. The decision to hand over day-to-day control demonstrates maturity in two

executives who are still quite young (both Page and Brin are just 43). The reorganization lets them shift the CEO duties to Pichai and focus on innovating.

Pichai is a known entity, having been with Google for more than 11 years and worked his way up the ranks. He has the requisite experience and a winning track record. According to most insiders at Google, Pichai is a proven leader. The new CFO, Ruth Porat, formerly of Morgan Stanley, has the task of increasing the accountability of the business units within Alphabet's Other Bets division. Since the reorganization, Google has shut down some projects and put others, such as the Boston Dynamics robotics acquisition, up for sale. Diane Greene, a founder and former CEO of VMware, is bringing greater coherence and sharper focus to Google's cloud businesses, and renewed drive to its enterprise business.

In this new arrangement, Page and Brin are now free to concentrate on serious engineering activities that have a chance to be world-changing. They aren't developing Google Cars because they want to run a major player in an industry already suffering from overcapacity; it's because they want to change the world and think they have a way to do it. This conviction shapes a central theme that emerges from examining Alphabet and Google: "We're not like you and you should want to be more like us."

Of course, to go with these positive directions are several major challenges:

- Changing market perceptions is hard work and can take several years to show significant results.
- Expanding its strategic beachheads with large enterprises will be a major battle.
- As Google continues to invest in a variety of new opportunities, enterprise customers will find its focus distributed across consumers and business users.
- The restructuring could fail to achieve its objectives: Page and Brin could be forced back into mainstream business issues, diminishing what they believe they can accomplish as innovators.
- The European Commission's long-running monopolies probe into Google's activities in Europe could distract Alphabet's management team.

1.2. Financial

Analysis by Adam Woodyer

Gartner gave Alphabet a "Positive" financial rating as of 30 September 2016, based on a methodology measuring growth, financial strength, liquidity and profitability (see "Understanding Gartner's Financial Ratings of IT Vendors").

Google generates 99% of Alphabet's revenue, and Google's advertising revenue made up 88% of Alphabet's revenue in the third quarter of 2016.

On a trailing 12-month basis (the four most recent quarters, ending 30 September 2016), Alphabet's revenue grew by 19.2% and its net income margin was 22.3%. Cash flow as a percentage of revenue was very strong, at 38.2%, and the company's liquidity was quite strong.

With debt comprising only 2.9% of its total capital, and with cash and short-term investments of over \$83 billion, Alphabet is in a strong position to continue to fund growth via internal innovation and acquisitions.

1.3. Marketing

Analysis by David Yockelson

Google is so dominant within the restructured company that most consumers and corporate executives still think "Google" rather than "Alphabet." Moreover, in both The Harris Poll's 17th annual "[Reputation Quotient Summary Report](#)" and in Gartner's "2015 CEO Survey: Committing to Digital," Google received third-place rankings in corporate reputation and digital business leadership (Amazon took first and second places in those surveys). Finally, Forbes placed Google second in its 2016 ranking of "[The World's Most Valuable Brands.](#)" Clearly, Google remains near top of mind in a variety of sectors.

Google Marketing is now a part of Alphabet Marketing. In terms of sales and marketing expense, Alphabet spent about \$9 billion in 2015 (just over 12% of the company's revenue). Of that, \$184 million was spent on advertising and promotion, with the rest allocated to categories such as staffing, compensation and professional services/consulting fees. The Google segment is the nexus of those efforts with respect to outbound marketing, visibility and (from customers) attention.

Most customers, whether enterprise or consumer, know little about the Other Bets (save perhaps Nest — see Table 2). Yet those Other Bets contribute powerfully to the overall perceptions of Google through the vendor's public relations efforts and the press coverage of the many announcements, acquisitions, partnerships and other activities related to both Other Bets and the "moonshots" (the term used in Alphabet's financial statement) such as Project Loon (balloon-based internet connectivity) and autonomous cars. Google is the economic engine that funds these Other Bets, though obviously they have costs associated with them that far outweigh their revenue. Ultimately, they make an incredibly powerful contribution to the vendor's brand and marketing position through the free marketing and publicity that they generate.

Google's marketing performance in the enterprise segment has historically been mixed. In 2014, it announced its Google for Work brand, encompassing the set of productivity offerings directed at business users. The Apps and Cloud Platform areas were marketed under that Google for Work umbrella, but were managed independently. In November 2015, these three offerings (as well as Chrome for Work and Android for Work) were united under a new leader: former VMware CEO Diane Greene, also an Alphabet board member. This reorganization is important both symbolically and substantively as a show of strength relative to competitors such as Microsoft and Amazon Web Services (AWS).

The momentum continued early in 2016 at the Google Cloud Platform Next event. The company announced a variety of additions and enhancements to the platform as well as several significant new customers, including The Coca-Cola Co., The Walt Disney Co. and, later, Home Depot.

In September 2016, at the company's Horizon event,¹ Diane Greene announced a new umbrella brand aimed at enterprises of all sizes: Google Cloud. This incorporates every business-oriented offering from Google, including:

- *Google Cloud Platform (GCP)* — Includes storage and infrastructure; application development; and data, analytics and machine learning
- *APIs* — Include machine-learning APIs, enterprise Maps APIs and Google's API platform (Apigee)
- *G Suite (formerly Google Apps for Work)* — Refers to all of Google's user-facing collaboration and productivity applications
- *Devices* — Those that connect to the cloud, including Android phones and Chromebooks

Brand unification is another sign that Google is better-focusing on enterprise customers. However, while Google's marketing performance continues to improve, there is still a gap between Alphabet's enterprise focus and the ways and reasons enterprise buyers buy and use such products and services.

Google Cloud — now Alphabet's main front to the enterprise — has a strong and growing set of technology offerings that exhibit many of its leadership qualities. But technology alone is not enough for an effective enterprise selling strategy — Google must demonstrate that it is equally focused on developing relationships and empathizing with enterprise buyers and their processes.

Historically, Google has come across as inflexible to many enterprise customers, some of which have also perceived it as arrogant. Google and Alphabet must take pages from its competitors' books while building upon the new organizational structure and marketing emphasis described earlier. Microsoft years ago and AWS more recently learned to create links from their technologies to enterprise business issues, applications and investments. This experience created their entrée into enterprise commercial and government organizations, and they've developed a sensitivity to enterprise buyers' needs.

Toward that same end, Google Cloud has added new sales and marketing leadership. It has made some recent announcements about establishing an office of the CTO, a Customer Reliability Engineering team and a Professional Services Organization, all designed to work more closely with customers. Diane Greene's customer orientation is permeating the organization.

Google has historically been stronger with "digital native" companies — its products, pricing and practices better for smaller or newer businesses with less legacy technology and fewer long-standing, baked-in policies, processes and operating assumptions. We expect to see continued progress here by Google as it expands into more-traditional large enterprises.

Clearly, the addition of Diane Greene, the new leadership she has brought in and the creation of the Google Cloud division represent a good start; Google is making progress with enterprise partners. Further, Alphabet is certainly investing for this opportunity, with a 15.7% increase in sales and marketing spending as of the nine months ending 30 September 2016.²

2. Market Offerings

This section is divided into two subsections: product/service and technology.

2.1. Product/Service

2.1.1. Marketing and Advertising Services

2.1.1.1. Google Advertising

Analysis by Andrew Frank

Google's digital advertising business continues to grow, although Facebook, its biggest competitor in digital advertising, has been taking market share.³ Google's advertising growth has been propelled by continued expansion of the overall market and its ongoing innovations, especially in mobile. Innovations include local search ads and Promoted Pins for Google Maps as well as expanded text ads and responsive ads for AdWords. The end-to-end DoubleClick ecosystem fortifies Google's ad market position, with the most popular ad servers for both advertisers and publishers joined by an array of industry-leading solutions, such as DoubleClick's Bid Manager, Campaign Manager, Creative Solutions and Ad Exchange solutions.

Highlights:

- Google's attention to programmatic video is attracting brand advertisers with roots in TV, which are grappling with shifts in consumer behavior toward streaming and mobile viewing. Google is positioned to play a key role in TV-digital video convergence, which will divert billions of dollars in TV advertising toward digital. Facebook competition is also contributing to urgency on this front.
- Although Gartner research indicates that enterprise marketing budgets for search have recently declined, search continues to provide an indispensable source of traffic for marketers (see "What Search Advertising's Evolution Means to Multichannel Marketing"). Google continues to enhance its DoubleClick Search offering with smarter tools for bidding and performance-based optimization. Apple's decision to make Bing the default search engine for Siri queries underscores search's enduring competitiveness and importance in the evolving world of voice interface and virtual personal assistants.
- The threat of ad blockers and Google's response have been subjects of much trade press speculation. But the situation is unlikely to significantly harm Google's ad business in the long term as publishers, consumers and ad platforms adapt to demands for more relevance and control over ad targeting and context. Ultimately, advertisers must raise their game to avoid ads being blocked.

Pay Close Attention to:

- *The relationship between Google's ad and marketing analytics businesses:* Products such as Google's Audience 360 data management platform present complications for some marketers. Some would benefit from connecting their customer data with Google's vast knowledge of consumer behavior, but they harbor concerns about Google's transparency and neutrality.
- *The competitive actions of Google's adversaries:* Apple's recent moves suggest a strategy aimed at diminishing the overall presence of mobile ads — especially on mobile websites. Apple CEO Tim Cook has made comments implicating Google's business model in the decline of privacy. Microsoft also has attacked Google on privacy, appealing to regulators to take legal steps to reign Google in. Google's advertisers could get caught in the crossfire.
- *Search performance:* Advertisers must continue to closely monitor performance and adjust ad investments accordingly.

Summary Advice:

Google is essential to virtually all digital marketers, but there are additional options to consider. The landscape of consumer behavior and device capabilities is evolving rapidly. Advertisers and their media agencies must be agile in response to potentially sudden changes in the efficiency and effectiveness of their advertising channels. Investment in multitouch attribution is essential for measuring ad effectiveness.

2.1.1.2. Google Analytics 360 Suite

Analysis by Andrew Frank

In March 2016, Google announced the Google Analytics 360 Suite — a strong suite of enterprise-class analytics products for marketers. It competes directly with cloud-based marketing offerings from Adobe, IBM, Oracle, Salesforce and other enterprise software providers. But the suite stops short of offering a complete solution for multichannel campaign management or marketing resource management. It is separate from Google's DoubleClick suite of advertising solutions, which is complementary.

The seven component products consist of three new, three renamed and one upgraded product, united under the 360 brand:

- *New products:* **Audience Center 360** is a data management platform that enables enterprise marketers to find, expand and reach their customers. **Optimize 360** (site testing and personalization) and **Data Studio 360** (data analysis and visualization) are currently available in limited beta. These products have not been evaluated by Gartner.
- *Renamed products:* Adometry is now **Attribution 360**, Consumer Surveys is now **Surveys 360** and Analytics Premium is now **Analytics 360**. Google Analytics Premium was declared a Leader in Gartner's 2016 "Magic Quadrant for Digital Marketing Analytics" report.

- *Upgraded product:* **Tag Manager 360** is an enterprise version of a formerly free product. It has become the dominant player in tag management, where few competitors remain.

Google has longstanding aspirations to compete in enterprise markets. But few if any of its enterprise initiatives so far are as well-positioned for enterprise success as Google Analytics 360 Suite is.

Highlights:

- Google's cross-device identity graph is second only to Facebook's, putting analytics vendors relying on third-party identity solutions at a disadvantage. This is especially important as marketing is consolidating around identity resolution for analytics and personalization. Audience Center 360 is natively integrated with over 30 third-party data providers. Marketers can use third-party data alongside Google and first-party data.
- Google's high-margin media business allows it to compete favorably on price, while meeting concerns about its low-touch, self-service heritage head-on with a focus on account services, training and support. It's too early to tell whether this focus will be enough to overcome reports of frustration some enterprise users have had with other Google product support efforts.
- Google's high-profile investments in machine learning and big data infrastructure have boosted its reputation among data scientists, who will influence many enterprise analytics investment decisions.

Pay Close Attention to:

- Some enterprise IT and marketing executives express reluctance about onboarding sensitive data to a marketing cloud, citing privacy, security and competitive concerns.
- Google will need to overcome skepticism that its tools may be subtly biased to shape results in favor of its own media products, which are among the investment options the tools must analyze. This follows charges of Google biasing search results in a similar manner.
- Google Analytics users will need to accommodate service restrictions that prohibit them from sending personally identifiable information to Google Analytics. Google must enforce these due to the heightened sensitivity of regulators and corporate adversaries to its privacy practices. Additionally, leveraging identity data from its Android, mobile app and website logins could raise additional privacy and fair competition concerns.

Summary Advice:

For enterprise marketers looking to replace or extend their current marketing analytics solutions, consider putting Google Analytics 360 Suite on the evaluation shortlist.

The new suite sets Google on a trajectory to extend its offerings beyond advertising and analytics into a full range of data-driven marketing applications.

2.1.2. Developer and IT Services

2.1.2.1. Application Services

Analysis by Ray Valdes

Google's application service portfolio ranges from the widely known to the deeply obscure. In recent years, Google has grouped services in three broad categories:

- *Business* — Including applications such as Analytics and AdWords
- *Consumer* — Including Gmail, Calendar and Translate
- *Geo* — Including Maps and Earth

Some of these are used only by specialists, but others now dominate their respective categories. Their strengths are Google hallmarks: a high level of functionality, a quality user experience and, most importantly, a free option for certain use cases and low transaction volumes. Google continues experimenting with pricing and portfolio priority changes, which can trigger criticism by some user segments.

Here we discuss some of the key offerings in Google application services.

Google Analytics has been on the market over 10 years and grown from a limited-function, low-end offering to a broad-scope portfolio of related offerings. According to W3Techs, it has 83% market share across the top 10 million websites. The tool can provide data-driven insight into audience, advertising, conversion, flow and user behavior. It can integrate with CRM, from mobile apps and from other data sources. The free version of Google Analytics is targeted to small businesses and individual authors. In 2012, Google Analytics Premium was released for the enterprise market. It was rebranded in April 2016 as Google Analytics 360 and is now part of the Google Analytics 360 Suite. The suite provides support and additional capabilities.

Gartner expects that the Analytics portfolio will continue to dominate the category, due to the combination of freemium pricing, ongoing functional enhancement and integration with other Google services (primarily advertising, but also niche services such as Google Surveys). There are competitive products that have established good reputations and followings in certain corners of the market — for example, Mixpanel, Kissmetrics, Crazy Egg, WordPress Stats plugins, Clicky, Yandex.Metrica, Baidu Analytics, Facebook Analytics for Apps and, at the other end of the spectrum, Adobe Analytics for high-end consumer sites.⁴ While these will continue to have a presence in the market, the overwhelming share will be in Google's camp.

For full details on Google Analytics 360 Suite, see the 2.1.1. Marketing and Advertising Services section, 2.1.1.2. Google Analytics 360 Suite profile.

G Suite is the collection of productivity tools that was rebranded from Google Apps for Work in September 2016. The suite includes a wide range of enterprise-oriented productivity tools marketed to the small business, education, midmarket and enterprise markets. G Suite complements the consumer-oriented point products such as Gmail, Photos, Maps, Translate and Search.

Google has broadened the suite's scope from individuals working alone to supporting team structures, adding an array of team capabilities such as Team Drives and a revamped UX in Google Hangouts (see the Enterprise Applications and Services, Unified Communications as a Service section for more on Hangouts). Google has used machine intelligence to enhance capabilities in Mail (smart reply), Calendar (smart scheduling), Sheets (the Explore capability), Drive (Quick Access) and others.

Regarding market share, Gmail dominates Yahoo and Outlook in web-based mail. But in the broader category of mobile-friendly email clients (web and mobile), Gmail is second in enterprises to Apple's iOS and macOS mail apps, according to a September 2016 survey by Litmus Email Analytics. Google continues to face strong competition from Apple and Microsoft. In the use of public-cloud-based enterprise email by public companies (a category that is growing quickly overall), we expect Google to hold its own but not significantly change its relative share position.⁵

For full details on G Suite, see the 2.1.6. Enterprise Applications and Services section, 2.1.6.2. G Suite profile.

Google Maps was a revolutionary product when first released in comparison to relatively static web maps such as MapQuest and Yahoo Maps. Over the years, Google has continued to enhance Maps with satellite view, directions, traffic, transit, pedestrian info and so on. The Google Maps API enabled many thousands of websites to embed its maps for functions such as store location display.

In recent years, the focus has shifted to mobile platforms. Apple has become a major competitor after a shaky launch in 2012, following continued investment and significant improvement. As Apple Maps is the default choice on Apple devices while Google Maps must be downloaded, Apple has said that its offering is used three times as often as its "nearest competitor" (presumably Google Maps).⁶ Across the broader mobile space, due to Android having larger market share than iOS, Google Maps has almost double the market share of Apple Maps (according to comScore Mobile Metrix 4Q15).⁷ Google's share becomes significantly larger when web mapping is included.

Google makes its Maps services available to developers of mobile apps and to websites via APIs. The pricing models and names have changed over the years. For public sites, it continues to be free if those sites do not charge or restrict access to users (up to 25,000 map loads per day, with \$0.50 charged per 1,000 loads after that⁸). For others, Google offers the Google Maps APIs Premium Plan (called several names in the past — Google Maps Premier, Google Maps for Work, Google Maps for Business, etc.). Pricing is not disclosed, but is handled by negotiation with direct sales staff. The portfolio of services available via APIs includes Places, Geocoding, Directions, Distance, Elevation, Timezone and Roads.

Google has made many changes in the direction and user interface of Maps, as well as pricing. Some users complained that recent redesigns degraded the user experience rather than improved it. Consequently, there has been a small but steady increase in usage of open-source competitors, namely OpenStreetMap. Additional competitors include Microsoft Bing Maps (for consumers, developers and enterprise sectors), and Esri and MapInfo Pro (for developers of GIS solutions).

Despite this competition, Gartner expects Google Maps to maintain its strong position across web and mobile channels.

Highlights:

- Application services maintain a high level of functionality and a quality user experience
- Free options are offered for certain use cases and low transaction volumes

Pay Close Attention to:

- Google's continuing experimentation with pricing and portfolio priority changes

Summary Advice:

- Plan for negotiating with direct sales staff on pricing for Google Maps APIs Premium Plan
- Evaluate merging open-source rivals for Google Maps services

2.1.2.2. Google Cloud Platform

Analysis by Lydia Leong and Yefim Natis

Google has been one of the early pioneers in cloud platforms as well as in the use of OS containers for hyperscale computing (cgroups were contributed to Linux by Google). In the last eight years, the Google Cloud Platform (GCP) has expanded far beyond the initial 2008 release of the Google App Engine application PaaS (aPaaS). GCP now includes IaaS capabilities (compute in the form of VMs and containers, storage, and networking elements) and other PaaS-layer services such as multiple data stores, event processing, analytics and most recently machine learning.

At the 2016 GCP Next conference, Google finally announced its intentions to address the enterprise Internet of Things (IoT) market with GCP. *(For more details, see the 2.1.4. Enterprise Devices section, 2.1.4.4. Internet of Things profile.)*

Developers, startups and some major web businesses have embraced GCP.⁹ But its presence has been minimal outside of tech-centric businesses, with many Google customers turning to other vendors for their primary cloud platform. In response, Google created the Google Cloud organization responsible for all enterprise-related business. *(For more details, see the 1. Corporate Viability section, 1.3. Marketing profile.)*

Technology services available from Google are offered as an integrated continuum, with a shared customer portal, data center technology and business practices. The seamless IaaS and PaaS integration of GCP is a visionary development that is also adopted by AWS, Microsoft and others. Customers are free to select services that best fit their objectives and integrate their colocated investments.

Google's IaaS and PaaS portfolios lag those of AWS and Microsoft Azure.¹⁰ Google lacks hybrid computing solutions and some high-demand enterprise capabilities, such as:

- An ecosystem of application solutions and accelerators (SaaS)
- Application and data integration (for example, Google does not offer iPaaS for application integration — such as Dell Boomi — or for data integration — such as Informatica)
- Business process orchestration and management
- Assembled IoT platform suite or digital twin architecture

However, API management capabilities are part of the Apigee portfolio, which Google purchased in October 2016, and the capabilities that GCP does provide are well-implemented. Because of the narrower scope of these capabilities, to date, customers have been less likely to consider Google as a strategic provider. However, Google's strengths in areas such as big data, analytics and machine learning may attract two types of customers: those who are strategically aligned to these technology resources, and those who are willing to use multiple cloud providers and who will select Google for the use cases for which it delivers best-in-class functionality.

Google also competes aggressively on price. In combination with the platform's technical capabilities, pricing often attracts high-performance computing customers and others with batch workloads.

Google's cloud vision is often well ahead of the broader market, and ahead of mainstream enterprise abilities and practices. Historically, however, Google's business practices have hindered efforts to build a reputation and presence with customers that are not "cloud-native." Google is working to address many of the issues limiting enterprise adoption of GCP. Among other improvements, we expect to see:

- Improved sales and contracting practices, removing inconsistencies, and increasing flexibility in contract negotiations
- More assistance on solution architecture
- Enhanced surrounding ecosystems for training, ISV support, professional services and managed services (with some evidence of change already showing in the latter part of 2016)

Google's engagement with mainstream enterprise customers has been slow to form the all-important long-term account relationships and loyalty. (It takes a long time for any entity to build these relationships.) The vendor is working to meet customers where they are, even if the ultimate goal is to transform these customers to something more "Google-y" in terms of cloud deployment. Prospective customers should expect these changes to be gradual.

Google has the technical know-how and resources to grow in the enterprise. Its innovation and contribution to open source have notable influence with leading-edge vendors and users. Provided the company can sustain the strength of will and leadership commitment, users can expect ongoing improvements of GCP's technical capabilities and ability to serve enterprise customers.

Highlights:

- GCP now includes an array of IaaS and other PaaS-layer services, including innovative machine-learning capabilities
- GCP has well-implemented capabilities but it lacks the breadth of capabilities of its primary competitors, AWS and Microsoft Azure

Pay Close Attention to:

- Google's release of new services, as well as enhancement of existing services — especially services that are of interest not just to digital businesses, but traditional enterprise IT organizations
- Google's expansion of sales, support and solution architecture to help onboard new customers, as well as developing an ISV and service ecosystem

Summary Advice:

- Select Google for use cases in which it delivers best-in-class functionality
- Leverage Google's strengths in areas such as big data, analytics and machine learning

2.1.2.3. Machine Learning

Analysis by Alexander Linden

In April 2016, the annual "[Founders Letter](#)" to Google (and now Alphabet) stockholders made clear that machine learning has become central to Google's business and will drive innovation in many initiatives.

Google has been investing heavily in machine learning and especially deep-learning technologies for years, but most of the results have been behind the scenes, enabling more-intelligent search, presenting advertisements based on users' click behavior or filtering spam from Gmail inboxes. Machine learning enables Google to continuously optimize users' online experience.

The vendor also has top-notch prefabricated machine-learning models for such tasks as text or image classification. These models have been trained using vast amounts of Google data. Google offers a growing array of well-regarded, cloud-based REST APIs that let applications call these back-end smart capabilities. There are APIs for [speech](#), [images](#), [natural-language processing](#) and [translation](#). They are very easy to use and to integrate with existing business processes. Clients do not have to bother creating their own machine-learning expertise.

Google's direction in "democratizing" machine learning — making these capabilities readily available and easily used by a growing developer community — is seen in its work with [Google Cloud Datalab](#), introduced in 2015 as the beta release of an interactive tool for large-scale data exploration, analysis and visualization. To do this, Cloud Datalab relies on Google Cloud Platform (GCP) services such as [BigQuery](#), [App Engine](#) and [Cloud Storage](#). Cloud Datalab itself is based on

the Jupyter project (formerly IPython), which lets users create and share notebooks that contain live code, equations, visualizations and explanatory text. In August 2016, Google unveiled an updated beta version of Cloud Datalab with two key changes:

- Runs on local machines in addition to the Cloud Platform.
- Supports open-source [TensorFlow](#), a machine-learning framework developed by Google to enable users to begin experimenting on local machines while simultaneously leveraging Cloud Platform services.

In May 2016, Google announced [SyntaxNet](#) — a syntactic parser that can accomplish part-of-speech tagging plus tokenization. It is a core component in natural-language processing/text analytics applications (sometime referred to as natural-language understanding [NLU] systems). It has been implemented in the TensorFlow open-source software library for machine learning. SyntaxNet's high accuracy makes it a compelling, integral component for many research projects and smaller startups, though it is currently available only for English. So far, adoption is limited, in part because it is so new and because the cost of switching from any more-established NLP library is likely to be very high.

Google is one of several major vendors investing heavily in developing and providing machine learning (deep learning) and natural-language processing capabilities as cloud-based services. Major competitors include IBM, Microsoft, Baidu, Wipro, Tata Group, Oracle, SAP, SAS and Salesforce.¹¹ There are also hundreds of smaller specialist players competing in this space.

Compared to machine-learning services from GCP, IBM and Microsoft have broader collections of generally available, AI-related services. But Google's TensorFlow framework is popular, particularly with large enterprise IT organizations experimenting with deep learning. Overall, TensorFlow may be the most popular deep-learning project on GitHub.¹²

These are still early days for AI-rich (deep learning and natural-language processing), general-purpose platforms or suites of machine-learning capabilities. Each vendor's offering varies widely in its capabilities and in maturity and effectiveness: Google is no exception here.

Highlights:

- Google is introducing machine learning into more of its businesses, products and services, and exposing those capabilities to developers in easy-to-use APIs.
- Prefabricated machine-learning models and cloud services from Google let organizations leverage these emerging capabilities without having to create them from scratch internally.

Pay Close Attention to:

- Google's machine-learning development platform, which can help clients build their own solutions on their own data, is currently only in beta.

- Any announcement around Google Cloud Datalab, which has been in beta since its October 2015 unveiling. As of this writing, there is no indication of when Google might release a generally available production version.

Summary Advice:

- Plan on doing your own testing for machine-learning applications and the associated APIs. Each Google API competes against dozens of others and must be benchmarked against your specific domain needs for precision, privacy and scale.
- Compare Google's machine-learning features, APIs and services at least to those of IBM, Microsoft, Amazon and Baidu; also don't overlook the many specialist offerings from other vendors.

2.1.3. Consumer Devices

2.1.3.1. Android for Consumers

Analysis by Roberta Cozza

The Android OS dominates the consumer mobile device market, reaching a varied range of users at many price points. This is due to the strong appeal of Google Mobile Services (GMS) and Google's ongoing platform development, which has enabled Android OEMs to deliver rich mobile device experiences.

Numerous OEMs in every region support the platform, releasing a wide range of devices priced from over \$600 to \$40 or less in emerging markets. Android-powered hardware dominates the global smartphone market in volume and share.¹³ In the third quarter of 2016, its share grew to 88%, with an installed base expected to have reached 2.7 billion users by the end of 2016.

Android also has rapidly established a leading position in the tablet market, with a 72% share in the same quarter. This was driven by strong sales of lower-cost 7-inch basic and white-box tablets in 2015. But user demand has weakened and the tablet market is experiencing continued declines, with consumers moving away from 7-inch tablets. In enterprise, Android tablet sales have strengthened but still lag Apple iPads in adoption.

Android fragmentation is still a persistent issue. As of January 2017:

- Almost 30% of active Android users visiting Google Play had Android Marshmallow (v.6), released in 2015
- Around 36% of users were on Android KitKat (version 4.4) or older
- Less than 1% were on the latest version, Android Nougat (v.7)

This fragmentation creates problems for both developers and users. The user experience can differ wildly given the number of active Android versions, with one result being that most Android users are deprived of the latest key functionalities and technologies that Google adds yearly to Android.

Google continues to address fragmentation with various initiatives, such as working with manufacturers to ensure faster OS updates, and cutting the memory footprint needed so that versions can be run in some older lower-end smartphones. But success has been limited. More promisingly, Google is decoupling key apps from specific OS versions and shifting more control over pushing app upgrades to its GMS suite.

Google has also taken more control of hardware and service integration by releasing its own "Phone by Google," the Pixel premium smartphone, in the third quarter of 2016, in an effort to offer people the first phone made by Google. With Pixel, Google is leaning into its "AI-first" vision: Pixel is the first Android smartphone in the market with the virtual personal assistant service, Google Assistant.

The Android market is so highly commoditized that many products are undifferentiated. Despite the massive market share of Android, most Android device vendors are struggling to drive profitability. That struggle will get harder because the way that value is derived from the smartphone market is changing: value increasingly is in experiences created through services, software and content. This will likely lead to major disruption and change in the global Android vendor landscape, which has entered a much more dynamic and fluid phase. One possible result is the entrance of new, big ecosystem players with new business models and a new wave of services, which could use Android simply as a building block to push their own service revenue, bypassing Google.

In the latest Android version (Nougat), Google introduced over 250 new features to the OS, focusing on three main areas:

- *Performance* — Including the new Vulkan 3D graphics API, Android runtime and compiler optimization
- *Security* — Including file-based encryption, media framework security hardening and smoother automation of OS upgrades when available
- *Productivity* — Including better multitasking and multiwindows features, split-screen view and notification management

Google is further evolving and diversifying the Android platform by broadening its reach into wearables, connected homes, cars, TVs and, more recently, its Android N-powered Daydream VR platform and its own Daydream View head-mounted VR display.

Highlights:

- Android is able to span multiple device types and price points, and address different consumer segments.
- Millions of users have already invested in Google's applications and services beyond its search engine, such as Gmail, Maps and YouTube. Strong integration of these very popular services into Android has critically strengthened the Android platform's value proposition.
- Android is evolving rapidly and strongly, with Google introducing competitive technology features and expanding Android smartphone functionality to new areas such as VR. It is

enabling more-intelligent virtual assistant interaction with its users and further linking with new emerging segments such as wearables and the connected home.

Pay Close Attention to:

- Fragmentation of Android OS versions and the variable quality and performance of low-cost Android devices, which are obstacles to delivering a consistent user experience. For users, fragmentation could mean being deprived of key technology features and capabilities as well as latest security improvements. For developers, it drives up development and support costs.
- Forked Android variants without built-in GMS, which can significantly disrupt Google's role in Android. Rivals with strong ecosystems can shift to open-source Android versions from the Android Open Source Project, bypassing Google and pushing their own branded app stores, software and services. Amazon has already done this, and it's a reality in China where GMS is banned.

Summary Advice:

- Expect Google to continue to effectively manage the complicated balancing act between enabling third-party innovation and the need to contain fragmentation.
- Android manufacturers should shift their value proposition and competitive focus in the market by offering content, services and a distinctive user experience.

2.1.3.2. Android Pay

Analysis by Roberta Cozza

Android Pay is a tap-to-pay and in-app mobile payment system, launched in 2015 for Android smartphones. It builds on the earlier Google Wallet technology from Google's acquisition of Softcard. Google is repurposing the Google Wallet app to focus on sending and receiving money, and retired the original Google Wallet Card in June 2016. Android Pay uses NFC technology for in-store transactions, and runs on Android KitKat and above. With Android Marshmallow, Google added support for native Android Pay fingerprint authentication.

The reach of Android Pay to a large base of devices is a key strength compared to competing systems. Android Pay adds value to the purchasing experience by supporting the use of coupons and gift and loyalty cards. It automatically notifies users about nearby stores that support loyalty cards and Android Pay. Android Pay is currently available only in the U.S., Singapore, Australia and the U.K., and Google needs to continue to broaden support across credit card players, retailers and banks.

Highlights:

- With Android's global smartphone market share at 88%, Android Pay has a wide potential base.
- Android Pay is based on NFC only, with added security enabled via support for native fingerprint recognition only in Android Marshmallow and above.

- Gartner expects that, by 2018, 50% of consumers in mature markets will use smartphones or wearables for mobile payments.

Pay Close Attention to:

- The progress of support from credit/debit card providers, banks, key merchants, retailers and supported apps
- The pace of country expansion above all within emerging markets in Asia and EMEA

Summary Advice:

- Monitor the ability of Google to differentiate Android Pay from competition by leveraging Google's assets (e.g., Maps, Google Now/Assistant) to create a more engaging mobile payment experience, with more-personalized interactions and greater product information beyond just payment.
- Monitor Google's progress in extending Android Pay to its own Android Wear OS for use cases in wearables.

2.1.3.3. Augmented Reality/Virtual Reality

See the 2.2. Technology section, 2.2.1. Augmented Reality/Virtual Reality profile.

2.1.3.4. Chromebase

Analysis by Isabelle Durand

Chromebase is the all-in-one desktop display that runs Chrome OS. It's designed as an affordable device for users with basic online needs. Overall, Chromebase implementations range in price from \$269 to \$899. Acer launched Chromebase 24 earlier in 2016, offering both nontouchscreen and touchscreen models and emphasizing its strengths for videoconferencing.

Like the Chromebox and the Chromebook, Chromebase is designed to be used mainly while connected to the internet, as most applications and documents are in the cloud. Users can store files on the machine or use Google's online storage service, Google Drive. Chromebase targets consumers but is also for use cases in schools, libraries, hotels and call centers. In office settings, the larger screen sizes create a better videoconferencing experience.

Google and AOPEN, of Taiwan, signed a 2015 co-development agreement to promote new Chromebase devices. One result is Chromebase Commercial, available in 19- and 22-inch display sizes, both targeting business users. It has an SSD and has been designed for durability and security. The product is intended for integration with POS systems, electronic kiosks, advertising boards and digital signage.

PC vendors are looking for new revenue sources as the desktop PC market continues to contract (by 11% in 2015 and 9% in 2016, according to Gartner estimates). But Gartner does not expect Chromebase to have the same success as Chromebook — it will not revive the desktop segment.

2.1.3.5. Chromebit

Analysis by Isabelle Durand

Chromebit is a new variety of Chrome OS device, for the [stick PC](#) category (full PCs packaging into a USB or HDMI dongle). A screenless, low-cost PC that can fit in a pocket, Chromebit can plug into a monitor or TV via a HDMI port and connect to a keyboard and mouse using Bluetooth 4.0. In some use cases, it can replace or eliminate the need for a conventional PC. With Chrome OS, the device works entirely with cloud-based services.

Chromebit competes with comparable devices such as Intel Compute Stick, Dell's Wyse Cloud Connect, Lenovo Ideacentre Stick 300 and Archos PC Stick. Google itself launched the Chromebit CS10 with Asus in 2015, with a price tag of \$85. For that price, a user gets:

- Rockchip ARM-based CPU
- 802.11ac Wi-Fi
- One USB 2.0 data port
- 16GB internal storage
- 2GB RAM

Compared to some other devices, Chromebit can seem expensive — it needs peripherals for streaming video and web browsing, and it's more than double the price of Chromecast, which costs \$35. But Google has been positioning Chromebit as a digital signage product, which doesn't require peripherals and thus becomes a plug-and-play solution.

Demand for Chromebit was lower than expected in the B2B segment during 2015 and 2016. Gartner believes the stick PC market will evolve as a low-volume, companion device market niche with limited use cases. Stick PC will have no impact on PC sales at least through 2019.

2.1.3.6. Chromebook

Analysis by Isabelle Durand

Google's Chromebook family of cloud-oriented mobile computers are cost-effective, flexible solutions for an array of use cases, especially when combined with Google's cloud applications and services. It's been a compelling value proposition in education, but Chromebooks still struggle for a foothold in business segments. This analysis covers Chromebooks in both markets.

Chromebooks are mobile computing devices that run Chrome OS. Available from a range of manufacturers, they are designed primarily to access cloud services, cloud storage (typically Google's offerings) and Chrome web-based applications. All applications are accessed or

downloaded from the Chrome Web Store. Most models are typically low-cost devices, with prices ranging from \$149 to \$319, although some offer higher-resolution screens and other features at a premium price. Acer, Asus, Dell, Haier, Hisense, HP Inc., Lenovo, Samsung and Toshiba have Chromebooks in their mobile portfolio.

To expand the Chromebook ecosystem and increase Chromebook's value, Google is adding the ability for Chrome OS to run Android apps and access the Google Play store. This capability currently is available on some [select Chromebooks](#) that are running Chrome OS v.53 and up. This move gives Chromebook users a large stock of Android apps, including Microsoft Office Mobile. (Users of Microsoft Office 365 on Chrome OS devices with screens larger than 10.1 inches will need an Office 365 subscription.)

This announcement could persuade Android device users to buy a companion Chromebook or even switch to one from Windows when they consider their next PC purchase. Businesses may reconsider Chromebook as this change will give users access to a large array of Android apps and an improved offline capability, as well as give IT administrators the ability to manage those apps from the Google Admin console.

According to Gartner estimates, Chromebooks have had their greatest success in education — specifically the U.S. K-12 market. Other relevant data:

- Total Chromebook sales to end users reached almost 9.4 million units in 2016, growing 38% over 2015.
- More than 90% of Chromebooks were shipped to the U.S. market in 2016.
- Chromebooks continued to gain share in the U.S. K-12 market in 2015 and 2016.

School districts have invested in Chromebooks for several reasons:

- The Chromebook value proposition, which emphasizes security and manageability.
- The low hardware price and simple apps.
- Availability of G Suite for Education, Google's cloud-based set of applications that enables teachers and students to communicate, collaborate and create. It is free for schools with support at no cost. G Suite for Education grew from 8 million users in 2010 to 70 million users as of January 2017.¹⁴

This success in education points to the main challenge for Chromebook in the future: expanding to other professional markets. Enterprises are piloting Chromebooks, but not buying them in large volumes given Microsoft Windows is the reigning corporate standard. Some enterprise vendors such as Dell have added more choice for enterprises and small businesses: Dell introduced Chromebook 13 dedicated to these segments, as did HP with Chromebook 13. More recently, Acer introduced Chromebook 14 for Work, targeting small businesses and other commercial customers, while Lenovo launched the ThinkPad 13 Chromebook targeting B2B customers.

Google itself targets businesses with its Chromebooks Program. During 2015, Google announced several new capabilities for this program:

- Chromebooks now can integrate with Microsoft infrastructure
- Support for a growing number of legacy applications through virtualization tools such as VMware Horizon, Dell vWorkspace and Citrix's Receiver for Chrome
- Easier connectivity to Dropbox, Microsoft OneDrive and other cloud storage services

This combination of hardware, cloud services and apps is spurring adoption by some larger enterprises. In 2015, Arbejdernes Landsbank, a full-service retail bank in Denmark, introduced Chromebooks in branch office kiosks to let customers log onto their accounts and access documents. Construction company Lafarge Tarmac selected Chromebooks and Chromeboxes to replace 80% of its Windows desktops and laptops. Others such as Netflix, Sanmina and Starbucks have adopted Chromebooks mainly due to Chrome OS's security and ease of use.

In the consumer market, hybrid Chromebook models offering convertible and detachable form factors will fuel Chromebook growth: Gartner forecasts that consumer Chromebooks will grow 41% in 2016 and 4% in 2017. Google has improved Chrome OS's touch support and vendors are offering new Chromebook form factors. Hybrid Chromebooks with touchscreens and 360-degree hinges, such as the Asus Chromebook Flip C100, will enable Google to better penetrate the consumer market.

Chromebooks are suitable for two groups in the consumer market: tech-savvy consumers and families with children. The majority of Chromebook users are tech-savvy types who purchase one as a companion device to their primary notebook or desktop device. Families with children could be a growing market as children become more familiar with the device through their use in school.

A key challenge for Google is to grow adoption outside the U.S. market. But for users in emerging countries, unstable and relatively slow network connections are serious obstacles for a cloud-oriented computer.

Highlights:

- Chromebook's strengths in security and manageability, proven in the education market, are becoming attractive to business organizations.
- Google's hardware partners are introducing a range of affordable Chromebooks, including new hybrid form factors with a range of performance and display improvements, aimed at business users.
- Google continues to expand its ecosystem, making the library of Android applications available for Chromebooks and letting IT administrators manage them from the Chrome Admin console.

Pay Close Attention to:

- The recent availability of Android apps on Chromebooks. Determine the suitability of these apps for business use, the extent of developer support and innovation, and the ease of application management via Google Admin.
- The emerging touchscreen Chromebook hybrids within Google's Chromebooks for Work program; they could prove suitable for various business use cases.

Summary Advice:

Organizations should evaluate the suitability of Chromebooks and Google's ecosystem if either:

- They are moving strategically to embrace or are already living in the cloud, or
- They have minimal or declining Microsoft Windows deployments and legacy applications

2.1.3.7. Chromecast

Analysis by Roberta Cozza

Chromecast is a media streaming dongle that lets a user stream video from a smartphone, tablet or PC to a flat panel TV via HDMI. It eliminates the need to buy a set-top box. Users have to rely on the device as the content source, and currently there is no separate Chromecast remote control. Chromecast 2 was introduced in 2014 with a price of \$35. The new version features a round dislike design, a faster processor and better connectivity features, with support for 802.11ac Wi-Fi and the 5GHz band for better video streaming with less buffering.

With Chromecast 2, Google also announced the Chromecast app to improve the smartphone UI and content search. Google also introduced Chromecast Audio (\$35), which casts music to any AUX-in speakers in the home.

Google released the Cast SDK in 2014 to help broaden the developer ecosystem and increase the number of Chromecast-ready apps, which today number in the low hundreds. A number of media companies, including HBO, Netflix, Hulu, Spotify and Pandora, as well as Google's YouTube, now support Chromecast.

Its affordable price and ecosystem support have enabled Google to sell 26 million Chromecast devices as of May 2016. More sophisticated and expansive — but also more expensive — rival products include Apple TV or Amazon Fire TV.

2.1.4. Enterprise Devices**2.1.4.1. Android for Enterprise**

Analysis by Chris Silva

Despite the overwhelming popularity of Android among consumers,¹⁵ enterprises tell Gartner of misgivings about broad Android adoption. Google is addressing those misgivings by adding features to improve enterprise deployment and management, including file-level encryption and the ability to turn work profiles on and off in v.7.0 of the OS.

Google standardized Android device management with the announcement of enterprise management capabilities in 2015, following the release of v.5.0 of the OS in early 2015. It added native management capabilities dubbed Android for Work (the name was dropped in 2016),¹⁶ which features included app-level controls, data separation and management modes for bring your own device (BYOD) and corporate-liable deployments. These capabilities were enhanced in Android 6.0 in late 2015, with several security and device-side management improvements, including support for single-use scenarios.

Yet Gartner has seen enterprise adoption of the Android platform remain slow. This is despite more device models now supporting the management improvements: as of February 2017, Android v.5.x and later now run on over 60% of active Android devices, as measured by Google ([Dashboards](#)). These devices are those running Google Play services, which are a portion of all Android devices.

Enterprise buyers often express confusion about these native management capabilities' value proposition, how to use them, and even what they are. Furthermore, although Google has partnered with all major OEMs and enterprise mobility management vendors, availability and partner support for Android's native management can vary.

Gartner's guidance is to focus on adoption of Google-certified Android devices running Google Play services, shipping with Android 6.0 or later and with 1GB of RAM. As a result, Gartner advises enterprises considering an Android support program that relies on native Android device management to carefully compare support between vendors to ensure critical policy controls are supported. Although adoption of these capabilities is at an early stage, overall enterprise acceptance of Android is healthy, with many companies deploying Android through a variety of other, non-Google management solutions.

Google has made a major change to its approach to OS security by releasing monthly security updates to OEMs and communications service providers (CSPs), which can then be pushed to users' devices as an alternative to a full OS update. This approach has the potential to greatly improve security across devices. Yet these monthly updates are released to users only at the discretion of the OEMs and CSPs. It is only a partial solution to Android's fragmentation; the updates address major security issues but will not address feature variations across OS versions and device models, some of which may be critical to enterprise use cases. The result? Focus on what elements of policy require which elements of Android, and ensure that feature or control is supported. As a rule, aim to work with devices that have a stated commitment to Google's security updates, and match the device life cycle to the time span during which updates are guaranteed.

Until a more complete solution is ready, enterprises will be wary of large-scale adoption of Android. Acceptance of OEM-specific security packages, such as Samsung Knox, is slowly but steadily growing for Android deployments that require a high level of security.

Highlights:

- Android provides some best-in-class mobile device management and security features from v. 5.x through the latest release
- Continued development of Android controls enhances granular controls, with example features such as app-level authentication challenges, and frameworks to restrict access to AfW apps for nonexempt employees.
- Google's move to separate monthly security updates from broader OS updates is a definitive step to assist CSPs and OEMs in rapidly supporting necessary patches to the mobile OS.

Pay Close Attention to:

- Mobile hardware vendors' support for the newest version of Android, and commitments to support future OS and incremental security updates.
- Enterprise mobile management solutions' support for Android policy controls. If support is lacking, consistent application of policy on Android devices will be difficult.

Summary Advice:

- When supporting Android for enterprise-owned devices, insist on a fleet of devices that run the most recent version of Android, are capable of being managed using Android-based policy controls, and receive monthly security updates over the planned useful life of the device.
- Restrict OEM choice to the device manufacturers that can commit to a timeline of OS updates that the hardware will support.
- In BYOD scenarios, until Android support is universal among users' devices, consider the use of an overlay secure PIM tool to deliver enterprise email, contact and calendar data to those Android devices.

2.1.4.2. Chromebook for Enterprise

See the 2.1.3. Consumer Devices section, 2.1.3.6. Chromebook profile, which also covers business use cases.

2.1.4.3. Chromebox

By Isabelle Durand

Chromebox, introduced in 2012, is the desktop version of Chromebook. In the enterprise, Chromebox has two key use cases:

- Thin-client devices for employees
- Videoconferencing systems

As a thin client, low-end Chromeboxes start at \$229 and provide viable alternatives to Windows PCs in IT environments that rely on Google at Work or that primarily use web-based applications. In addition, Citrix XenDesktop supports Chrome OS, making Chromebox available as a device for virtual desktop infrastructure solutions.

As a videoconferencing system, Chromebox for Meetings devices support meeting rooms of up to 20 people, who can sync with colleagues around the world. Hardware includes dual microphone and speakers, dual screen support and the Logitech PTZ Pro Camera. Chromebox for Meetings devices start at \$999 for small rooms and \$1,999 for large room, which include the first year's management and support fees. Chromebox for Meetings is easy to use and affordable, and is a good choice for SMBs or small departments at larger organizations.

Chromebox is still not getting traction in the market, but some companies such as Whirlpool, Netflix and Foursquare have deployed Chromebox for Meetings.

Current Chromebox suppliers include Acer, Asus, Dell, HP and AOPEN.

2.1.4.4. Internet of Things

Analysis by Mark Hung

In 2015, Google gave the first glimpse of its broadening ambitions with the announcement of Brillo, an embedded OS for the Internet of Things (IoT), and Weave, a communication platform. At the 2016 GCP Next conference, Google finally announced its intentions to address the enterprise IoT market with Google Cloud Platform (GCP).

Android Things (formerly Project Brillo) is a new fork of Android built for connected devices. In December 2016, Android Things was announced as a public developer preview, allowing developers to access the Android tools, APIs and ecosystem to build IoT devices as they would any Android app. It provides turnkey hardware solutions that reduce barrier to entry and accelerate time to market. Developers also get access to Google services such as Google Play services and Weave, and Google's security and update infrastructure.

Weave is a communications platform that provides a Device SDK, device manager console and cloud services to connect devices to the cloud. The Weave Device SDK currently supports schemas for light bulbs, smart plugs and switches, and thermostats. In the coming months, Google will be adding support for additional device types, custom schemas/traits, and a mobile application API for Android and iOS. The Weave platform also provides a point of integration between IoT devices and Google Assistant, including voice control via the Google Home device. Its competitors include other IoT communication protocols such as the Qualcomm-led AllJoyn and Intel-led OCF.

GCP brings several of its capabilities to the realm of IoT:

- Container Engine (Kubernetes) for microservice deployment
- Cloud Dataflow for stream processing of IoT events
- Cloud Bigtable for high throughput time series

- Stackdrive Monitoring for logging and alerts
- BigQuery for analytics
- Machine learning

For application-layer communications, GCP currently supports only gRPC, HTTP and Weave. Rival IoT cloud offerings support a broader array of protocols. Google has partnered with Intel both on IoT gateways as well as IoT security (EPID and Marshal Point). The company has announced both internal (Nest) and external (Philips Hue) customers for its GCP IoT platform.

Highlights:

- At the 2016 GCP Next conference, Google finally announced its intentions to address the enterprise IoT market with GCP.
- GCP currently supports only gRPC, HTTP and Weave. Rival IoT cloud offerings support a broader array of protocols.
- Google's device-side technologies, Android Things and Weave, are still in nascent stages of adoption by developers.

Pay Close Attention to:

- Expansion of GCP IoT services beyond the initial trio of service discovery, logging and alerts, and analytics — especially if the company decides to apply its machine-learning prowess.
- Broader adoption of the Android Things OS, released at the end of 2016.
- Any attempt by Google to bolster industry support for Weave, a communication protocol that ties together IoT devices regardless of the physical-layer technology.

Summary Advice:

- Assess Google's enterprise IoT offerings while being mindful that they are still germinating.
- Look for evidence of Google's IoT maturity in broader deployment among developers of device-side technologies, and in clearer differentiation between Google's IoT capabilities and those of a diverse set of competitors.

2.1.5. Consumer Apps and Services

2.1.5.1. Apps

Analysis by Brian Blau

Google's consumer apps and services are a focal point of the vendor's business — its brand and revenue successes have been built on a 20-year relationship with billions of engaged technology

users. This engagement is the foundation of advertising revenue and of the value of Google's mobile apps — both a significant resource for the company.

Google apps run on a growing array of technology platforms, ranging from smartphones and tablets to household consumer electronics. Services include communication tools, entertainment and games, and productivity solutions. The ecosystem of Google and third-party app properties is a key interaction point that keep consumers engaged and active.

Google's consumer apps and services span the most popular categories, and include some of the most-used apps in their categories (Gmail, Maps, YouTube). Its offerings fall into four broad areas:

- *Communications* — Via one-to-one or one-to-many communication paths, Gmail and Hangouts as well as the new Allo and Duo apps launched in 2016 enable personal, private and public conversations.
- *Entertainment* — YouTube's success has created its own ecosystem of online video stars and video content businesses. Google's music, television and movie downloads are competitive, but not as popular as the leading rivals.
- *Productivity* — Google offers office productivity apps, and many of the touchpoints in this category start with Google Drive. From Drive, users can create and edit documents, spreadsheets, forms and presentations, all with built-in collaborative editing and sharing capabilities.
- *Others* — Including fitness, photos, payments, voice, cloud storage, translation, content creation, wearables and more. These apps create various-sized niches that attract users but are not yet large-scale revenue sources or engagement drivers. Some apps, such as Duo and Allo, are starting to add AI and smart-assistant capabilities that change how users interact with many Google services.

Google Play is the vendor's distribution point for apps and for many of the services listed above. It is also a launching point for Google's third-party app ecosystem through its app discovery mechanism. Additional apps are available from third-party app stores, such as those owned by Amazon, Baidu and Tencent. Google's approach to apps is evolving: at Google I/O 2016, the vendor announced Android Instant Apps, which can be launched more quickly. The change potentially could bypass the need for an app store interface.

The Google Android OS, the largest and most broadly used consumer app platform, is central in Google's overall strategy. The broad array of consumer apps that run on it is a key factor in how users engage with Google's core products: search and advertising. Google's own apps sit alongside those from third-party Android developers, but the company's open approach means that these developers can and often do compete directly with core Google apps and services.

For information on the Chrome browser, see the 2.2. Technology section, 2.2.5. Google and the Web profile.

Highlights:

- Google has a broad and expanding range of app offerings for consumers, use of which drives engagement with many Google technologies and services.
- The pace of adoption of consumer apps in enterprise ("consumerization") is increasing.
- New apps, such as Allo and Duo, along with updates and improvements to many of Google's platforms, will help keep users engaged across a diversified technology offering.

Pay Close Attention to:

- Google's advancement in AI/smart-assistant technology, as the vendor moves search from typing to voice.
- Consumers' maturing use of third-party apps — they are not adopting as many apps, but they still value those with which they have a long-term relationship.
- Enterprise employees' use of consumer apps and services, which often results in pressure to adopt equivalent enterprise applications and services.

Summary Advice:

- Monitor enterprise usage to determine use cases where formal app adoption and support make sense.
- Evaluate how AI/smart-assistant advances will impact the Android app user experience for employees and customers.

2.1.5.2. Identity and Privacy Services

Analysis by Brian Blau

Google offers several features and products that let consumers manage their profiles, identity and social interactions. These offerings focus on:

- Single authoritative user identification
- Connected apps and services
- Data protection

To exploit the benefits of nearly any Google app or service, an authenticated Google account is required. These accounts link into nearly all of the vendor's managed services.

Developers can tap into user identity services by integrating login and site services, and by offering user authentication for mobile apps and websites. Google's developer single sign-on and social sign-on services compete strongly with those offered by some rivals, such as Twitter, but lag others, such as Facebook's similar services.

Google takes user data protection seriously, as evidenced by the continuing release of upgraded consumer technology features that make user data more secure while maintaining its ease of use. Google also now implements the European Court of Justice's controversial "right to be forgotten" ruling, which allows, via a petition to Google, for individuals to have certain search results removed. At the same time, Google must comply with local data and privacy regulations and government data requests. The vendor now issues regular updates to its Transparency Report, which documents how many user information requests it receives from governments and courts around the world.

New Google capabilities such as pseudonyms, two-factor identification and a move toward end-to-end encrypted communications show an evolving identity and privacy strategy, and a willingness to respond to user demands — even if those changes could have a negative effect on business performance. The single sign-on capability lets Google tie apps and services to each other across devices and platforms. One resulting business benefit is that advertisers can more easily target prospects through better user data analysis — an example of how Google leverages its large consumer base.

Highlights:

- Google is a public advocate for user privacy and data security.
- Google's consumer apps and services protect data and user privacy information in many of its customer-facing products as well as internally — for example, between Google servers.

Pay Close Attention to:

- How Google's new devices and platforms use and protect data they derive from voice interactions, such as voice-based search.
- How Google derives user targeting information as it improves its learning and AI/smart-machine capabilities.

Summary Advice:

- Leverage Google's mature and large consumer ecosystem as a reliable technology platform for brands.
- Plan on competing with Google as it adopts new platforms, such as home and car, and so extends its reach deep into consumer's use of technology.

2.1.6. Enterprise Applications and Services

2.1.6.1. Search

Analysis by Whit Andrews

Google told customers in February 2016 that it will retire the popular on-premises Google Search Appliance, but has not publicly explained what its cloud replacement will do or what the migration path to it will be. Google's enterprise search strategy is now in transition from the established

Search Appliance, introduced in 2002, although it will continue to sell short-term licenses for the appliance through 2017.

Search Appliance was the vendor's response to enterprise concerns about using Google's first search product, a software-as-a-service offering that most users then found unacceptable for enterprise purposes. In June 2016, Google announced Springboard — a new tool that searches across G Suite and assists by proactively providing useful information and recommendations. It will ultimately be released under the name Google Cloud Search.

Clients said they were surprised and confused by Google's decision to retire the appliance without at the same time explaining how customers could switch to the replacement. Among customer references for the most recent Magic Quadrant for enterprise search, two in five references said they had considered the Google appliance before finally selecting another — an indication of Google's strong market presence.

Conversations with Gartner clients reveal that a significant proportion of them will reject a cloud search service, no matter how Google architects and secures it, due to internal or external policy or regulation. If this sample is representative, this stance could be taken by potentially thousands of organizations. Until Google's proposed cloud search product is more fully tested and proven, Gartner recommends that clients consider alternatives.

Highlights:

- Google's Search Appliance has long been successful and popular among enterprises thanks to its ease of use for managers.
- Google will retire the appliance over the next several years.

Pay Close Attention to:

- Google's plans for migrating appliance customers to its new cloud service.
- How the cloud service is designed to offer transparency for security.
- The models that Google adopts for integration cloud and on-premises data resources for searchability.

Summary Advice:

- Research alternatives if your organization has on-premises appliance requirements.
- Evaluate the viability of cloud-based search services in light of enterprise requirements and constraints.

2.1.6.2. G Suite (formerly Google Apps for Work)

Analysis by Jeffrey Mann

As of September 2016, G Suite has been the new branding for Google Apps for Work.

G Suite provides the most popular enterprise collaboration and communication tools from a 100% cloud platform. Google's intent is to provide a simple, easy-to-use and powerful set of tools that employees use for their everyday work. (See the 2.1.2. Developer and IT Services section, 2.1.2.1. Application Services profile for a summary of where G Suite fits in the larger picture.)

G Suite consists of 10 services:

- [Gmail](#) (enterprise email)
- [Hangouts](#) (instant messaging, screen sharing and audio/videoconferencing)
- [Calendar](#)
- [Drive](#) (enterprise file sync and share)
- [Docs](#) (docs, sheets, forms and slides)
- [Sites](#) (simple project sites)
- [Admin](#) (management console)
- [Vault](#) (archiving and ediscovery)
- [Mobile Management](#) (mobile device management)
- [Google+](#) (social networking)

G Suite trails Microsoft Office 365, its primary competitor in this market, in market penetration in the large public corporate segment (see "Survey Analysis: Microsoft Dominates Cloud Email in Large Public Companies but Shares the Rest With Google"). Microsoft offers a mix of on-premises and cloud products.

When Google first launched Google Apps Premier Edition 10 years ago,¹⁷ there were few differences between this G Suite predecessor and the consumer-oriented versions of its component applications. Google has progressively added enterprise features to build a capable platform for business use. It is the only realistic challenger to Microsoft in the cloud office space. As of April 2016, Google claimed that over 5 million businesses were using G Suite.

Google strongly emphasizes simplicity as one of the main characteristics that differentiate its offering from competitors. This quest for simplicity manifests itself in several ways.

Cloud-only deployment with no on-premises versions. G Suite is a cloud-only offering, as befits a company that believes so solidly in the cloud. While some third parties can provide integration with on-premises products from other vendors, this is not a priority for Google. As a result, G Suite avoids the complexity of highly customized applications and hybrid deployments. Google generally believes that on-premises software is itself a problem, and therefore should not be part of the solution.

Browser-only deployment. Users access all of Google's functionality through standard browsers (preferably Chrome but also Internet Explorer, Firefox and Safari). Except for mobile device apps and a small sync client for Drive, nothing is installed on the endpoint.

Simple licensing. Google offers two licensing plans compared to about 20 for Microsoft:

- *G Suite Basic* — The foundational offering at \$5 per user per month.
- *G Suite Business* — The default choice for most enterprises choosing Google. At \$10 per user per month, this adds unlimited storage and additional archiving, governance and e-discovery capabilities.

Negotiating licensing with Google is far less complex than with Microsoft, because there is no need to include credit for other contracts or perpetual licenses that the client has already purchased. Except for large deals, Google is less likely to negotiate on price than many other enterprise vendors. A company pays the same price regardless of how many of the services it uses.

Avoid difficult technical areas. G Suite does not provide deep capabilities for technical areas such as unified communications, enterprise content management and complex workflow beyond the capabilities of the recently announced App Maker module or on-premises integration. These capabilities are difficult to develop and maintain, often requiring significant customization and custom development. Google works with ISVs that can offer some of these services for those customers that require them.

For example, Hangouts can provide an easy-to-use IM and video/audioconferencing experience, but it does not provide corporate telephony services. This is because Google expects that users are moving to these browser-based online services supplemented by a mobile phone, so there will be less need for widespread telephony services. Google partners with Dialpad or RingCentral to offer these services to customers.

Fewer functions, but the important ones. Google products generally offer less functionality than their Microsoft counterparts. Google promotes this positioning as a benefit. Microsoft offers plenty of Office functions that most users never use or even see, especially on mobile devices; Google focuses on implementing only the ones that really matter to provide a sleeker, simpler cross-device experience.

Demand for infrequently used Microsoft Office functions that are not available from Google may be declining as work moves to mobile devices, but Gartner does not expect the need for unavailable functions to disappear from every part of every enterprise. Decision makers need to be supportive of cases where selected users need functions not available from Google.

We have seen several companies opt for Google because they perceive that it is "just like Microsoft but cheaper." That is a big mistake. Users will be disappointed — the cost savings will be less than expected because organizations will likely have to add third-party products to make G Suite look and act more like Microsoft Office 365. To deploy these Google services successfully, companies should understand and embrace Google's approach to this market: the vendor has a distinct view of how to develop products and a near-obsession with simplicity in all things.

Highlights:

- G Suite appeals to organizations that want a radical break in the cost structure and collaboration infrastructure model, through a 100% cloud model.
- Google's offering is the main alternative to Microsoft Office 365 in the cloud office market.
- Google has established a respectable track record of meeting enterprise collaboration requirements with respect to functionality, availability and security.

Pay Close Attention to:

- Google's bringing a distinctive vision and strategy for helping enterprises structure their collaboration efforts. Those considering G Suite need to understand and embrace the Google approach.
- Whether there are individual users still dependent on Microsoft Access and applications built on Microsoft Office. This would mean having to support both G Suite and Microsoft Office for those users, adding complexity and cost.
- Partner alignment with enterprise needs. While Google's partners are agile, some (such as PwC) are clearly attuned to large enterprises while others are more attuned to the needs of SMBs.

Summary Advice:

- Users looking for dramatically different cost, deployment and support models for their collaboration products, or who want to consider a mainstream alternative to Office 365, should consider G Suite.
- For those not looking to adopt the entire suite, Google Drive can be a good starting place as a competitive enterprise file synchronization and sharing product. Its pricing is competitive with other such stand-alone products, and adopters have access to other components of G Suite at no incremental cost.

2.1.6.3. G Suite: Digital Workplace Perspective

Analysis by Matthew Cain

Google embodies many of the values of the digital workplace — a business strategy to boost employee agility and engagement through a more consumerized work environment. At the heart of Google's customer-facing digital workplace initiative is its consumer-friendly, cloud-based G Suite. But Google's greatest contribution to the digital workplace movement may be the competitive threat it poses for Microsoft, which is now aggressively investing in cloud productivity via Office 365.

G Suite is a rethought and redesigned approach to personal and team productivity. Its resulting success has forced Microsoft to invest heavily in Office 365, with a particular emphasis on consumer attributes and new technology.

G Suite has three core priorities: consumer-first, cloud-only and technology-first.

Consumer-first. Gmail and other G Suite components were originally designed for consumers. Only after wide adoption did Google target business users. This approach benefits Google in several ways: Employees who have experience with Google apps as part of their consumer or education experiences are more likely to embrace the service at work; Google's strong focus on usability helps employees quickly build competency with the apps.

This consumer-first orientation is the opposite of that taken by Microsoft, which designs most services — such as Office 365 — for business first, and only then targets the consumer. Google's consumer-first orientation has resulted in a slower pace in meeting enterprise requirements for operational insight, security and identity, and access management — features that are baked into the Microsoft platform from the start.

Cloud-only. Google services are designed exclusively for cloud deployment, in direct contrast to Microsoft, which has taken on-premises workloads such as Exchange and transformed them for the cloud. Google's cloud-only approach makes it easy for customers to access services from anywhere, at any time, on any device — a major contrast to on-premises deployments. As a result, employees with G Suite have greater flexibility on when and where they work.

The cloud-first strategy lets Google innovate rapidly, pushing changes out on a regular basis. It allows Google to avoid the chronic on-premises delay (of up to five years) in adopting new versions. This pace improves employee agility by making new tools available on a steady basis. The cloud also lets Google aggressively use data-driven application development mechanisms, such as A/B testing, which lets the company test new features, such as interface changes, to determine which are most popular with customers. The result is more-intuitive services.

Google also leverages its cloud approach to embrace a key digital workplace idea: making applications inherently collaborative. Real-time sharing of Google Docs, Sheets and Slides has proven very successful. Customers routinely point to that collaborative experience as having a transformative impact on how teams work. Microsoft has struggled to match the easy sharing of these apps, and is only now approaching parity with Google in-app sharing.

But Google's cloud-only emphasis can result in enterprise trade-offs. For example, Microsoft mandates that Office 365 customers pick a particular geography where their data and services will be hosted. In contrast, Google locates services in the data center closest to the employee's primary location. This results in a low latency service, but it also means that organizations cannot restrict services and data to a particular geography. For enterprises looking to keep activity within a particular geography for compliance and/or data sovereignty issues, the Google approach can be problematic.

Technology-first. Google promotes employee agility by introducing many of the technologies that Gartner has identified as important emerging digital workplace technologies. These Google introductions include:

- Machine-learning capabilities in Gmail with its Inbox technology, which helps employees prioritize and winnow large email streams.
- Expanding virtual personal assistant capabilities with Google Assistant.

- The Chrome OS-based Chromebox for Meetings, a \$999 videoconferencing system that makes Google an active participant in the physical workplace. (See the 2.1.4. Enterprise Devices section, 2.1.4.3. Chromebox profile.)
- The immersive user experience with Google Glass, which is now targeted at enterprise use.
- An application development construct called "progressive disclosure," which helps employees improve digital dexterity and gain apps proficiency through contextually displayed hints about functions that the customer has not yet used — for example, nudging the customer to use voice input with Google Docs.
- The rise of the "personal cloud" — employees using Google apps for business purposes, often without the explicit approval of the IT group. Google Drive is often part of the personal cloud, enabling "silo busting" by letting employees easily share data and apps across the organization.
- Google Hangouts conferencing technology has boosted the collaborative capabilities of teams.

Yet Google has fallen short in several technology initiatives. Its Google+ social network, another silo-busting capability, never gained traction in either the enterprise or consumer spaces. Google is breaking up Google+ into more-purposeful apps, such as Collections, Streams and Circles, but so far there are few signs of sustained success with this new approach. The company has also been late to the "ChatOps" movement, where IM is transformed into a persistent platform for teams, which can create separate channels for individual workstreams and to integrate with other apps via codeless "recipes."

As stated upfront, Google's greatest contribution to the digital workplace movement may well be the competitive threat it poses for Microsoft. We believe that the prospect of Microsoft Office losing market share to Google was the key impetus for Microsoft to accelerate Office 365 investments. Partly due to this threat, Microsoft is now cutting investments in its on-premises workloads in favor of the cloud deployment model.

Highlights:

- Google is the only true alternative to Microsoft for a broad suite of personal and team productivity applications.
- Its cloud-first and user-first orientation makes it a bellwether for the post-PC era.

Pay Close Attention to:

- Google's lack of success in the social software market, which is especially relevant given Microsoft's pending acquisition of LinkedIn.

Summary Advice:

- Consider G Suite as an alternative to the Microsoft suite of personal and team productivity apps.

2.1.6.4. G Suite: Midsize Enterprise Market Perspective

Analysis by Joe Mariano

Gartner estimates that about half of G Suite clients come from midsize enterprises. Many start with the consumer-side services and then move to the business versions. A key benefit, constantly cited by midsize enterprise IT leaders, is the suite's ease of use for both end users and IT administrators. They also appreciate having a one-stop shop for a complementary set of services (analytics, mobile applications, collaboration, etc.).

There are several reasons why G Suite has worked well for midsize enterprises.

Cost. Google's price model is standardized and clear, with aggressive price points (for example, G Suite for Business is \$10 per user per month). Prices are generally in a nonnegotiable package, though Google will negotiate with very large customers. Pricing has stayed stable year over year, which allows for more-predictable operational expense forecasting regardless of which Google services the customer is using.

Resource return. Google's low costs and simplicity potentially free up IT resources to be reallocated to other areas. Almost all Google services are cloud-based, relieving IT administrators of the burden of hardware and certain software upkeep responsibilities, which are shifted to Google.

Innovative functionality. Midsize originations gain a more agile and mobile set of services that allow for a more connected ecosystem of products. They can also evolve their infrastructure smoothly without having to manage disruptive upgrades. The flexibility and interoperability of these services, together with other core Google services, facilitate many different ways of collaborating.

Highlights:

- G Suite is a highly collaborative set of services that allows for greater mobility and agility, which most midsize enterprises could not afford with stand-alone cloud-based or installed solutions.
- The intuitiveness and simplicity of administrative dashboards greatly simplify managing these applications, even for business users.
- G Suite has a very strong partner network, with many partners that focus on midsize enterprises.

Pay Close Attention to:

- G Suite's regular update release schedule, the frequency of which may overwhelm some midsize organizations at first. IT administrators may not be able to review all the details in every release (although for many customers not every detail, such as a font update, needs review).
- G Suite not being a catchall for every enterprise need, despite its many services. Midsize IT leaders can sometimes try to overextend G Suite in an effort to save money and resources.

Summary Advice:

- Assess G Suite holistically to determine to what degree it meets the full set of enterprise needs. Pay special attention leveraging G Suite's exclusive functions to maximize return on investment. Cost and resource return should not be the only factor for midsize enterprises considering Google.
- Exploit the G Suite partner network as well as other Google enterprise offerings to fill in feature or function gaps.

2.1.6.5. Unified Communications as a Service

Analysis by Dan O'Connell

Google Hangouts is the vendor's offering in the highly competitive global market for unified communications as a service (UCaaS). Users typically say that Hangouts is very intuitive, and organizations often find that users are leveraging all of its functionality without training. But Google's innovation and expansion of Hangouts' features currently lag those of its competitors.

Part of Hangouts's appeal is that it's one part of G Suite. Key UC functions supported by Hangouts include IM, presence, web/videoconferencing, over-the-top voice and mobility. Google's Chrome browser or native mobile apps serve as the user interface. The platform currently supports up to 25 simultaneous video sessions via WebRTC. Google also supports Chromebox for Meetings video, which offers high-resolution, affordable, room-based video systems based on off-the-shelf hardware. (See the 2.1.4. Enterprise Devices section, 2.1.4.3. Chromebox profile for further details.)

A key strength of Hangouts is its global availability, with infrastructure in 15 data centers spanning North America, South America, Europe and Asia/Pacific. The IT administrative portal supports 28 languages. The Hangouts infrastructure allows global organizations to "home" their employees to the closest data center, as opposed to one centralized data center. This is a critical feature in optimizing the performance of real-time UCaaS. Hangouts has been especially successful in the high-tech and education verticals, and does well in the SMB market.

But Hangouts lacks support for enterprise telephony or PSTN audioconferencing. These services must instead be supported via partnerships with such providers as RingCentral, Dialpad or InterCall. Google does limited co-marketing with these partner providers, and their offerings can be procured via the G Suite Marketplace. With 25 maximum simultaneous video sessions, Hangouts is best-suited for team workgroups as opposed to larger events or formal meetings with business partners. Hangouts users also cite that the reporting tools are high-level so do not provide granular data, and that video integration with third-party video platforms can be complicated.

There are dozens of UCaaS competitors from a variety of suppliers, including CSPs, system integrators, technology vendors and cloud UC application specialists. Hangouts's largest competitor is Microsoft's Skype for Business Online, which is more comprehensive and supports enterprise telephony, audioconferencing and PSTN connectivity — all purchased directly from Microsoft. Cisco's highly scalable UCaaS stack spans WebEx, Spark and HCS — all strong global brands. In the past two years, Google has not expanded its Hangouts functionality at a comparative level to industry leaders such as Microsoft and Cisco.

Highlights:

- *Ease of use* — Hangouts is intuitive and requires minimal training. Even low-tech employees find ad hoc ways to leverage Hangouts video and screen sharing to improve business productivity.
- *Value* — Hangouts is included as part of the G Suite productivity stack. There is no extra charge for the rich base of scalable, intuitive UCaaS functionality included in the basic price.
- *The Google network* — For over a decade Google has invested heavily to build out its own global, high-capacity fiber network. Many users across the globe are physically close to Google POPs to yield sufficient network performance for real-time Hangouts services.

Pay Close Attention to:

- *New features and functionality* — Improvements relative to new Hangouts features and functions have been incremental in the past two years, though Google has announced that an enhanced user experience is forthcoming in 2017. Google's Hangouts investment in this time is below those of competitors such as Microsoft, Cisco, RingCentral and BroadSoft.
- *Partnerships* — The gaps in Hangouts make it insufficient for serving as a comprehensive UCaaS offering. Follow Google's partnership programs to track how some of the gaps can be filled in.
- *Adjacent offerings* — As Hangouts does not have a comprehensive UCaaS stack, businesses must also procure other UC services (either cloud or on-premises) for such capabilities as supporting over 25 users, enterprise telephony and premium video (telepresence). This is an expense and requires management oversight.

Summary Advice:

- Research adjacent offerings. The majority of G Suite customers will find Hangouts a valuable tool for supporting internal communications, but they may be disappointed by its gaps and that they will have to purchase adjacent UC functionality to fill them.
- Encourage the workforce to experiment with Hangouts. Both low-tech and high-tech Hangouts customers cite examples of employees figuring ad hoc ways to incorporate Hangouts to improve productivity. Often this is centered on Hangouts being incorporated into mobile smartphones and tablets.

2.2. Technology

2.2.1. Augmented Reality/Virtual Reality

Analysis by Brian Blau

Google's foray into immersive head-mounted displays (HMDs) for augmented reality/virtual reality (AR/VR) solutions expanded in 2016. These solutions now extend from simple to sophisticated and reach both consumers and businesses.

Google's latest push into VR is Daydream, announced in May 2016. Daydream is a VR package that includes smartphone-compatible and potentially all-in-one HMDs, an OS, a developer platform, and content distribution. The Daydream device specification lets OEMs offer their own HMD and upgraded smartphone devices. Samsung, HTC, Huawei, LG, ZTE, Asus, Alcatel and Xiaomi all appear to be actively working on or releasing Daydream-compliant devices for the first half of 2017.¹⁸

Google Cardboard was launched in 2014 as a demonstration that VR could be simple but effective. Today there are dozens of products using the Cardboard app as standard. In fact, Cardboard devices dominated the nascent HMD market by unit volume in mid-2016.

Google Glass Explorer Edition prototypes had an initial limited release beginning in April 2013, with a general release in May 2014. The associated hype and ensuing backlash raised awareness of HMDs, as well as of AR and VR. Glass at Work is an update to the original device, available only to select developers. It features a small glanceable screen but lacks a true AR experience — features that may be attractive to some businesses that don't require sophisticated graphical overlays. But rivals already have more-capable AR.

The Tango platform, which combines an array of sensors for 3D computer vision, plays a significant role in HMDs at Google. The sensors' capability to decode the user's environment brings context to the user about their surrounding in continuous digital form. Don't expect Tango and HMD to merge at Google in the next year, but do expect advanced HMD devices to gain simultaneous location and mapping (SLAM) sensing capabilities in the not-too-distant future.

Google's overall approach to HMDs is to create a global ecosystem of devices, content, OS software and developer tools. This approach represents the most diverse strategy and offering of any other player in the market. In addition, Google has invested significant funds in Magic Leap, a U.S. startup developing a head-mounted virtual retinal display that projects what it calls a "digital light field" into the user's eyes, to superimpose 3D computer-generated imagery over real-world objects. The investment could give Google access to yet more-advanced HMD technology, but Magic Leap is also evidence of how immature and hypercompetitive the HMD market is. Google must be vigilant to stay at the forefront.

Highlights:

- Google's history and announced plans in HMD technology show that the vendor intends to keep a market-leading position in a still very immature market.
- Google's ecosystem will support multiple types of HMD technology as the vendor builds out a broad platform offering over the next two years.

Pay Close Attention to:

- The rollout of Daydream and partner devices that started in the second half of 2016, end-user and business participation, and overall market growth.
- Outcomes from Google's investment in Magic Leap, which represents Google's best display and sensing technology play in the past two to four years.

Summary Advice:

- Assess the potential impact and benefits of HMD solutions in such areas as for field service, maintenance, training, design or medicine; be prepared to aggressively build, market or integrate these solutions.
- Identify and partner with ISV providers to develop a vibrant HMD solution channel to better help businesses integrate immersive technology to enable smart workplace environments.

2.2.2. Communication Initiatives**2.2.2.1. Wireless: Project Loon, Project Fi and Google Wi-Fi**

Analysis by Mark Hung

Alphabet's three largest efforts in the wireless arena are Project Fi, Google Wi-Fi and Project Loon.

- *Project Fi* — Google's MVNO service, in partnership with Sprint and T-Mobile US, to piggyback on their wireless infrastructure to offer cellular service to its customers. Project Fi's salient features include maximizing the use of the Wi-Fi network for both phone calls and data, and a much lower monthly price than those of the four incumbent U.S. carriers (Verizon, AT&T, T-Mobile, Sprint). But Fi is currently available only in the U.S. and only on five Google-branded smartphones (Nexus 5/5X, Nexus 6P, Pixel/Pixel XL).
- *Google Wi-Fi* — The company's Wi-Fi hot spot network offering. After debuting to much fanfare more than a decade ago, the service today is largely instantiated as the Wi-Fi provider for Starbucks in the U.S. (Google replaced AT&T as the coffee chain's wireless network provider). More recently, Google has become one of the partners for New York City's high-speed Wi-Fi project, LinkNYC. Google serves as the network administrator and display advertising provider through its Sidewalk Labs subsidiary.
- *Project Loon* — Alphabet's solution for bringing internet access to rural and remote areas. It uses the 2.4GHz and 5.8GHz bands, which means it is compatible with existing Wi-Fi devices. After a long development cycle with the balloons used for the network, the project started carrier trials in Indonesia and Sri Lanka in 2016.

2.2.2.2. Wireline: Google Fiber

Analysis by Bettina Tratz-Ryan

In October 2016, Google announced that it will stop searching for new municipal sites for Google Fiber, its gigabit fiber-based communication service. Instead, the vendor will focus on managing its existing eight municipal installations and finishing deployments that it had started in four upcoming cities in the U.S.: Huntsville, Alabama; Irvine and San Francisco, California; and San Antonio, Texas. Google Fiber will be laying off about 13% of its workforce, according to industry sources. [In a blogpost](#) announcing the changes, Craig Barratt, SVP, Alphabet and CEO of the Access unit, said he was stepping down.

Rather than being a setback, the decision could be the first step in dramatically improving the Google Fiber deployment model. In June 2016, Google Fiber acquired Webpass, an Ethernet and fixed wireless ISP targeting apartment buildings and commercial real estate in San Francisco, Boston and other locations. It advertises bandwidth of 100, 200 and 500 Mbps via point-to-point wireless connections. Webpass has been testing a technology called pCell, from Artemis Networks, which creates a "personal cell" with maximum wireless bandwidth for each subscriber. With pCell, Google is acquiring a new technology that, despite its novelty, is also under trail by Nokia Networks for use in Nokia's cellular networking technology portfolio.

Fiber deployment is physically labor-intensive, therefore costly, lengthy and unpredictable, as well as often legally contentious, with disputes over rights of way. Google had required candidate cities to preregister potential subscribers, but preregistration was only for the lowest connectivity package — it rarely included additional, higher margin services. As a result, the massive physical infrastructure investment did not fully pay off.

Webpass enables Google Fiber to change these constraints. It offers a far more cost-efficient fixed wireless infrastructure for high-speed internet services to multitenant residential and commercial properties. Deployment is simpler and faster. In populous areas, this model could dramatically lower customer acquisition costs.

However, Google Fiber needs to clarify and focus on the target markets it wants to address, and decide on the scale of its offering.

- Will it be a niche service provider or a pioneer in low-cost, high-bandwidth internet services?
- Will it concentrate on connectivity or leverage connectivity-with-service offerings?
- With Webpass focusing on the business market, would this be a more lucrative market than single-family homes?

Connectivity packages alone will not provide the margins necessary to create a user-focused service offering. The innovative idea of driving a digital society remains a long-term goal, progress toward which is based on the ability to connect users to value-generating Google content and context.

Highlights:

- Google Fiber announced in October 2016 a halt to deploying new gigabit fiber internet services, but fiber deployments already started in four cities will continue.
- Google acquired Webpass to offer wireless broadband instead.

- Google is forging a new strategy that "enhances our focus on new technology and deployment methods" for "superfast internet."

Pay Close Attention to:

- How and when Google will innovate on the Webpass service to boost bandwidth.
- Deployment scheduling for the new technology and any attendant internet services.

Summary Advice:

- Webpass is not the only fixed wireless provider. Evaluate local or regional providers in light of your business needs for bandwidth, flexibility, affordability and speed of deployment.

2.2.3. Data Center Technologies

Analysis by Martin Reynolds

Google's scale-driven data center systems are not designed for the needs of traditional enterprise customers. But its "serverless computing" approach, a container-based strategy which hides servers from software developers, has promise. Google has launched limited trials to bring economies of scale to enterprise customers.

Scale. Google operates about 2.5 million servers spread across 15 sites around the globe, according to Gartner's assessment based on the vendor's financial reports. Most of the sites are in the U.S., followed by four in Europe; one in Chile; one in Singapore, and one in Taiwan. The typical data center holds up to 150,000 servers, according to Gartner's estimate.

The bulk of these servers support Google's mainstream products: their primary goal is generating advertising revenue. A relatively small percentage (we estimate less than 10%) support Google computing services including Google App Engine (GAE), Google Compute Engine (GCE) and Google Container Engine (GKE), and Google's Data, Analytics and Machine Learning services. By contrast, Amazon, which may have a similar server count, probably has 90% of its capacity devoted to third-party computing.

Google has about 60,000 employees, resulting in a ratio of over 40 servers per employee. But very few of those employees work in the highly automated data centers. Most Google employees focus on growing the business, not running servers. This ratio emphasizes how important it is to Google to keep computing costs low. It does so by relentlessly working to manage and minimize operational, procurement, labor and building costs.

Location. Google sites its data centers based on cost of power, cost of land and geographic need. We believe that the company will lay fiber across long distances to optimize the power and land factors, as connectivity is the easiest variable to manage. Geographic locations are driven by regional legal requirements regarding data sovereignty and privacy, or by the need to be closer to customers.

Server procurement. Google specifies its own servers (they lack front and back panels, for example) and has the motherboards built by ODMs or contract manufacturers. The company also negotiates its own contracts for processors, memory and storage, buying at the scale of a top five server manufacturer. Servers are also used for storage and network functions. Rack switches are proprietary Google designs. We believe that Google is targeting 40 Gbps of network bandwidth per server. Storage is distributed across many servers; data center images suggest that there are four drives per server. This structure allows Google to offer cold hard drive storage at \$0.01 per GB per month — a compelling price for long-term archival.

Energy efficiency. The energy efficiency of a server is defined by the electrical efficiency of its components. We believe that Google keeps its servers up to date by using a three-year product life cycle. The cooling energy costs are largely driven by the speed of air flow. To this end, Google fully encloses the hot side of its racks, backing them up to two-sided central air ducts. All cabling comes from the front of the server, with a simple plug mechanism for power and networking. With an effective seal, air movement speeds can be low, which dramatically reduces cooling costs (fast fans are the primary energy drain in an inefficient data center — doubling the speed of a fan increases the energy consumption by at least eight times). Google states that its data centers use less than 10% of their power for cooling — a dramatic contrast to the 30% typical of the better enterprise data centers.

Resilience not redundancy. Google application architectures are designed to be resilient: if a server or cluster fails, the load is quickly taken up elsewhere. This is a major architectural shift from the traditional redundancy approach, which relies on dual systems. Google uses a sophisticated automated orchestration tool named Omega, which can deploy and manage application processes across servers with minimal overhead. The company is moving toward Kubernetes, an open-source project which it is promoting as a server and container orchestration system.

Google is also making a major push into the enterprise. The company has hired VMware's Diane Greene, staffed an enterprise sales team and committed to investing a billion dollars in the initiative. Google has positioned the initiative's key component of serverless computing against virtual machines, citing greater computing efficiency, faster development cycles and greater flexibility. Google now has to convince prospects that it can meet enterprise requirements.

Highlights:

- Google operates about 2.5 million servers in 15 data centers around the world.
- The vendor is relentless in managing and minimizing operational, procurement, labor and building costs.
- Google has only recently started to address enterprise customer needs in its data center designs and operations.

Pay Close Attention to:

- Google's expanding trials bringing economies of scale to enterprise customers.

- Google's emerging serverless computing architecture, and how services based on it may be exposed to enterprise compute customers.

Summary Advice:

- Charge IT managers to understand the processes needed to develop applications for Google's infrastructure.
- Review project plans and push new projects to serverless architectures.
- Modernize legacy systems by jumping straight to serverless concepts.

2.2.4. Emerging and Future Technologies

Analysis by Mark Hung

Google's Advanced Technology and Projects (ATAP) group is a technology incubator. Its function is similar to Alphabet's X, but ATAP projects are limited to two years.

Two of ATAP's best-known projects are no longer part of its portfolio:

- *Tango* — Uses various sensors and imaging processing to create, on a mobile device, a real-time 3D model of the physical environment. It has graduated into production, with Lenovo having announced the Tango-enabled Phab 2 Pro, a 6.4-inch smartphone.
- *Ara* — Was intended as a modular smartphone platform that lets the user hot-swap different hardware functions (e.g., camera modules, sensors, wireless technologies) as needed. A developer edition was slated for fall 2016 release, but Google instead canceled the program.

Google has long had a presence in the consumer IoT market with such offerings as Android Wear (wearables), Nest (connected home) and Android Auto (connected car). Consumer IoT is a prominent part of ATAP's efforts, with two publicly announced projects:

- *Project Jacquard* — An innovative approach to wearables: a conductive yarn that can comprise the entire fabric, available in many colors and a variety of textile weaving techniques. It will enable wireless communications and touch interface capabilities on a wide variety of garments. Levi Strauss & Co. is a launch partner for the technology. Its Jacquard garment will be a jacket whose sleeve the wearer can touch to answer or block a phone call. Initial applications that will support Jacquard include Spotify, Google Maps and Strava. The product is expected to be available in early 2017, with a beta trial at the end of 2016.
- *Project Soli* — A Google-developed chip that uses the 60GHz wireless spectrum and incorporates a "gesture radar" that creates a much larger surface area for wearables to interact with. The goal of the technology is to provide users with more space to interact with the UI elements on wearables such as smartwatches, instead of having to struggle with small-screen constraints. The current implementation includes four antennas and draws 0.054 watts — a power reduction of 22 times compared to the first prototype.

2.2.5. Google and the Web

Analysis by David Smith

Google continues to influence the web more than any other vendor, and vice versa.

"To make the web a better place"

Google's reasoning for some of its innovations

Driven primarily by search and monetized by online advertising, Google's mainstream businesses have long been dependent on the web. The company line above does not reflect altruism; the better the web is, the more people use it and fuel Google's advertising business. With that comes increased presence and market power. While Google was born well after the internet (it was founded in 1998), its name has long been synonymous with the web.

Web technologies and standards continue to advance. Increasingly, Google drives these advances. Its Chrome browser now leads in all market studies covering the consumer web, and even in the enterprise Chrome is now the most commonly used browser. The lack of other vendors focusing on the web gives Google the opportunity to shape it to its own best advantage.

- Apple is increasingly focused on native capabilities, especially in mobile, but the mobile web has not advanced as many had expected.
- Microsoft's client, mobile and device businesses are facing many challenges, causing its focus to be primarily elsewhere (although it has introduced its new Edge browser).
- Mozilla is the only other organization focused almost exclusively on the web, but it has limited assets and little mobile presence.

The general weakness of the plethora of standards organizations also creates the opportunity for a large vendor with almost unlimited assets to set de facto standards.

The rift between Google and Apple continues to widen, with Google forking WebKit, an open-source rendering engine project that was originally jointly sponsored by the pair. With Apple's native focus and Google's aggressive web focus, expect Google's Blink (the rendering engine behind the Chrome browser) to continue to gain traction.

It is in Google's best interests for the world of tomorrow — mobile and beyond — to closely resemble the web world of today, which Google knows how to monetize. Google continues bringing Android and Chrome OS closer together, recently enabling Android apps to run on Chrome OS. Its Chrome browser is a key part of this strategy. Now clearly leading the desktop browser market, Chrome is also a major presence on the mobile web. Because of Google's influence, it is really the only vendor or force that can make the mobile web a success.

One of the ways Google is attempting to boost the mobile web is to make it indistinguishable from the world of apps. In this approach, Google is adopting for the user/consumer view instead of the developer view. This is key, as mobile users today dislike the mobile web. They have been conditioned by the rise of mobile to want only apps. There are many reasons for this dislike — some

rooted in myth, others in reality. Regardless of the reasons, mobile users don't know or care what technology is used: they think that apps are good and that the mobile web is not.

To blur this distinction between apps and the web, Google is taking several steps:

- Material Design — The design language that uses simple, responsive design characteristics to create an illusion of depth through shading and animations. Google is bringing the language to Android and the web (including the mobile web), and now to iOS via its apps, and beyond as well. An important aspect of Material Design is that apps and the web (including the mobile web) will look the same. Increasingly, it will become more difficult to tell which is which.
- Facilitating seamless movement from the web to apps, by allowing apps to populate the browser's recent search results.
- Indexing apps in Google search and facilitating access to apps from the web.
- Additional efforts such as deep linking.

Despite surrendering the browser crown to Chrome, which nosed past Internet Explorer this year, Microsoft maintains significant influence in enterprises. Most enterprises still claim to have a standard browser, and that standard is usually a Microsoft specification. However, enterprises are increasingly adopting a type of two-pronged browser strategy. Today, Internet Explorer plays the role of a legacy browser, while Google Chrome is part (often a prominent one) of a modern browser strategy. We do not recommend standardizing on any browser, including Chrome, and maintain that a modern browser strategy should account for multiple implementations.

Highlights:

- Increasingly Google is driving web advances and innovations.
- Via the Material Design language, Google is working to ensure that apps and the web (including the mobile web) look the same.
- Google Chrome is the now the leading browser for both consumers and the enterprise.

Pay Close Attention to:

- Google's continuing efforts to bring Android and Chrome OS closer together.

Summary Advice:

- Adopt Google offerings with the assumption that they will usually align with the direction of the web.
- View investments in web technologies anticipating that, in many cases, Google's agenda will set the tone for the future of the web.
- Plan for Google's offerings that have not yet been driven by the web (Android, for example) to be increasingly influenced by web forces.

- Don't standardize on any browser, including Chrome.

2.2.6. Robotics

Analysis by Bettina Tratz-Ryan

The robotics investments by Google and now by its parent, Alphabet, have captured the industry's attention. Speculation is rife about the innovation potential and the commercialization direction that the vendor might take.

But the negative side effect of the speculation and hype is that organizations can have unrealistic expectations of out-of-the-box results. In fact, robotic successes for Alphabet (and other players) have been few and far between so far, given the focus on the technology aspects of robotics instead of on industry use cases. At this point, Alphabet has not laid out a clear, actionable strategy for robotics.

More uncertainty is being created by continued but unconfirmed reports that Toyota is finalizing a deal to buy Boston Dynamics, a key part of Alphabet's Replicant robotics division. The division launched in 2013 with Boston Dynamics (an outgrowth MIT's Leg Laboratory) and eight other robotics companies.

The visible results of the acquisition were demonstrated in February 2016: Boston Dynamics released a video showing a humanoid robot, dubbed Atlas, which can move unassisted over outdoor terrain. The robot incorporates sensors in body and legs that help to maintain or regain balance. It uses light detection and ranging (LIDAR) and stereo sensors to analyze the surrounding environment, avoid collision and assist in navigation. With funding from the U.S. Defense Advanced Research Projects Agency, Atlas was designed especially for resilience in catastrophic incident environments.

In June 2016, Boston Dynamics released a video of SpotMini, a smaller version of the original four-legged robot "dog" that is trained to work in a residential environment. The robot's head is attached to a neck that acts as an elongated arm. That neck can grab items and move them around.

One of Alphabet's most significant innovations is combining robotics' physical engineering complexities with the vendor's advanced research in AI (machine learning and natural-language processing). [Google Brain](#), for example, is a research group focused on technologies and products related to large-scale-distributed deep-learning networks. Research areas include machine-learning algorithms and techniques and natural-language understanding.

This research will be key to advances in robotic safety and sensitivity, in the social integrity of the human-machine interface and in cybersecurity. In turn, these advances will enable Alphabet robots to address complex business and residential use cases.

Alphabet is not unique in this regard.¹⁹ The combination of robotics and AI is attracting the attention of governments and regulatory agencies. Alphabet will likely face special scrutiny as these capabilities are implemented in commercial robots.

Highlights:

- Replicant's focus on robotic stability and on leveraging machine-learning capabilities is starting to show success.
- Replicant is adding a range of new capabilities, such as improved mobility, indicating a greater focus on industry use cases.
- Replicant is trying to identify the scope of issues that AI (machine learning and natural-language processing) has on robotics and humanoids.
- Google's Brain division has published, together with researchers from Stanford University, UC Berkley and OpenAI, a white paper entitled "[Concrete Problems in AI Safety](#)" (v.2 released in July 2016) that explores the side effects, risks, potential undesirable behaviors and supervision issues related to robotics.

Pay Close Attention to:

- Google and Alphabet announcements related to investment in and the direction of their robotics projects.
- How Alphabet leverages the synergy between its robotics development and its leading machine-learning capabilities and ongoing research.

Summary Advice:

- Discount the hype around robotics and focus on realistic and realizable industrial and commercial uses cases, where Google can take action.
- Start a robotics innovation center than can develop the organization's ideas and requirements about robotics, and map these to Google's emerging capabilities.
- Stay informed about competitive alternatives — Google is only one of many players rushing to innovate in robotics.

2.2.7. Security

Analysis by Steve Riley

Google's security posture. Security is a principal differentiator between Google's business and consumer services. For both Google Cloud Platform (GCP) and G Suite, Google states that business customer data belongs to the customer. Content is not scanned for advertising-related keywords and no ads are displayed in the core services.

Google describes its security practices in a collection of white papers, including a general document (see "[Google Security Whitepaper](#)") and one focused on G Suite (see "[Google for Work Security and Compliance Whitepaper](#)"). Google's security and privacy practices follow typical industry practices for large Tier 1 cloud service providers. These include:

- Published contracts that contain commitments for data ownership, data use, security, transparency and accountability.
- An optional data processing amendment that offers additional assurances, intended primarily for European customers (see "[Data Processing Amendment to G Suite Agreement](#)").
- Strict policies governing access to customer data by Google employees. All activity is monitored and logged; logs are scanned to determine inappropriate access.
- Encryption of all data in transit between Google facilities as well as all data at rest — a change prompted by the 2013 Edward Snowden revelation that the U.S. National Security Agency was snooping on traffic between Google's data centers (see "[NSA Infiltrates Links to Yahoo, Google Data Centers Worldwide, Snowden Documents Say](#)").

Increasingly, Google resists government requests for data, and has successfully narrowed the scope of several. Google publishes a detailed [Transparency Report](#) that shows government requests to examine customer data.

GCP service-level agreements (SLAs) vary by service and range from 99% to 99.95%. Most GCP services can be started in customer-chosen geographic zones and regions; some services include geographic redundancy. G Suite's SLA is 99.9% with no scheduled downtime. The RTO and RPO targets for G Suite are zero. All actions are replicated simultaneously in two data centers; G Suite provides no mechanism for customers to indicate specific geographic residency requirements.

G Suite has achieved the following third-party verifications:

- SOC 1 (SSAE-16/ISAE-3402)
- SOC 2 and 3
- ISO 27001
- ISO 27018:2014
- FedRAMP ATO at FIPS 199 Moderate

GCP has achieved the same verifications as above, plus:

- ISO 27017:2015
- PCI-DSS v3.0

Available security controls. Google has chosen not to use security as a differentiator between GCP and competing IaaS clouds. Instead, Google claims that GCP benefits from companywide investments in improved security, and works to convince customers of the trustworthiness of Google's cloud (to counteract years of suspicion of Google's consumer services). Google's security and privacy practices follow typical industry best practices for large Tier 1 cloud service providers, including obtaining several important third-party attestations. GCP includes the basic controls required for secure deployments of enterprise workloads. More-advanced capabilities, such as identity and access management (IAM), bidirectional traffic filtering and limited support for bring your own key, are only now beginning to appear.

In G Suite, security does become a principal differentiator between Google's business collaboration services and its equivalently named consumer services. G Suite includes an adequate set of security controls that address most security requirements for cloud-based collaboration. For certain areas (e.g., encryption, IAM, privileged access management, information rights management and data loss prevention), third-party controls are likely to be more useful as these fall outside Google's core competencies. Device management capabilities for Android are very thorough though, with iOS lagging somewhat and Windows Phone lagging significantly.

GCP and G Suite can consume identities from Google or from any third-party SAML identity service. In GCP, App Engine can use SAML for authenticating to web applications. In G Suite, accounts can be placed into organizational units that can be granted specific rights for syncing and sharing content, storing offline content, and installing company and external applications. G Suite can also synchronize with LDAP directory servers.

HIPAA compliance in GCP and G Suite is possible. Customers must sign a business associate agreement (BAA) to store personal health information (PHI). Permitted GCP services include Compute Engine, Cloud Storage, Cloud SQL, Genomics and BigQuery. Permitted G Suite services include Gmail, Drive, Docs, Sheets, Slides, Forms, Calendar, Sites and Vault. No other Google services are permitted for HIPAA-protected data.

PCI compliance in GCP is possible. App Engine, Compute Engine, Cloud Storage, Cloud Datastore, Cloud SQL and BigQuery have achieved PCI DSS v3.0 compliance and can be used to build PCI-compliant applications that process cardholder data. No part of G Suite is PCI-compliant.

Customers who choose to leave G Suite can export data from most services, sometimes with a choice of formats. Optionally, data can be imported into Dropbox or Microsoft OneDrive. No extra fees are charged for exporting data.

Highlights:

- Cloud Key Management Service, a new GCP feature, offers a generalized, servicewide managed encryption service for applications that need to create and use secrets. It can't be used for encrypting Compute Engine disks or Cloud Storage buckets.
- Customers using both GCP and Amazon Web Services (AWS) can consolidate monitoring onto Stackdriver, which Google acquired in 2014. The current beta release provides monitoring for GCP and AWS resources. It goes beyond basic AWS CloudWatch metrics to include dependency mapping, event correlation, root cause analysis and recommendations for performance optimization.
- Within your GCP account, resources are grouped into *projects*. Projects provide distinct compartments for management and billing. Deleting a project deletes all associated resources. Projects work very well for maintaining a typical development/test/production deployment.

Pay Close Attention to:

- The virtual networking controls in GCP, which aren't as comprehensive as those in AWS or Microsoft Azure. GCP firewall rules apply only to subnets and operate only inbound. Host-based filtering or third-party firewall instances will be necessary for more-sophisticated traffic control and segmentation.
- Compute Engine and Cloud Storage's basic support for encrypting data with customer-supplied keys. For Compute Engine, this feature actually encrypts the Google-generated keys that in turn encrypt only persistent disks. For Cloud Storage, this feature replaces Google's managed at-rest encryption key with the customer-supplied key.

Summary Advice:

- Remember that while cloud service provider contracts can often sound appealing, their primary purpose is to protect the providers themselves.
- For troubleshooting subscriber issues, customers can optionally require an additional customer-approval step before access is granted.
- If using GCP or G Suite for HIPAA workloads, block access to nonpermitted services for users who handle PHI. See Google's HIPAA implementation guide for more information (see "[HIPAA Compliance & Data Protection With G Suite](#)").
- To avoid G Suite PCI compliance issues, configure DLP in Gmail to prevent sending messages with credit card numbers, and run audits on Drive to ensure that no credit card numbers are stored.
- Google will delete data from its systems within 180 days after customers delete it from their services. A better method for truly deleting data is to first encrypt it and then discard the key, which renders leftover objects useless. The same advice applies to GCP.

Gartner Recommended Reading

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

"Vendor Rating: Google"

"How to Enhance the Security of Google Apps for Work"

Evidence

¹ "[Introducing Google Cloud](#)," Google Cloud Official Blog.

² See "[Alphabet Inc. Form 10-Q for the Quarterly Period Ended September 30, 2016](#)," U.S. Security and Exchange Commission (SEC) filing.

³ See "[Google Still Dominates the World Search Ad Market](#)," eMarketer, 26 July 2016, and "Hype Cycle for Digital Marketing and Advertising, 2016."

⁴ See "Market Guide for Mobile Marketing Analytics."

⁵ See "Survey Analysis: Microsoft Grows Its Share of Public Cloud Email Among Public Companies Faster Than Google."

⁶ See "[Apple Maps, Once a Laughingstock, Now Dominates iPhones](#)," The Boston Globe.

⁷ See "[comScore Reports December 2015 U.S. Smartphone Subscriber Market Share](#)," comScore, 4 February 2016.

⁸ See "[Pricing and Plans](#)," Google Maps.

⁹ See Gartner Peer Insights, "[Reviews for Cloud Infrastructure as a Service](#)" and "Critical Capabilities for Public Cloud Infrastructure as a Service, Worldwide."

¹⁰ See "In-Depth Assessment of Google Cloud Platform."

¹¹ See "Conversational AI to Shake Up Your Technical and Business Worlds."

¹² There have been more than 13,000 gross [TensorFlow](#) commits on GitHub by 587 different contributors since its initial commitment by Google on 6 November 2015. Commits are unqualified so these numbers are directional indicators, not detailed measures of investment activity. There are also more than 5,500 TensorFlow-related repositories listed on GitHub. We have no specific data on Google-related GitHub activity by large enterprises versus the larger market.

¹³ See "Market Share Alert: Preliminary, Mobile Phones, Worldwide, 3Q16" and "Market Opportunity Map: Personal Devices, 2016 Update."

¹⁴ See "[Google Says Its G Suite for Education Now Has 70m Users](#)," Techcrunch.

¹⁵ Gartner's most recent data shows Android captured almost 88% share of market among major mobile platforms — see "Market Share: Final PCs, Ultramobiles and Mobile Phones, All Countries, 3Q16."

¹⁶ See "[Name Change From Android for Work to Android; Google Play for Work to Google Play](#)," Google.

¹⁷ See "[Google Introduces New Business Version of Popular Hosted Applications](#)," Google.

¹⁸ See "[Welcoming More Devices to the Daydream-Ready Family](#)," Google.

¹⁹ Two examples of industry activity in AI and robotics: [Toyota](#) is developing a Human Support Robot, and announced that it will invest \$1 billion over the next five years to establish a new Silicon Valley R&D arm focused on AI and robotics. The Toyota Research Institute (TRI) plans to hire

hundreds of engineers to staff a main facility in Palo Alto, California, near Stanford University, and a second facility located near MIT in Cambridge, Massachusetts. [XIAOI](#) in China develops intelligent chatbots that, in the smart home and smart city context, create intelligent interfaces between a person and their home environment through voice command, asking the robot to perform and learn based on the human interaction.

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