

Transform. Innovate.

How DevOps and Cloud are changing Engineering

Melody Meckfessel Engineering Director melody@google.com

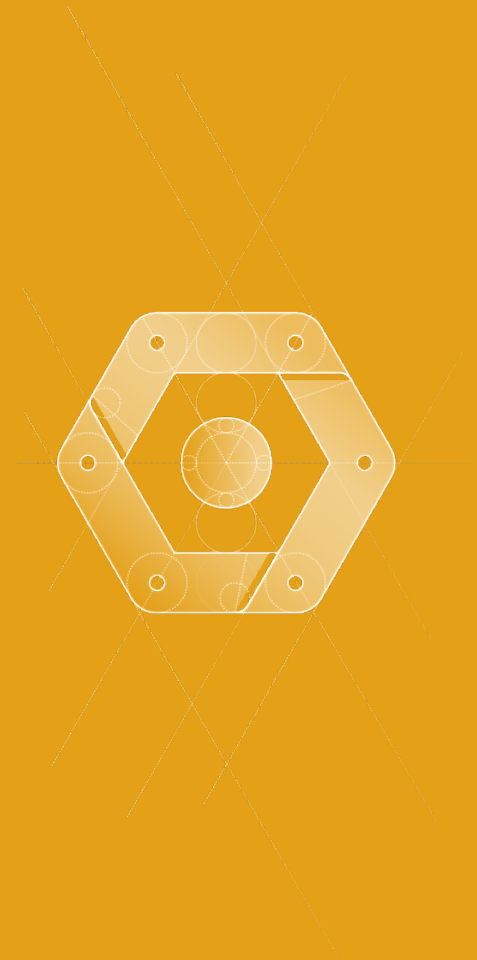
Agenda

Cloud Computing

Innovation in Engineering

The Road Ahead

Cloud Computing



Big Trends

Any Device

enabling a new world via mobile

Any Time

global connections at any minute

Any Place

connections virtually everywhere

Any Team

minds of many need to collaborate

Speed

vitaly important to stay ahead

Adoption

consumer leads, business follows

STANDARD & POOR'S

500

(average age of a company
joining the S&P 500)



40%

own a smartphone



95%

using cloud services



230k Years

social media per month

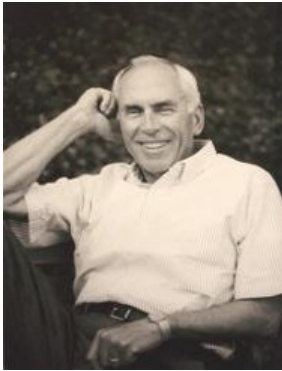


Gartner[®]



Enterprise Cloud Platform market will
exceed \$22B globally by 2015.

2013



“

“People tend to overestimate what can be done in one year and to underestimate what can be done in five or ten years.”

Amara's Law

IT Trends



Affordable Capacity

The decreasing cost of storage enables virtually limitless storage in the cloud. \$600 can buy enough storage for the world's music.

(Source: McKinsey Global Institute May 2011)



On-demand computing

Computing as a utility is now available for easy purchase, provided from massively efficient data centers.

(Source: Nicholas Carr, The Big Switch, 2008)



Instant access

The internet allows for a model of real-time access to new innovation, information and applications from a wide range of devices.

Cloud Computing



IaaS

Infrastructure-as-a-Service



PaaS

Platform-as-a-Service



SaaS

Software-as-a-Service

Google Cloud Platform

Cloud Computing

■ You Manage ■ Vendor Managed

Packaged Software

Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking

IaaS

Infrastructure-as-a-Service

Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking

PaaS

Platform-as-a-Service

Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking

SaaS

Software-as-a-Service

Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking

Google

Build Your Apps in the Cloud

Save

Save on capital
and operational costs

Scale

Leverage massive,
scalable computing power

Succeed

Concentrate on your
core mission

Google Cloud Platform

Compute



Compute Engine



App Engine

Storage



Cloud Storage



Cloud SQL



Cloud Datastore

App Services



BigQuery



Cloud Endpoints

Innovation in Engineering



Innovation at Google

Rich and broad mission scope

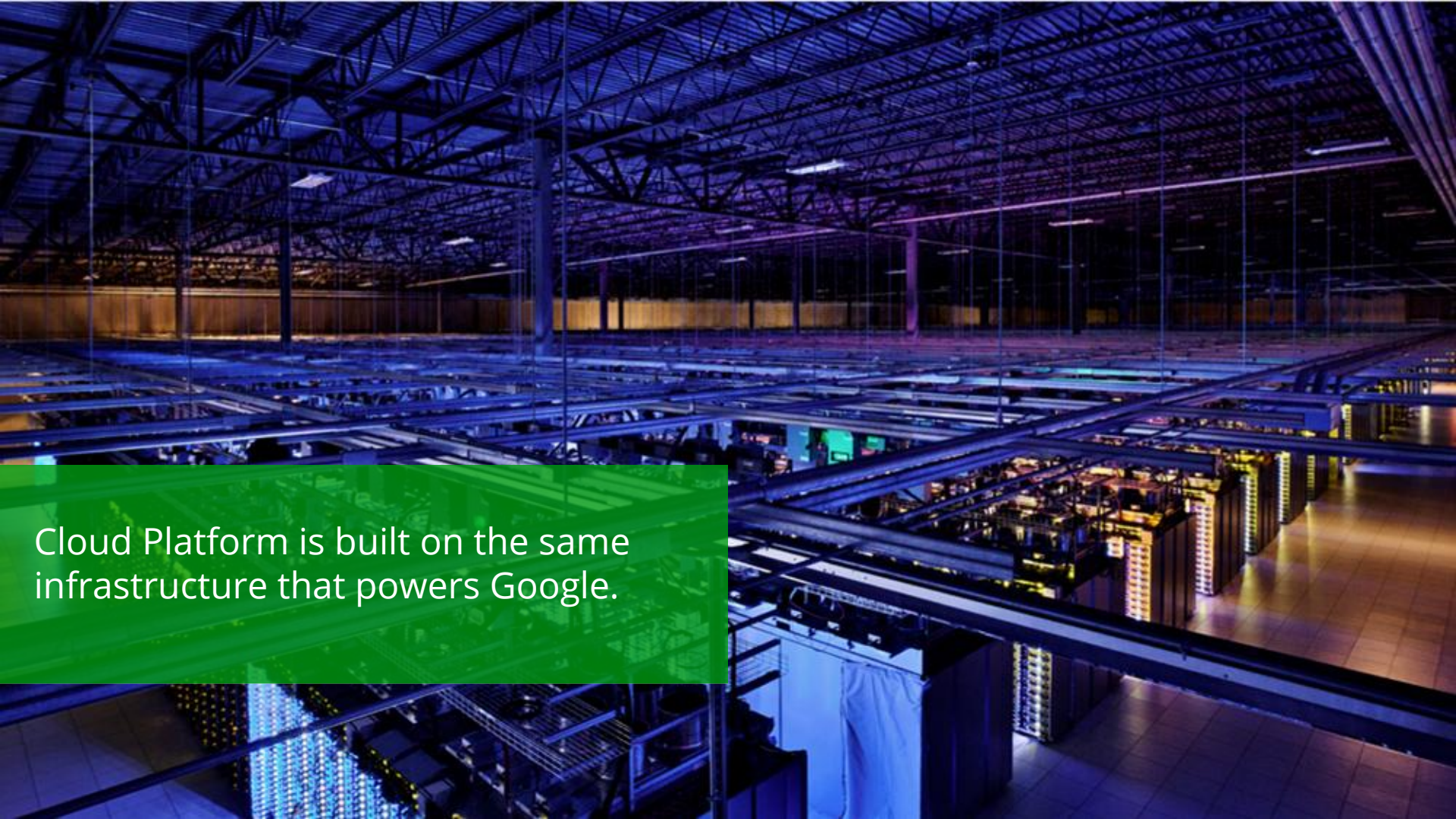
Tolerance of failure and encouragement of risk-taking

Technical leverage (Cloud Computing)





For the past **15 years**, Google has been building out the world's fastest, most powerful, highest quality cloud infrastructure **on the planet**.



Cloud Platform is built on the same infrastructure that powers Google.

DevOps at Google



EACH DAY...

800K
BUILDS

2PB+
BUILD OUTPUTS

100M+
TEST CASES RUN

30K+
CHANGELISTS

Building at Google

- Recipe for making software
- Express relationships between libraries & binaries
- Fast feedback

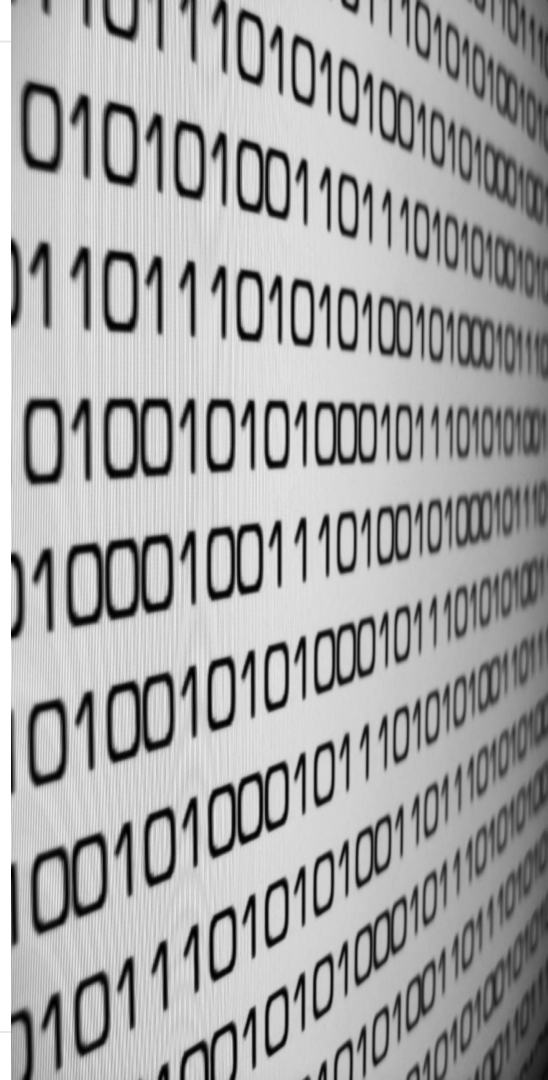


Testing at Google

- Test the *entire* codebase after every repository update
- Makes testing available before submit
- Easy test environment management
- Automated web app testing

Code, code, and more code

- Single monolithic code tree
- Fast, no-downtime access to code
- Merge/integrate early and often
- Code open to modification & experimentation
- Variety of languages



Code, code, and more code

- Globally analyze and refactor code
- Answer interesting questions about who uses my APIs & libraries
- Easy rollback when it doesn't work
- Help fix other engineer's bugs
- **Mandatory Code review**



To be a Google Engineer

- Collaboration and co-development
- Sharing between products and teams (tools, libraries, services)
- One size does not fit all
- Dogfooding: use it ourselves to be more productive

Getting from 2001 to Now

Many ideas, large and small, were tried and abandoned.

“What worked” was defined by user excitement

The approach:

“Launch and Iterate”

Fail early, fail often

Prototypes and early trials to validate with users



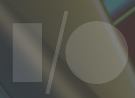
Our Struggles

- No matter how fast, it is never fast enough
- Keeping up with change
- Quality processes - help and hurt
- Finding and fixing bugs is tough



**DevOps you
deserve**

Continuous Delivery

The image features a central magnifying glass with a dark handle and a silver rim. The lens is focused on a grid of binary code (0s and 1s) in a reddish-brown hue. The background is a dark green circuit board with glowing blue lines and binary code scattered throughout. The text 'Continuous Delivery' is written in a large, bold, white sans-serif font, centered over the magnifying glass and the circuit board.

Deploying to App Engine

```
$ gcloud app --help
```

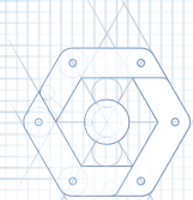
```
Usage: gcloud app [optional flags] <command>
```

```
command may be    cancel-deployment | delete | deploy | download | get-logs | get-resource-limits | list-versions | run | set-default | set-managed-by | setup-managed-vms | start | stop
```

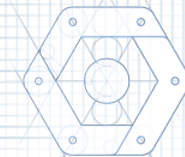
```
$ gcloud auth login
```

```
$ gcloud init your-project-name
```

```
$ git push origin master # Pushes your changes to production.
```



Push to Deploy



Release Pipeline

Update pipeline

Delete pipeline

Code repository

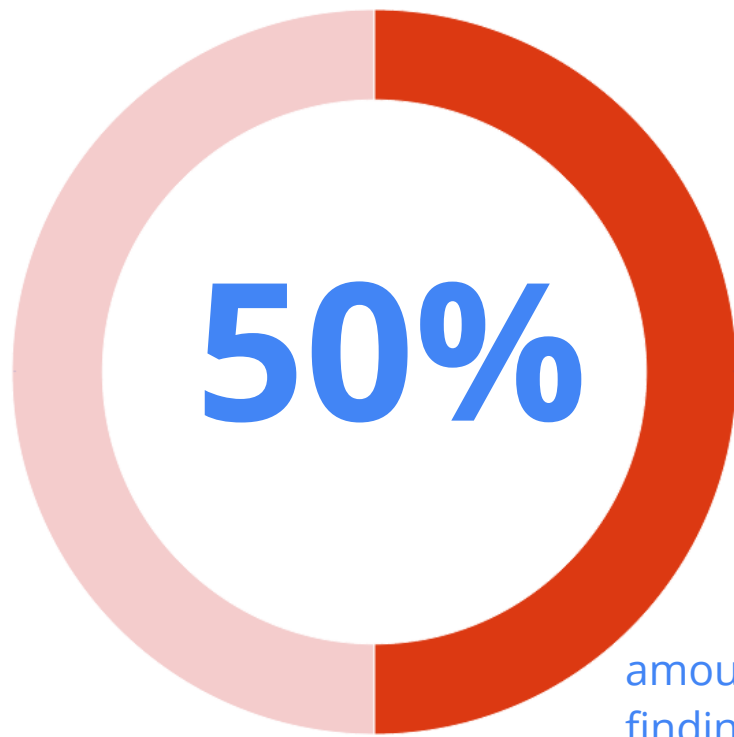
<https://source.developers.google.com/p/io-p2d/>

Build with and run tests

Java: Use Maven to build, test, and deploy

| DATE | COMMIT | AUTHOR | COMMENT | TASKS | RESULTS | CHANGES |
|---------------------------|------------------------------|--------|-------------------------------|--|----------------------------|----------------------|
| Sep 16, 2014, 10:57:34 AM | eb7885b40c87 | | enable cloud debugger | ✔ Build ✔ Test ✔ Deploy | Build Logs | Diff |
| Sep 16, 2014, 9:48:44 AM | 22f4559c229e | | change the path we ADD to ... | ✔ Build ✔ Test ✔ Deploy | Build Logs | Diff |
| Sep 16, 2014, 9:31:08 AM | 09d201dc707f | | change the path we ADD to ... | ✔ Build ✔ Test ! Deploy | Build Logs | Diff |

Time Spent Troubleshooting: The Old Way



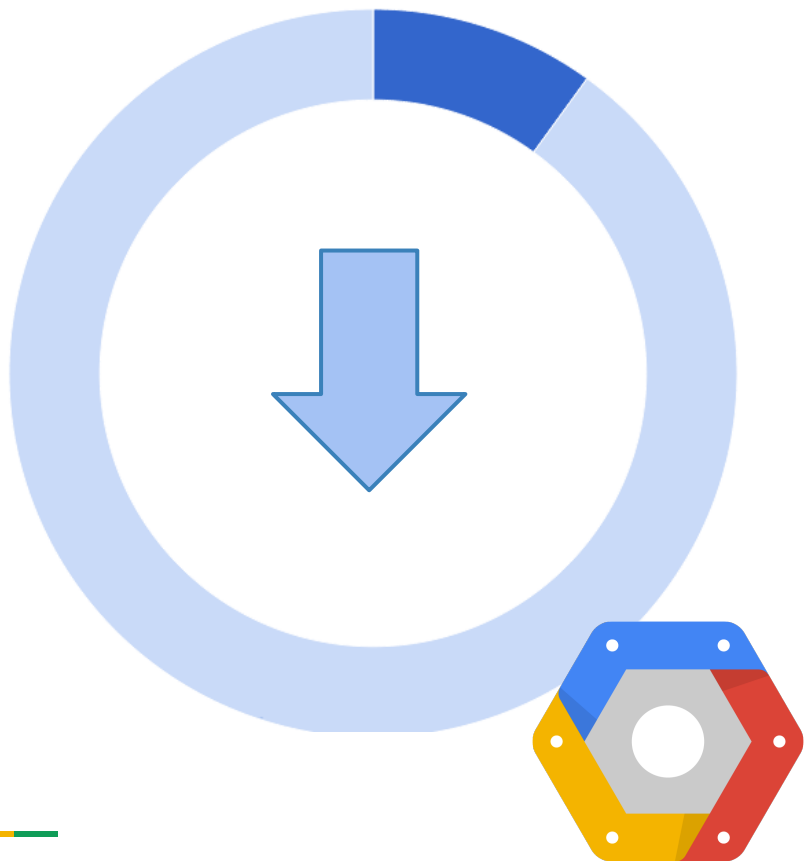
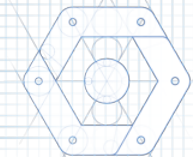
- *High stakes and time critical*
- *Data rich; information scarce*
- *Imperfect system understanding*

amount of time most developers spend
finding issues in production (source)

When Things Go Wrong in Production



Time Spent Troubleshooting: The Modern Way

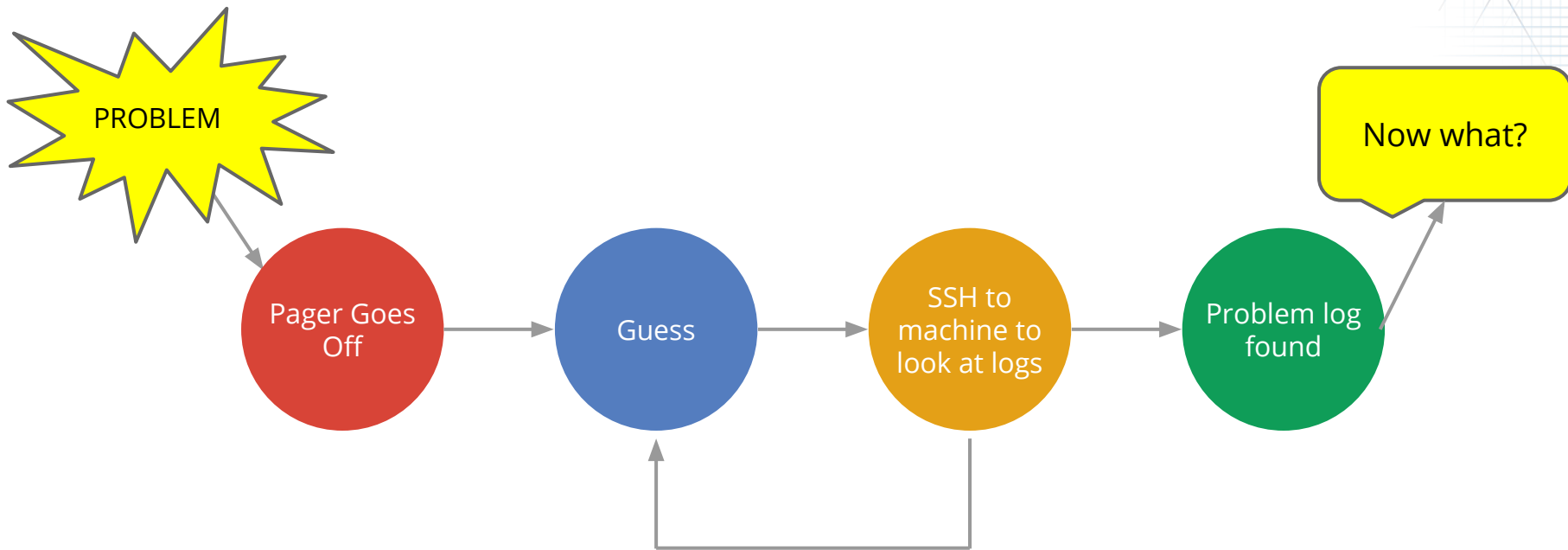
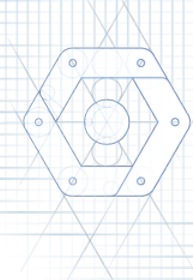


- *Reduce the guess work*
- *Speed up iteration cycle*
- *Provide system transparency*

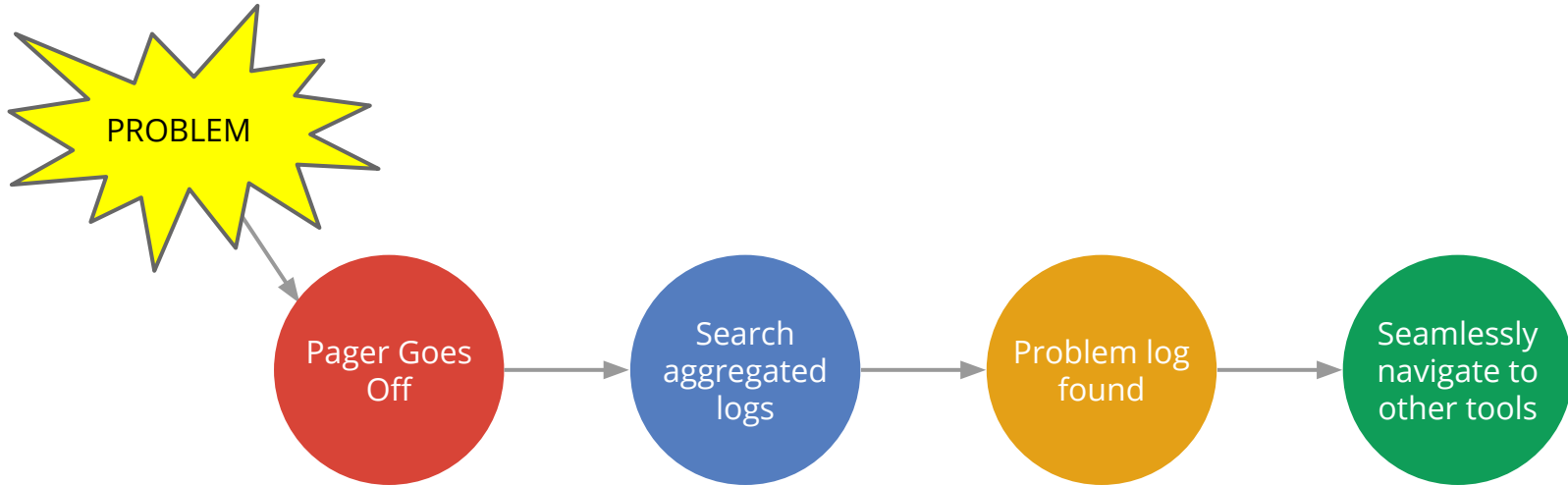
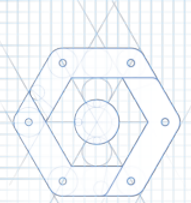
Debugging in the Cloud

- 1 → Eliminate Server Errors with Cloud Logs
- 2 → Reduce Latency with Cloud Trace
- 3 → Deep Understanding with Cloud Debugger

Debugging with Logs: the Old Way

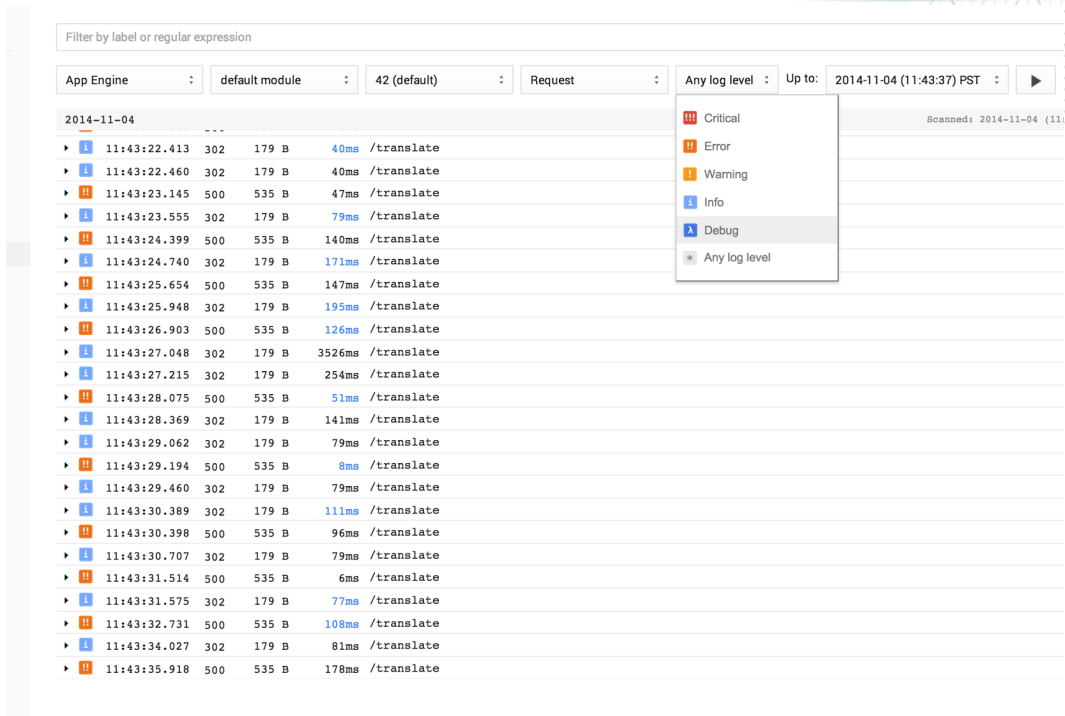


Debugging with Logs: the Modern Way



Google Cloud Logs

- Search ALL your logs
- Navigate to & from
 - Monitoring
 - Trace
 - Source
- Infiniscroll & Live streaming!



Filter by label or regular expression

App Engine : default module : 42 (default) : Request : Any log level : Up to: 2014-11-04 (11:43:37) PST : ▶

2014-11-04

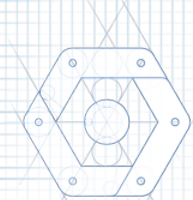
| | | | | | | |
|---|---|--------------|-----|-------|--------|------------|
| ▶ | ! | 11:43:22.413 | 302 | 179 B | 40ms | /translate |
| ▶ | ! | 11:43:22.460 | 302 | 179 B | 40ms | /translate |
| ▶ | ! | 11:43:23.145 | 500 | 535 B | 47ms | /translate |
| ▶ | ! | 11:43:23.555 | 302 | 179 B | 79ms | /translate |
| ▶ | ! | 11:43:24.399 | 500 | 535 B | 140ms | /translate |
| ▶ | ! | 11:43:24.740 | 302 | 179 B | 171ms | /translate |
| ▶ | ! | 11:43:25.654 | 500 | 535 B | 147ms | /translate |
| ▶ | ! | 11:43:25.948 | 302 | 179 B | 195ms | /translate |
| ▶ | ! | 11:43:26.903 | 500 | 535 B | 126ms | /translate |
| ▶ | ! | 11:43:27.048 | 302 | 179 B | 3526ms | /translate |
| ▶ | ! | 11:43:27.215 | 302 | 179 B | 254ms | /translate |
| ▶ | ! | 11:43:28.075 | 500 | 535 B | 51ms | /translate |
| ▶ | ! | 11:43:28.369 | 302 | 179 B | 141ms | /translate |
| ▶ | ! | 11:43:29.062 | 302 | 179 B | 79ms | /translate |
| ▶ | ! | 11:43:29.194 | 500 | 535 B | 8ms | /translate |
| ▶ | ! | 11:43:29.460 | 302 | 179 B | 79ms | /translate |
| ▶ | ! | 11:43:30.389 | 302 | 179 B | 111ms | /translate |
| ▶ | ! | 11:43:30.398 | 500 | 535 B | 96ms | /translate |
| ▶ | ! | 11:43:30.707 | 302 | 179 B | 79ms | /translate |
| ▶ | ! | 11:43:31.514 | 500 | 535 B | 6ms | /translate |
| ▶ | ! | 11:43:31.575 | 302 | 179 B | 77ms | /translate |
| ▶ | ! | 11:43:32.731 | 500 | 535 B | 108ms | /translate |
| ▶ | ! | 11:43:34.027 | 302 | 179 B | 81ms | /translate |
| ▶ | ! | 11:43:35.918 | 500 | 535 B | 178ms | /translate |

Scanned: 2014-11-04 (11:43:37) PST

Any log level : Up to: 2014-11-04 (11:43:37) PST : ▶

- Critical
- Error
- Warning
- Info
- Debug
- Any log level

Logs Viewer



Filter by label or regular expression

App Engine

default module

1 (default)

Warning

Up to:

2014-09-03 (05:59:26) PDT



2014-08-19

Scanned: 2014-08-04 (15:58:06) - 2014-10-26 (06:19:16)

[Expand All](#)

2014-08-26

▶ 10:31:24.990 404 0 B 175ms /robots.txt

2014-09-02

▶ 05:43:11.089 404 0 B 152ms /robots.txt

▶ 11:19:06.751 404 0 B 231ms /robots.txt

▶ 11:19:06.752 404 0 B 201ms /robots.txt

2014-09-03

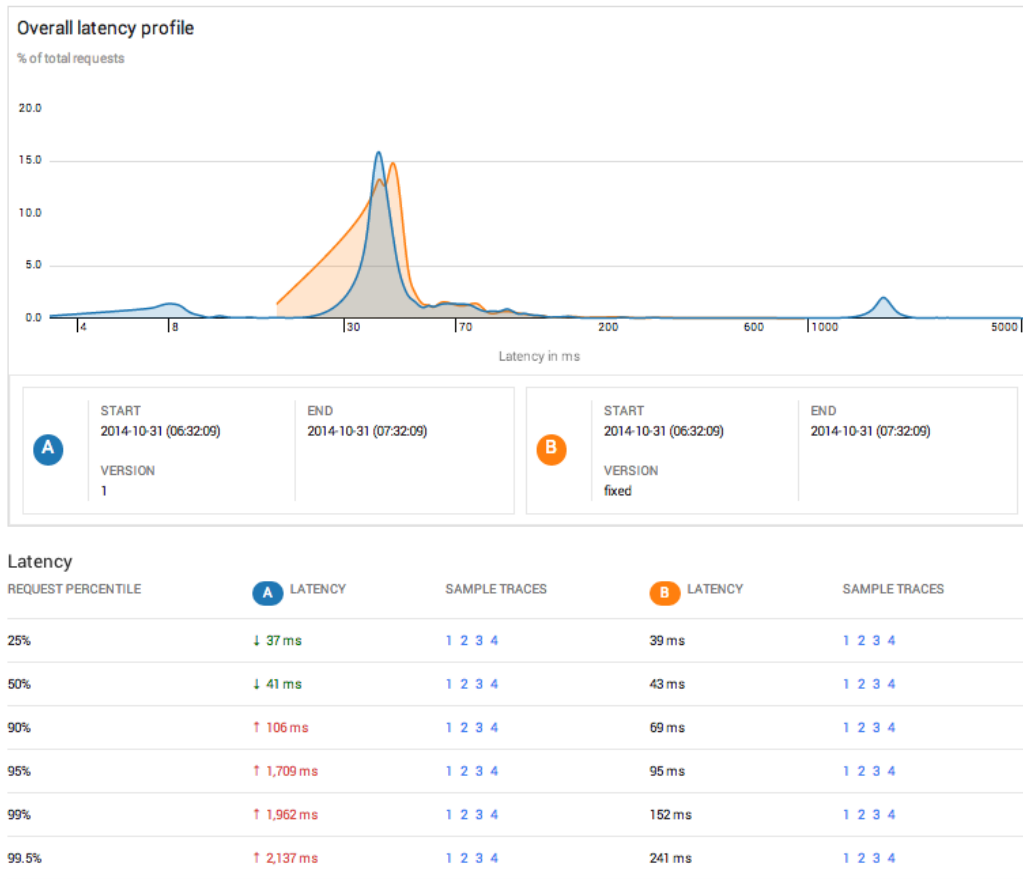
▼ 05:59:26.539 200 0 B 76ms /highscore?score=1

```
82.52.30.214 - - [03/Sep/2014:05:59:26 -0700] "POST /highscore?score=1 HTTP/1.1" 200 0 "http://fluttery-bird.appspot.com/"
"Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:31.0) Gecko/20100101 Firefox/31.0" "fluttery-bird.appspot.com" ms=76 cpu_ms
=43 instance=00c61b117c3ecd2671514188721ea7730e8ba0 app_engine_release=1.9.10
```

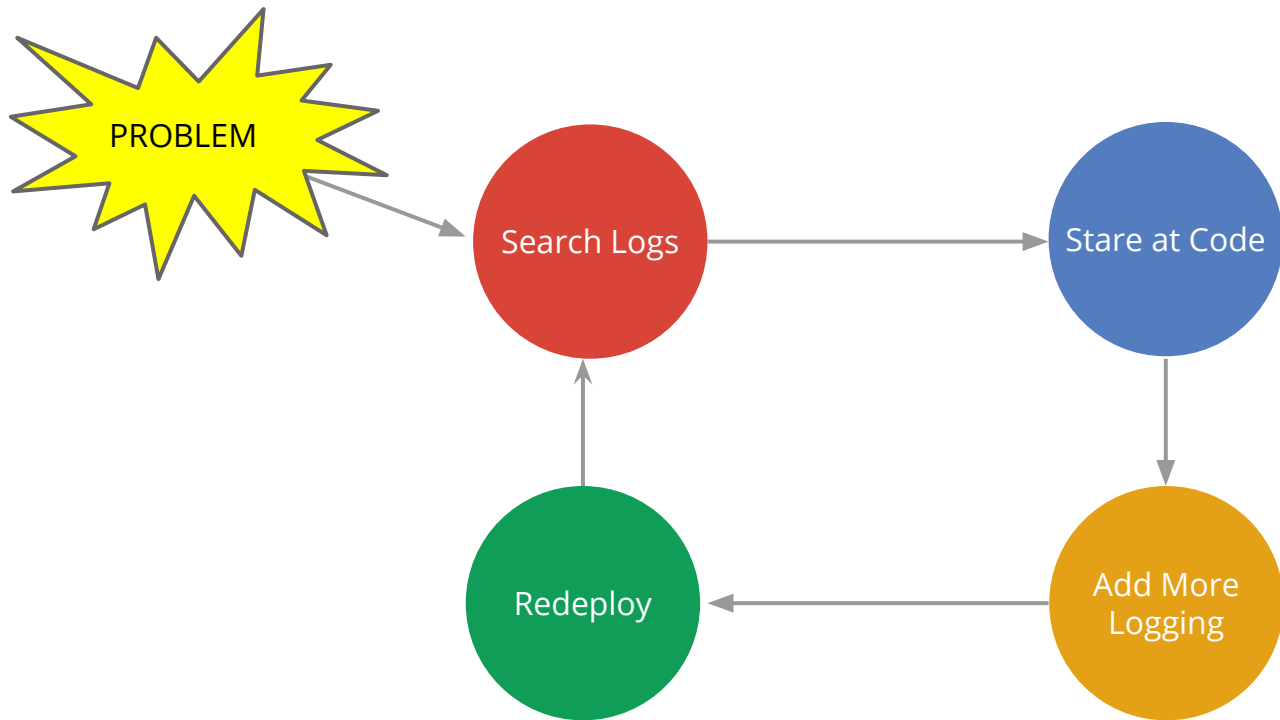
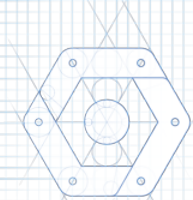
```
 05:59:26.533 com.google.games.flutterybird.HighScoreServlet doPost: Error uploading high score: Non-admin user
attempting to upload a high score!
java.lang.RuntimeException: Non-admin user attempting to upload a high score!
    at com.google.games.flutterybird.HighScoreService.addNewScore(HighScoreService.java:89)
    at com.google.games.flutterybird.HighScoreServlet.doPost(HighScoreServlet.java:93)
    at javax.servlet.http.HttpServlet.service(HttpServlet.java:637)
```

Google Cloud Trace

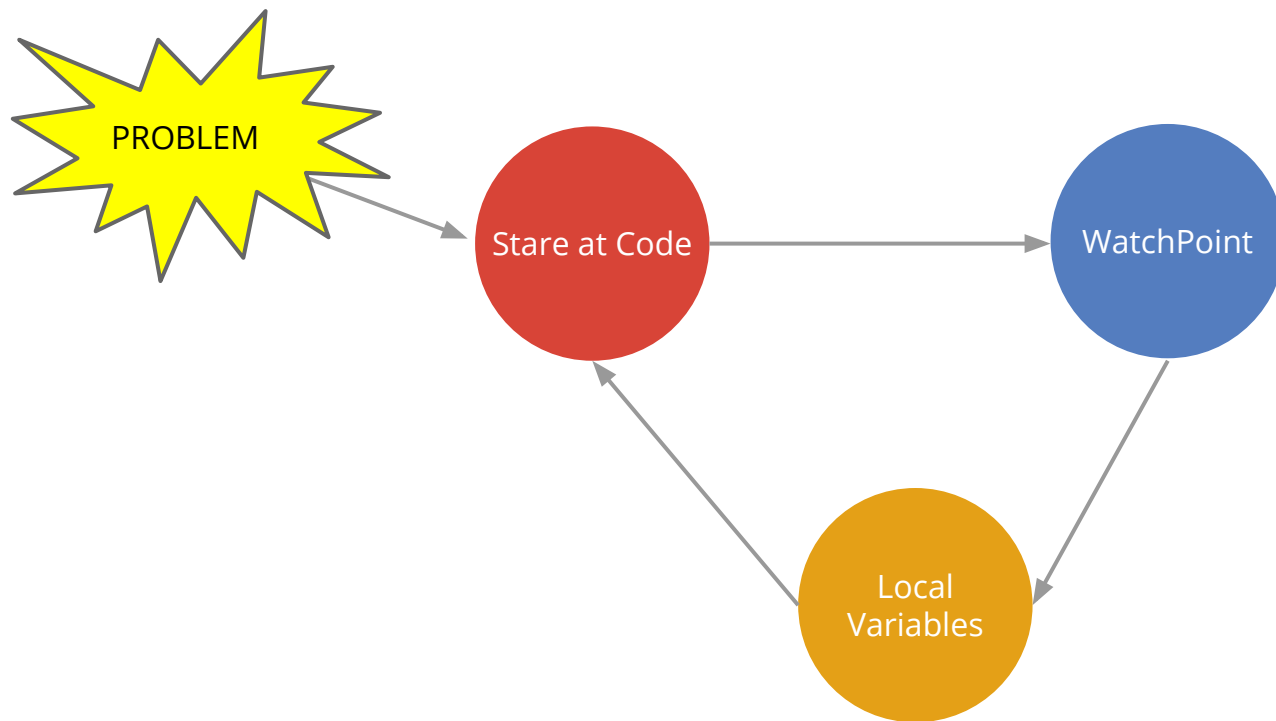
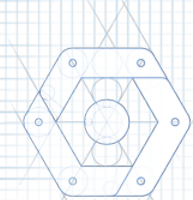
- Visualize and understand the time spent
- Compare performance from release to release with a detailed report
- Low Overhead - Always On



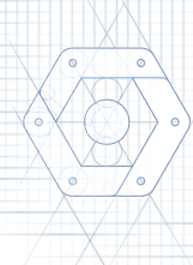
Cycle of Debugging in the Cloud: the Old Way



Cycle of Debugging in the Cloud: the Modern Way



- Attaches (listens) to all instances
- Negligible performance impact
- Access stack and locals



Google Cloud Debugger: The Modern Debugger

- Enables modern production debugging
- Negligible performance impact
Evaluations < 40us
Captures < 10ms
- Access to stack and locals
- No setup is required, on by default!
- Use today on Managed VMs for Java

The screenshot displays the Google Cloud Debugger interface for a Java application. At the top, there's a search bar with the ID '3b979f0426b8' and a 'Diff against...' dropdown. Below this is a breadcrumb trail: / > src/ > main/ > java/ > com/ > google/ > appengine/ > demos/ > guestbook/ > TranslateServlet.java. The main area is split into three panes: Watch expressions, Locals, and Call stack. The Watch expressions pane shows a single expression: `content.indexOf("tonight") >= 0`. The Locals pane shows variables: `this` (content: "tonight?"), `word` ("tonight"), `temp` (""), and `l` (1). The Call stack pane shows the current method: `com.google.appengine.demos.guestbook.TranslateServlet...javaservlet.http.HttpServlet.service`. The right pane shows the source code of `TranslateServlet.java` with line numbers 102 to 168. A red circle highlights line 136, which is the start of a `switch` statement for the `word` variable. The code includes logging, property setting, and URL redirection logic.

Runtime Insights

Cloud Logs

<https://cloud.google.com/appengine/articles/logging>

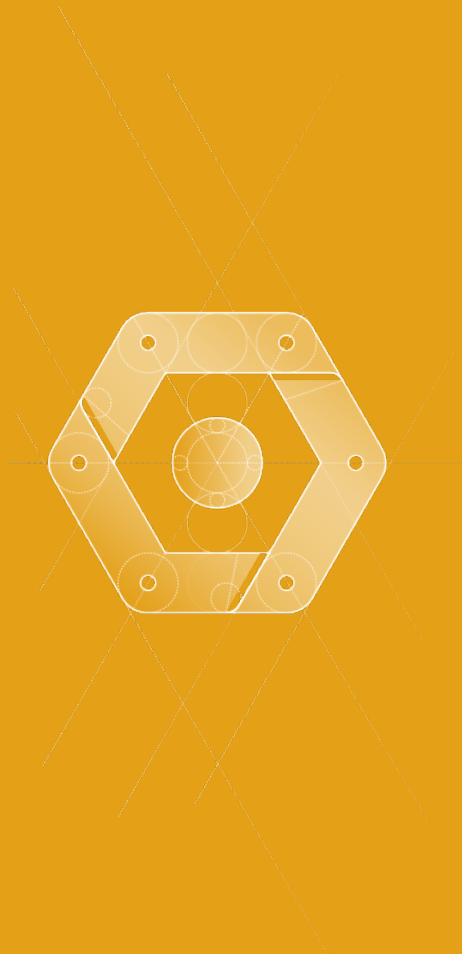
Cloud Trace

<https://cloud.google.com/tools/cloud-trace>

Cloud Debugger

<https://cloud.google.com/tools/cloud-debugger>

The Road Ahead

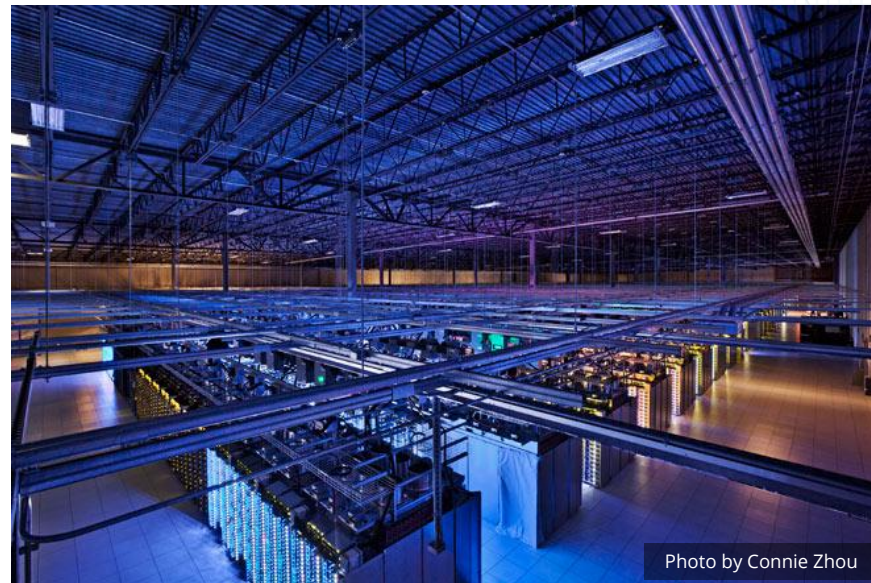


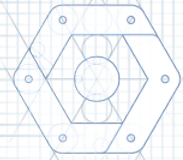
Cloud Computing

Don't deal with unnecessary "stuff"

Cliffs are for climbers

Ops should be easy





Operations, operations, operations

- The most important driver of long term TCO are early design decisions
- Factoring is critical
- Help developers fall into the 'pit of operational success'

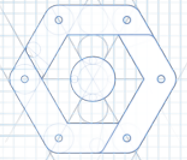


www.shutterstock.com · 95676682



**Developer
Velocity /
Efficiency**

- Focus on application code
- Shift operations to Cloud
- Integrated development environment and toolchain





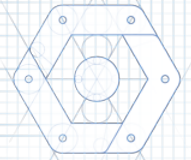
Scale

- Built on single compute stack
- All performance innovation percolates up
- Super low latency between all application components



Open Solutions

- Users can customize or replace runtimes
- Open Source Software is huge
- Integration with any third-party software
- Involve the community in shaping the APIs



Technology Enabling Innovation

Culture of launch and iterate is great... but need right systems to support

“In the cloud” means

Lower cost of Deployment and Operations

Resilience

Developers choose

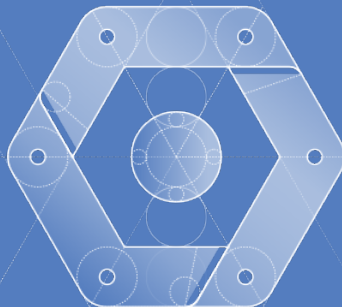


DevOps using the Cloud is about helping you,
the developer, do what you love.



Thank you!

Melody Meckfessel Engineering Director melody@google.com

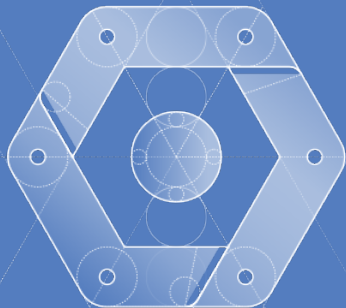


\$500 in Cloud Platform credit to build your idea!

Go to g.co/CloudStarterPack

Enter promo code: `qcon-sf`

With Cloud Platform you can access application, compute, storage and big data services. You're now building on the same infrastructure that powers Google.



Questions?

