Google Cloud Executive Spotlights

Leadership perspectives on today & tomorrow in cloud

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Urs Hölzle

Senior Vice President,
Technical Infrastructure

"What differentiates Google Cloud from other cloud providers is that we build an ecosystem, not just products. This approach is a foundational one for Google."

An open ecosystem driven by the success of all

Aside from unparalleled product strength in analytics, machine learning, networking, and security, what differentiates Google Cloud from other cloud providers is that we build an ecosystem, not just products. This approach is a foundational one for Google. Take Android, for example. It's not a product. It's an ecosystem, upon which a wide and global community of software developers and hardware vendors can build and create their own successes.

With Google Cloud, our goal is to provide an open source hybrid platform that enables enterprises, developers, and SaaS providers to provide secure and reliable solutions with a minimum of operational hassle. Kubernetes allows developers to deploy containers on multiple clouds, and Istio provides highly secure containerized service management. And TensorFlow, as a low-level tool for machine learning, lets you run the same source code on any type of ML hardware including our custom TPUs.

In just a few years, very few customers will have to administer applications, including complex ones, in the detailed way we accept as normal today. Managed platforms like Google Kubernetes Engine and the new Cloud Services Platform will allow hassle-free service deployments that automate many of today's time-consuming configuration and operations tasks, even in a hybrid environment and for existing applications, while being based on a fully open-sourced core that allows for rapid adoption without vendor lock-in.

Security first, all else will follow

Security has been paramount to Google from the very beginning. (I would know!) We've been operating securely in the cloud for almost 20 years, and we have seven apps with more than a billion users that we protect from threats every single day, and GCP itself connects to more than a billion IPs every day. We believe that security empowers innovation—that if you put security first, everything else will follow.

Security is in the details—and we look at these details at the most granular level. We were the first to introduce SSL email by default in 2010, we created the U2F security token standard in 2014, Chrome was the first browser to support post-quantum crypto in 2016, and in 2017 we introduced Titan, a purpose-built chip to establish hardware root of trust for both machines and peripherals on cloud infrastructure. These examples show the level of depth that we go into when thinking about security and how we push the industry forward to stay on top of evolving threats.

Take for example Google's Project Zero team, which hunts for vulnerabilities across the internet and is behind the discoveries of "Heartbleed," "Spectre," and "Meltdown." We provide incentives to the security community to help us look for and find security bugs through our Vulnerability Reward Program.

We know how complex the security landscape is, and we've spent a lot of time thinking about how to solve this tough challenge. We've developed principles around security that define how we build our infrastructure, how we build our products, and how we operate.

For enterprises and end users to become more secure, security itself needs to be easy to use and built-in from the beginning. Our security whitepaper (found at *https://cloud.google.com/security/overview/whitepaper*) shows the security measures in place behind every GCP product, and our open-source projects Kubernetes and Istio aim for enterprise security by default.

"G Suite's integrated productivity and collaboration applications natively embed machine learning and reflect Google's commitment to Reimagine Work."

Prabhakar Raghavan
Vice President, Apps, Google Cloud

Work Reimagined with G Suite

Today, over 1B people around the world use G Suite apps—Gmail, Drive, Docs, Sheets and Slides—in their personal lives. Over 80M students and more than 4M paying businesses use G Suite to be more productive and creative. Whirlpool, Nielsen, Broadcom, ANA, BBVA, and Ocado are among the many businesses who choose G Suite in order to move faster, connect teams better, and advance their competitive edge. These businesses seek to overcome the common challenges faced when using legacy productivity tools—including barriers to collaboration like sending versioned attachments by email.

G Suite's integrated productivity and collaboration applications natively embed machine learning and reflect Google's commitment to Reimagine Work. We spend almost one third of our lives at work and spend much of that time on manual, repetitive tasks like responding to emails, searching for information and files, and scheduling meetings. Google AI works behind the scenes in G Suite to save time and help remove the mundane.

With G Suite, organizations collaborate faster, more simply, and more securely, directing more time and focus on impactful, creative activities that move the business forward.

Secure

G Suite is inherently more secure than legacy tools because it's built in the cloud. We've also eliminated attack vectors that others still accept as inevitable—for example, no one can lose a Google Doc if they lose a thumb drive. Our full-stack security is also self-administering—there are no

patches or software updates to roll out, so G Suite users are never working on an out-of-date version.

Gmail confidential mode, which helps protect sensitive content in email through expiration dates or by revoking previously sent messages, together with built-in Information Rights Management (IRM) controls that disallow forwarding, copying, downloading, or printing messages are other examples of recently released security features that provide added protections for our users.

Smart

Our many years of investment in AI enable us to remove the mundane in the work we do, letting us focus on our creative best. With AI, we can automatically suggest rooms for meetings, suggest data visualizations, make relevant documents available in context, and even suggest email text and replies.

Gmail Smart Reply is an example of how we've built AI into everyday tasks. Users have the option to choose one of several machine written reply suggestions; these now account for over 10% of Gmail replies. Smart Compose takes this a step further by autocompleting emails. It can complete sentences and fill in salutations and personal facts, such as addresses, creating even greater opportunities to save time using AI.

Simple

Simplicity is a fundamental design principle in G Suite; we don't encumber our users and admins with multiple toolbars and consoles. But we do more to make G Suite simple: AI helps automate tasks, and more importantly, makes that automation seamlessly accessible to all users across business functions. This helps to add a level of simplicity and ease that's so intuitive, we've found it can, at times, be imperceptible.

For instance in Google Drive, machine learning generates top predictions for files users are seeking. This saves time spent searching, browsing, and filtering files, and we're seeing that 50% of files opened in Google Drive are from this panel of predictions. That's a benefit that's changing user behavior, but the AI is so transparent that many users aren't aware that they're using a new feature. And because G Suite is cloud-native, these AI-driven features that add ease and simplicity to our work will evolve over time and can naturally expand to other applications in the Suite.

We design G Suite to be Secure — an advantage that comes from being built in the cloud, Smart — by using AI to remove the mundane, and Simple — so intuitive and light that billions of people are already using it. We'll continue the charge forward to help businesses and users carve out more time for creative, collaborative, inspiring work in all parts of their daily lives. Let's Reimagine Work with G Suite!

Fei-Fei Li

Chief Scientist, Google Cloud
AI & Machine Learning

"No technology is more reflective of its creators than AI. It has been said that there are no “machine” values at all, in fact; machine values are human values. A human-centered approach to AI means these machines don’t have to be our competitors, but partners in securing our well-being."

AI that’s good for people

My three goals for human-centered AI:

1. AI needs to reflect more of the depth that characterizes our own intelligence

Artificial Intelligence is a scientific quest to develop machine intelligence. From functionality to algorithms, there is a lot to learn from biological intelligence. This demands collaboration among fields beyond computer science, including cognitive science and neuroscience, which take us back to our roots as a field. Sixty years ago, neuroscience researchers David Hubel and Torsten Wiesel discovered how the hierarchy of neurons in a cat’s visual cortex responds to stimuli. And more than 30 years ago, cognitive scientist and linguist George Miller created WordNet to organize the semantic concepts of English. It’s the project that ImageNet, a data set of millions of training photographs that helped advance computer vision, is based on.

Reconnecting AI with fields like cognitive science, psychology, and even sociology will help us collaborate and communicate more naturally and effectively with technology.

2. Enhancing us, not replacing us

AI has the potential to make many jobs more accommodating to human skill by automating repetitive, dangerous, and error-prone tasks. Consider surgery, for example: intelligent systems might soon monitor an operation to detect a surgeon’s natural blind spots like fatigue and distraction, enabling a greater focus on strengths like dexterity and creative problem solving. Similarly, imagine the role such systems could play in a senior care facility; drug dosages and

safety checklists could be automatically tracked, freeing caretakers to spend more time building relationships with their patients. The goal is the same in both cases—reducing harmful inconsistencies while encouraging the creative, intellectual, and emotional roles we're best at.

3. Ensuring that the development of this technology is guided, at each step, by concern for its effect on humans.

Of course, no amount of ingenuity will fully eliminate the threat of job displacement. And labor is just a part of AI's complex societal impact; additional challenges include the tension between digital privacy and AI's appetite for data, the geopolitical implications of a global intelligence race, and, perhaps most significant of all, the potential for algorithmic bias to disenfranchise underrepresented communities. Solving these problems will be a multidisciplinary endeavor, requiring commitment and cooperation from our largest institutions. For instance, universities are uniquely positioned to foster connections between computer science and traditionally unrelated departments like the social sciences and even humanities. Governments can make a greater effort to encourage computer science education, especially among young girls, racial minorities, and other groups whose perspectives have been underrepresented in AI. And corporations can compliment their aggressive investment in intelligent algorithms with ethical AI policies.

No technology is more reflective of its creators than AI. It has been said that there are no "machine" values at all, in fact; machine values are human values. A human-centered approach to AI means these machines don't have to be our competitors, but partners in securing our well-being. However autonomous our technology becomes, its impact on the world—for better or worse—will always be our responsibility.

Making AI that's accessible to everyone

Early this year, we announced Cloud AutoML, which allows businesses with limited ML expertise in-house to start building their own high-quality custom models. By making advanced techniques like learning2learn and transfer learning from Google accessible to any business, we're doing more to democratize AI and create new avenues for discovery that aren't limited to only the handful of businesses in the world that have access to the talent and budgets needed to fully appreciate ML and AI advancements. Also, by removing time demands and process complications around building custom ML models, we hope to speed, broaden, and foster innovation with ML and AI cross-industry.

Our first Cloud AutoML release is AutoML Vision, a service that makes it faster and easier to create custom ML models for image recognition. It offers a drag-and-drop interface with easy image uploading and simplified ML model training and management. Users deploy trained ML models directly on Google Cloud. Early results using Cloud AutoML Vision to classify popular public datasets like ImageNet and CIFAR have shown more accurate results with fewer misclassifications than generic ML APIs.

We're proud that customers like Disney, Urban Outfitters, and Zoological Society of London have been able to put AutoML Vision to use.

Injong Rhee
Entrepreneur in Residence

"IoT intelligence at the Edge fundamentally shifts how we derive value out of massive data, informs and shapes our larger culture of device use, and creates new revenue opportunities for businesses in every industry."

IoT intelligence at the Edge

The proliferation of smart, connected devices used for everything from creating smart cities to managing oil and gas drilling equipment has prompted demand for greater intelligence that allows us to make sense of massive amounts of IoT data in real time as that data is captured. This is IoT at the Edge, which enables us to make real-time intelligent decisions in close proximity to or at the devices themselves without relying fully on processing everything in the cloud.

IoT intelligence at the Edge fundamentally shifts how we derive value out of massive data, informs and shapes our larger culture of device use, and creates new revenue opportunities for businesses in every industry. It will bring the advancements of AI to gateways and connected devices, making IoT applications smart, secure, reliable, and responsive. While Google Cloud IoT Core already provides developers and businesses services to scale, secure, and manage IoT devices and assets, extending these services to the cloud is becoming increasingly critical for customers with needs for lower latency, filtering, protocol translation, and real-time intelligence. Google Cloud continues to invest in its Cloud IoT Core technology that will bring scale and greater intelligence end-to-end.

Game-changing IoT Security

For companies building connected devices, security is critical, but applying a combination of strong identity, encryption, and access control to ensure the highest level of security poses significant challenges for many businesses. Digital access

to root certificates and private keys by bad actors, largely contributes to this security challenge because the root key is at the base of the entire security chain.

The advent of affordable and cloud-ready HW root of trust has been a gamechanger for IoT security. Understanding the importance of prioritizing security, Google Cloud has partnered with Microchip to add a secure element, Microchip ATECC608A cryptographic coprocessor chip, to store private keys, validate the firmware images at boot and sign authentication JWT. Microchip ATECC608A hardware stores key material and is designed to block physical hacking and key retrieval.

With security in mind, instead of relying on a bloated mutual authentication from TLS that is not well suited for very constrained devices, Google Cloud IoT uses a common JWT (JSON Web Token), signed with its private key, as a password to authenticate devices. This provides the same level of security as TLS mutual auth but requires a much smaller footprint on device. It also allows non-IP devices to authenticate to Google Cloud IoT through Edge devices.

IoT communication protocols

Google Cloud recently joined the LoRa Alliance, a fast-growing technology alliance and non-profit association built around a LoRaWAN open standard maintained by nearly 500 firms and developed by chip manufacturer Semtec. We joined the alliance to advance development of IoT communication protocols and enable low-power, low-cost, and long-range communication and broader access to data analytics and insights. The focus on openness and interoperability of the LoRa Alliance pairs well with our own commitment to openness, security, and creating more pathways to innovation. We're already seeing how these new communication capabilities are simplifying development, deployment, and management of IoT solutions. They're opening doors for new or advanced IoT applications, including asset tracking and advancement of "smart cities," which need a high number of sensors for city elements such as traffic lights, roads, buildings and parking garages, and are more feasible with the LoRa standard.

"Our partnering philosophy is driven by a set of principles that emphasize openness, innovation, fairness, transparency, and shared success in the cloud market."

Nan Boden
Head of Global Technology Partnerships

Google Cloud's partner ecosystem

Google Cloud's partner ecosystem is growing rapidly as we make more of Google's infrastructure available to the public and make the interfaces to it easier to access. Our partners look at Google as an opportunity to innovate fast and make their market presence more competitive. And, we distinguish ourselves from other cloud providers by partnering with companies engineer to engineer. In true partnership, we work hard to understand how our partners' business models are changing and strive to help them evolve.

Our partnering philosophy is driven by a set of principles that emphasize openness, innovation, fairness, transparency, and shared success in the cloud market. We hold firmly that an open platform encompassing diverse partners maximizes innovation for customers, letting them move more quickly. We believe an ecosystem built on this foundation will help drive not only Google's success and that of our partners, but will also help customers transform their business.

Google Cloud technology and go-to-market partners

Our customers benefit from two types of partnerships: tech partners who build their technology and business by integrating with Google Cloud, and go-to-market (GTM) partners. These GTM partners include resellers and global system integrators like Accenture, Salesforce, Cisco, SAP, Pivotal, Intel, Deloitte, and PwC that are using Google Cloud as a foundation for driving digital transformation.

For example, our partnership with Cisco helps our customers improve agility and security in a hybrid world with a fully supported, open solution

built on Kubernetes and Istio. The solution allows customers to develop and manage applications on-premises and in Google Cloud.

Also advancing the path to hybrid, we collaborate with Pivotal to use the open-source project Kubo, a tool that instantiates, deploys, and manages Kubernetes clusters with high availability on public and private clouds. We also work with VMware and Pivotal to support Pivotal Container Service™ (PKS), a new service that enables enterprises and service providers to deliver production-ready Kubernetes on VMware vSphere and Google Cloud Platform (GCP).

We also recently announced a first-of-its-kind strategic partnership with Salesforce that spans Google Cloud and Google Analytics to enable deeper insights and more collaborative experiences for our customers. Salesforce has also named G Suite as its preferred email and productivity provider and plans to use Google Cloud Platform for its core services as part of the company's international infrastructure expansion. Our teams are working very closely to develop new integrations that will connect Salesforce CRM with G Suite to offer the only cloud-native collaboration platform of its kind. These integrations will enable companies to surface powerful intelligence from Salesforce directly within Gmail, Sheets, Calendar, Drive, Docs, and Hangouts Meet.

Partners gain peace of mind with Google Cloud built-in security

In only a few years, we've seen a shift in perception around cloud security. Previously, we saw a good deal of concern tied to safety of data in the cloud. Today the nature of the conversation is different. Now, partners and customers realize that data and applications running locally are not necessarily safer by default. In fact, many now assert that the cloud can often be a safer place to store data and assets because there are so many safeguards in place, as well as greater transparency. Having data and application security managed centrally, by a security-focused company such as Google Cloud, helps give partners and customers strong assurances that their critical assets are secure. There's a certain freedom and peace of mind that our partners can gain knowing that in us, they have a partner who is experienced with protecting data and users.

Eric Brewer

Vice President, Infrastructure

Melody Meckfessel

Vice President, Engineering

Miles Ward

Director of Solution Architecture

Sarah Novotny

Open Source Strategy Lead, Google Cloud

"Open source is so important to Google that we call it out twice in our corporate philosophies, and we encourage employees, and in fact all developers, to engage with open source."

Why we believe in an open cloud

Open clouds matter more now than ever. While most companies today use a single public cloud provider in addition to their on-premises environment, research shows that most companies will likely adopt multiple public and private clouds in the coming years.

Open clouds let customers freely choose which combination of services and providers will best meet their needs over time. Open clouds let customers orchestrate their infrastructure effectively across hybrid-cloud environments. We believe in three principles for an open cloud:

1. Open is about the power to pick up an app and move it

An open cloud is grounded in a belief that being tied to a particular cloud shouldn't get in the way of achieving your goals. Open source is an enabler of open clouds because open source in the cloud preserves your control over where you deploy your IT investments. For example, customers are using Kubernetes to manage containers and TensorFlow to build machine learning models on-premises and on multiple clouds.

2. Open-source software permits a richness of thought and a continuous feedback loop with users

Through the continuous feedback loop with users, open source software (OSS) results in better software, faster, and requires substantial time and investment on the part of the people and companies leading open source projects. Here are examples of Google's commitment to OSS and the varying levels of work required:

- OSS such as Android has an open code base and development is the sole responsibility of one organization.
- OSS with community-driven changes such as TensorFlow involves coordination between many companies and individuals.
- OSS with community-driven strategy, for example collaboration with the Linux Foundation and Kubernetes community, involves collaborative decision-making and accepting consensus over control.

Open source is so important to Google that we call it out twice in our corporate philosophies, and we encourage employees, and in fact all developers, to engage with open source. Google regularly open-sources internal projects. Some top Google-initiated projects include: Kubernetes, TensorFlow, BBR congestion control algorithm, Open compute project rack, gRPC, Bazel, VP9, Chromium, Android, Golang, and V8.

3. Open APIs preserve everyone's ability to build on each other's work

Open APIs preserve everyone's ability to build on each other's work, improving software iteratively and collaboratively. Open APIs empower companies and individual developers to change service providers at will. Peer-reviewed research shows that open APIs drive faster innovation across the industry and in any given ecosystem. Open APIs depend on the right to reuse established APIs by creating independent-yet-compatible implementations. Google is committed to supporting open APIs via our membership in the Open API Initiative, involvement in the Open API specification, support of gRPC, via Cloud Bigtable compatibility with the HBase API, Cloud Spanner and BigQuery compatibility with SQL:2011 (with extensions), and Cloud Storage compatibility with shared APIs.

It's worth noting that not all Google's products will be open in every way at every stage of their life cycle. Openness is less of an absolute and more of a mindset when conducting business in general. You can, however, expect Google Cloud to continue investing in openness across our products over time, to contribute to open source projects, and to open source some of our internal projects.

Our new open cloud website offers more detailed definitions and examples of the terms, concepts, and ideas we've discussed here: *http://cloud.google.com/open-cloud*.

Thank you

Thank you for taking the time to learn what some of Google Cloud's leaders have to say about how open, more secure, and forward-looking cloud and AI technology can create ecosystems that drive success and access for all, reinvent the workplace, and inform and shape our larger culture of device use. To learn more about Google Cloud, visit *https://cloud.google.com/*

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