Fallout: Distributed Systems Testing as a Service

Guy Bolton King, Sean McCarthy, Pushkala Pattabhiraman, Jake Luciani and Matt Fleming
Introduction and Motivation

- Early performance testing and benchmarking is critical in building databases and distributed systems
- Tests must be reproducible
  - Hardware
  - OS configuration
  - Application-level tuning
  - Test Workload
- Fallout specifies all of the above using a single YAML-based configuration
  - ...and also captures this information in results
Introduction and Motivation

● Tests must be automatable
  ● Automation is driven via Jenkins talking to a REST API
● Manual tests are still possible
Background and History

- Good but limited tools
- We wanted to test:
  - with more tools
  - in more environments
- A new system had to:
  - provide a single interface for multiple teams to run test and benchmarking tools
  - be configurable with simple files that described real-world systems and workloads
  - capture and preserve artifacts alongside the test results
  - be easy to use
gke

Provisioner for the Google Kubernetes Engine.
Prefix: fallout.provisioner.kubernetes.google.
Example: No specific example usage, but see the general examples on github

properties:

- name: project
  description: Google Cloud Project to create the cluster within.
  required: yes

- name: region
  description: Region in which to provision the kubernetes cluster.

- name: zone
  description: The zone in which to provision all nodes.

- name: machine_type
  description: Machine type of the nodes provisioned in the kubernetes cluster. See <a>https://cloud.google.com/compute/docs/machine-types</a> for a complete list of valid machine types.
  required: yes

- name: cluster_version
  description: GKE version of the cluster.

- name: create_extra_args
  description: Any extra arguments which should be passed to the create command.

- name: gcloud_service_account
  description: Email of the service account which will execute all gcloud commands. Defaults to user profile.
200 tests/day
Fallout Server

Fallout Core

setup -> workload -> teardown + artifact collection -> artifact checking

sends aggregate data to

hunter -> History Server
Implementation

- Fallout is implemented in Java
- Test configuration is in YAML
- There is usually a 1:1 mapping between YAML configuration <-> Java
- A test definition has two sections
  - Ensemble
  - Workload
**Ensemble: Nodes and NodeGroups**

- An Ensemble represents all the NodeGroups in a test definition
- A NodeGroup is a cluster of one or more Nodes
- A Node is a single virtual machine instance
- Each NodeGroup has a role
  - Server(s)
  - Client(s)
  - Observer
  - Controller
Ensemble: Provisioners and ConfigurationManagers

- A NodeGroup is created and destroyed by a Provisioner
  - One Provisioner per NodeGroup
- Software is installed, configured, started and stopped on a NodeGroup by ConfigurationManagers
  - Ideally, one ConfigurationManager per software product
- Examples
  - Apache Cassandra
  - nosqlbench
Ensemble: NodeGroup Lifecycle

- NodeGroups have State
- A state machine decides whether to apply a Provisioner or the ConfigurationManagers for a NodeGroup as a function of
  - The current state
  - The desired state
- State is detected at runtime if unknown
  - Some level of reuse between test runs is possible
Workload: stages

- Split into three stages:
  - Module execution phases
  - Checkers
  - Artifact Checkers
Workload: Modules and Providers

- Modules encapsulate operations on the Ensemble
  - nosqlbench
  - cassandra-stress
  - chaos-mesh
  - Bash
- Modules perform operations using Providers
  - Installed by Provisioners and ConfigurationManagers on the Nodes of a NodeGroup
  - Also used for validation of test definitions
Workload: Checkers and Artifact Checkers

- Checkers
  - nofail
- Artifact Checkers
  - systemlog
  - hdrtool
Performance Reports

- Client performance metrics
- HDR Histogram format
- The hdrtool artifact checker also generates performance reports
- The performance tool allows generating reports across different test runs
Performance Reports

ec2 stability - stress-insert_standard:insert-st

Choose metric: Ops/Sec
Choose operation(s): stress-insert_standard:insert-st
Operation filter (regex): .+
Data smoothing: None
Show aggregates ✓
Min ops filter: 0
Zoom: reset
x min 0 x max 5.58
y min 0 y max 364268
To hide/show a dataset click on the associated colored box
History Server

- Graphite + Grafana server
- Stores aggregated metrics
  - Created by hdrtool
  - Posted to graphite by fallout
  - Triggered by haxx calling a fallout REST API
- Used to track aggregate performance of a product + test scenario across successive development versions
- Storage is very efficient, thanks to aggressive Graphite retention policy
History Server
Lessons Learned

- Configuration files should be short and expressive
- Templating for configuration files encourages reuse
- Tests need access to external files
- Long-running tests benefit from semantic checks and idempotency
Related Work

- MockFog 2.0
- Adelphi
- MongoDB’s Distributed Systems Infrastructure
- ...and more
Acknowledgements
Acknowledgements

- Jake Luciani, Joel Knighton, and Philip Thompson created Fallout
- Pierre Laporte created the History Server
- Christopher Lambert integrated much of the ctool support
- James Trevino continues to maintain and contribute
- Shaunak Das contributed many Modules
- Ulises Cerviño Beresi created haxx
- Many more DataStax colleagues, past and present have contributed to both Fallout and the ecosystem
- Jonathan Ellis and Jake Luciani championed the open-source version
Thank You!

https://github.com/datastax/fallout
DataStax Template

Google Slides

Updated June 15, 2021
Agenda

- Section name 01
- Section name 02
- Section name 03
- Section name 04
- Section name 05
- Section name 06
Agenda

- Section name 01
- Section name 02
- Section name 03
- Section name 04
- Section name 05
- Section name 06
Agenda

Section Name
(Match Box Color to Section Slide)

Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.

Section Name
(Match Box Color to Section Slide)

Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.
Agenda

01
Section Name
(Match Box Color to Section Slide)
Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.

02
Section Name
(Match Box Color to Section Slide)
Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.
Agenda

01

Section Name (Match Box Color to Section Slide)

Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

02

Section Name (Match Box Color to Section Slide)

Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.
Agenda

Section Name (Match Box Color to Section Slide)

Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.

01

Section Name (Match Box Color to Section Slide)

Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.

02
Agenda

Section Name
(Match Box Color to Section Slide)

Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.

01

Section Name
(Match Box Color to Section Slide)

Optional place for additional text.
If Section Slide is White, Box Color is Light Gray with DS Black text.
Delete this text box if not needed.

02
01
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

02
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

03
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.
01
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

02
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

03
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.
01
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

02
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

03
Section Name (Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.
Agenda

01
Section Name
Can Be 2 Lines

02
Section Name
Can Be 2 Lines

03
Section Name
Can Be 2 Lines

04
Section Name
Can Be 2 Lines
Agenda

01 Section Name Can Be 2 Lines
02 Section Name Can Be 2 Lines
03 Section Name Can Be 2 Lines
04 Section Name Can Be 2 Lines
01
Section Name
Can Be 2 Lines

02
Section Name
Can Be 2 Lines

03
Section Name
(Match Box Color
to Section Slide)
Optional place for additional text.
If Section Slide is White, Box Color
is Light Gray with DS Black text.
Delete this text box if not needed.

04
Section Name
(Match Box Color
to Section Slide)
Optional place for additional text.
If Section Slide is White, Box Color
is Light Gray with DS Black text.
Delete this text box if not needed.
| 01 | Section Name Can Be 2 Lines |
| 02 | Section Name Can Be 2 Lines |
| 03 | Section Name Can Be 2 Lines |
| 04 | Section Name Can Be 2 Lines |
| 05 | Section Name Can Be 2 Lines |
Agenda

01 Section Name Can Be 2 Lines

02 Section Name Can Be 2 Lines

03 Section Name Can Be 2 Lines

04 Section Name Can Be 2 Lines

05 Section Name Can Be 2 Lines
01
Section Name
(Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

02
Section Name Can Be 2 Lines

03
Section Name Can Be 2 Lines

04
Section Name Can Be 2 Lines

05
Section Name Can Be 2 Lines
01
Section Name
(Match Box Color to Section Slide)
Optional place for additional text. If Section Slide is White, Box Color is Light Gray with DS Black text. Delete this text box if not needed.

02
Section Name
Can Be 2 Lines

03
Section Name
Can Be 2 Lines

04
Section Name
Can Be 2 Lines

05
Section Name
Can Be 2 Lines
01
Section Name
Can Be 2 Lines

02
Section Name
Can Be 2 Lines

03
Section Name
Can Be 2 Lines

04
Section Name
Can Be 2 Lines

05
Section Name
(Match Box Color
to Section Slide)

Optional place for additional text.
If Section Slide is White, Box Color
is Light Gray with DS Black text.
Delete this text box if not needed.
01
Section Name
Can Be 2 Lines

02
Section Name
Can Be 2 Lines

03
Section Name
Can Be 2 Lines

04
Section Name
Can Be 2 Lines

05
Section Name
Can Be 2 Lines

06
Section Name
Can Be 2 Lines
01
Section Name
Can Be 2 Lines

02
Section Name
Can Be 2 Lines

03
Section Name
Can Be 2 Lines

04
Section Name
Can Be 2 Lines

05
Section Name
Can Be 2 Lines

06
Section Name
Can Be 2 Lines
Agenda

01
Section Name
Can Be 2 Lines

02
Section Name
Can Be 2 Lines

03
Section Name
Can Be 2 Lines

04
Section Name
Can Be 2 Lines

05
Section Name
Can Be 2 Lines

06
Section Name
Can Be 2 Lines
Section Header

Tell more about this section here
Title and Bullet Point

- Body copy level 1 is 14pt Roboto regular
  - Body copy level 2 is 14pt Roboto regular
    - Body copy level 3 is 12pt Roboto regular
      - Body copy level 4 is 12pt Roboto regular
        - Body copy level 5 is 10pt Roboto regular
Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.
Title and Two Columns Bullet Point

- Body copy level 1 is 14pt Roboto regular
  - Body copy level 2 is 14pt Roboto regular
    - Body copy level 3 is 12pt Roboto regular
    - Body copy level 4 is 12pt Roboto regular
    - Body copy level 5 is 10pt Roboto regular
  - Body copy level 2 is 14pt Roboto regular
    - Body copy level 3 is 12pt Roboto regular
    - Body copy level 4 is 12pt Roboto regular
    - Body copy level 5 is 10pt Roboto regular
Title and Two Columns

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.
Title and Three Columns Bullet Point

- Body copy level 1 is 14pt Roboto regular
  - Body copy level 2 is 14pt Roboto regular
    - Body copy level 3 is 12pt Roboto regular
      - Body copy level 4 is 12pt Roboto regular
        - Body copy level 5 is 10pt Roboto regular
  - Body copy level 2 is 14pt Roboto regular
    - Body copy level 3 is 12pt Roboto regular
      - Body copy level 4 is 12pt Roboto regular
        - Body copy level 5 is 10pt Roboto regular
  - Body copy level 2 is 14pt Roboto regular
    - Body copy level 3 is 12pt Roboto regular
      - Body copy level 4 is 12pt Roboto regular
        - Body copy level 5 is 10pt Roboto regular
Title and Three Columns

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.
Big Number
Main Point
Title Only
Section Title & Description

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.

- Body copy level 1 is 14pt Roboto regular
  - Body copy level 2 is 14pt Roboto regular
    - Body copy level 3 is 12pt Roboto regular
      - Body copy level 4 is 12pt Roboto regular
        - Body copy level 5 is 10pt Roboto regular
Example of Sample Code

**Change code font to** Roboto Mono and place a light grey box behind it.

This sample works by first making a connection to a Cassandra instance, this is defaulted to localhost. Once the Cluster object has been built the mapping between the User object and the users table is created using this code:

```csharp
MappingConfiguration.Global.Define(
    new Map<User>()
    .TableName("users")
    .PartitionKey(u => u.UserId)
    .Column(u => u.UserId, cm => cm.WithName("id"));
```

**Running**

To run this application use the following command:

dotnet run

This will produce output similar to the following:

- Retrieved 5 users
- Retrieved 1 users
- Retrieved UserId: 32e40afe-27e2-4509-9df9-a89468993d68, Name: User 0, Age: 0
- Retrieved UserId: 32e40afe-27e2-4509-9df9-a89468993d68, Name: User 0, Age: 0
“Quote lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod expananadium.”

Firstname Lastname in 14pt Roboto Bold
Title and company in 12pt Roboto
Quote lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod expanadium.
Quote lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod expanadium.
Thank You!
Square Icon

DS Black
#3A3A42
Logotype

Light Backgrounds

DataStax

White
#FFFFFF

Light Gray
#F8F9FA
Logotype

Dark

Backgrounds

DS Black
#3A3A42

Astra Red
#EB6C34

Enterprise Blue
#4A9AB4

DS Blue
#3980D3

Luna Gold
#998E5D

Blue 1
#055992

Blue 2
#054978

Blue 3
#043A5F
Co-branding

DataStax  |  cassandra

DataStax  |  Partner Logo Here
Theme Colors

- **DS Black**
  - Text and background 1
  - Dark Line
    - DS Black #3A3A42
      - Text and background 1

- **White**
  - Text and background 2

- **Body Text**
  - Text and background 3

- **Light Gray**
  - Text and background 4

- **Astra Red**
  - Accent 1

- **Enterprise Blue**
  - Accent 2

- **Luna Gold**
  - Accent 3

- **DS Blue**
  - Accent 4

- **Blue 1**
  - Accent 5

- **Blue 2**
  - Accent 6

- **Blue 3**
  - Custom

- **Light Line**
  - #E6E6E6
    - Custom
Iconography

Click into icon group to **change accent color** (do not change gray)

- Migration to Astra
- Global scale
- Cloud native
- Microservices
- Login screen
- Orbit
- Launch
- Indexes
- Active everywhere
- APIs

- Zero downtime
- Scale
- Integration
- Performance
- Developers
- Developer
- Developer persona
- Architect persona
- Operator persona
- Relevance

- Data-driven
- Availability
- Data
- Security-1
- Security-2
- Security-3
- IoT
- Ecommerce
- Agility
- Analytics

- OPs
- Backup recovery
- Logic
- AI-ML-1
- AI-ML-2
- Migrate-1
- Migrate-2
- Users/customers
- Leader
- Cluster
Migration to Astra
Data-driven
Cloud native
Microservices
Login screen
Orbit
Launch
Indexes
Active everywhere
APIs

Zero downtime
Scale
Integration
Performance
Developers
Developer
Developer persona
Architect persona
Operator persona
Relevance

24
Availability
Data
Security-1
Security-2
Security-3
IoT
Ecommerce
Agility
Analytics

OPs
Backup recovery
Logic
AI-ML-1
AI-ML-2
Migrate-1
Migrate-2
Users/customers
Leader
Cluster
Iconography

Use on Luna-related Slides

- Migration to Astra
- Global scale
- Cloud native
- Microservices
- Login screen
- Orbit
- Launch
- Indexes
- Active everywhere
- APIs
- Zero downtime
- Scale
- Integration
- Performance
- Developers
- Developer
- Developer persona
- Architect persona
- Operator persona
- Relevance
- Data-driven
- Availability
- Data
- Security-1
- Security-2
- Security-3
- IoT
- Ecommerce
- Agility
- Analytics
- OPs
- Backup recovery
- Logic
- AI-ML-1
- AI-ML-2
- Migrate-1
- Migrate-2
- Users/customers
- Leader
- Cluster
Typography

Kanit for titles

Roboto Normal for body text

Roboto Bold for emphasis

Pair Roboto Light with bold numbers

Example:

<30 Days to Implement Curbside Pickup, Powered by Apache Cassandra, across all North American stores

Roboto Mono for Code Samples
Astra

Square Icon

Logotypes

White #FFFFFF

Astra Red-Orange #EB6C34
Astra DB

Logotype

White #FFFFFF

Astra Red-Orange #EB6C34
Astra Streaming

White #FFFFFF

Astra Red-Orange #EB6C34
DataStax Enterprise

Square Icon

Logotypes

Enterprise

DataStax Enterprise

White #FFFFFF

Enterprise

DataStax Enterprise

Enterprise Blue #4A9AB4
DataStax Sub-brands 1

White #FFFFFF

DataStax Documentation

Dark Backgrounds

DataStax Documentation
DataStax Sub-brands 2

DataStax Developers

DataStax Community

White #FFFFFF

DataStax Academy

DataStax Community

DataStax Academy

Dark Backgrounds
K8S SANDRA

White #FFFFFF

Dark Backgrounds
Cloud Partners

Google Cloud

Google Cloud

Azure

Azure

aws

aws

vmware

vmware
Useful Logos and Symbols

Full-Color Versions

- cassandra
- PULSAR
- KESQUE
- kubernetes
- GraphQL
- open source initiative
- spring
- HELM
- Grafana
- kafka
- Prometheus
- docker
- traefik
- {REST}
Useful Logos and Symbols

1-Color Versions

[Images of various logos and symbols such as cassandra, pulsar, kesque, kubernetes, graphql, open source initiative, spring, helm, grafana, kafka, prometheus, docker, not available, rest, and others.]
Misc Brands

1-Color Versions
<table>
<thead>
<tr>
<th>Name</th>
<th>Title 1</th>
<th>Title 2</th>
<th>Title 3</th>
<th>Title 4</th>
</tr>
</thead>
</table>
# Table Example 2

<table>
<thead>
<tr>
<th>Column Title</th>
<th>Column Title</th>
<th>Column Title</th>
<th>Column Title</th>
<th>Column Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
</tr>
<tr>
<td>Title</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
</tr>
<tr>
<td>Title</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Blue Highlight</td>
</tr>
<tr>
<td>Title</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
</tr>
<tr>
<td>Title</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
</tr>
<tr>
<td>Title</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
<td>Lorem</td>
</tr>
</tbody>
</table>
Column Graph 1 – Black

Chart Title

[Bar chart with data values and years: 20XX]
Column Graph 1 – Blue

Chart Title
Column Graph 2 – Black

Chart Title
Venn Diagram – Black

Title
The doughnuts are editable shapes: click on the doughnut shape then click on the colored part of it, you can then pull the yellow diamonds to readjust the shape to your % number.

Delete this text after.

Lorem Ipsum
xx,xxx/xx,xxx
The doughnuts are editable shapes: click on the doughnut shape then click on the colored part of it, you can then pull the yellow diamonds to readjust the shape to your % number.
Delete this text after.
Pyramid – Blue – 2

Level 1 – Lorem ipsum
Level 2 – Lorem ipsum
Level 3 – Lorem ipsum
Level 4 – Lorem ipsum
Level 5 – Lorem ipsum
Process Flow Chart

Stage 1
Text detailing the different stages

Stage 2
Text detailing the different stages

Stage 3
Text detailing the different stages

Stage 4
Text detailing the different stages

Stage 5
Text detailing the different stages
Process Flow Chart

Stage 1: Text detailing the different stages
Stage 2: Text detailing the different stages
Stage 3: Text detailing the different stages
Stage 4: Text detailing the different stages
Stage 5: Text detailing the different stages
Quadrant Chart – Blue

Lorem
Lorem
Transformational Outcome Examples

**Customer Acquisition**
- System of record for 151M users
- Supporting $85B in customer data
- 100% uptime across 5 datacenters

**Operational Scale**
- Powering front and back-office services
- Migration of legacy Oracle technology
- Global replication and 100% uptime

**Digital Payments and Security**
- Millions of savings through fraud detection
- Application that integrates ML in real-time
- No downtime, scale easily for peak season
4 Points – Black

1. Lorem ipsum dolor sit amet, consectetur adipiscing elit
2. Lorem ipsum dolor sit amet, consectetur adipiscing elit
3. Lorem ipsum dolor sit amet, consectetur adipiscing elit
4. Lorem ipsum dolor sit amet, consectetur adipiscing elit
4 Points – Blue

1. Lorem ipsum dolor sit amet, consectetur adipiscing elit
2. Lorem ipsum dolor sit amet, consectetur adipiscing elit
3. Lorem ipsum dolor sit amet, consectetur adipiscing elit
4. Lorem ipsum dolor sit amet, consectetur adipiscing elit
## Icon Examples on White Background Slide

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Operations</th>
<th>People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining a data strategy</td>
<td>Organizational silos</td>
<td>Legacy processes</td>
</tr>
<tr>
<td>Lack of data analytical skills</td>
<td>Resistance to change</td>
<td></td>
</tr>
</tbody>
</table>

- Defining a data strategy
- Organizational silos
- Legacy processes
- Lack of data analytical skills
- Resistance to change
Defining a data strategy

- Organizational silos
- Legacy processes
- Lack of data analytical skills
- Resistance to change
Icon Examples on White Background Slide

Digital  Data-Driven  AI Enabled
Icon Examples on White Background Slide

Operational Scale & Edge

Customer/User Acquisition

Relevance