Software as a Service Engineering

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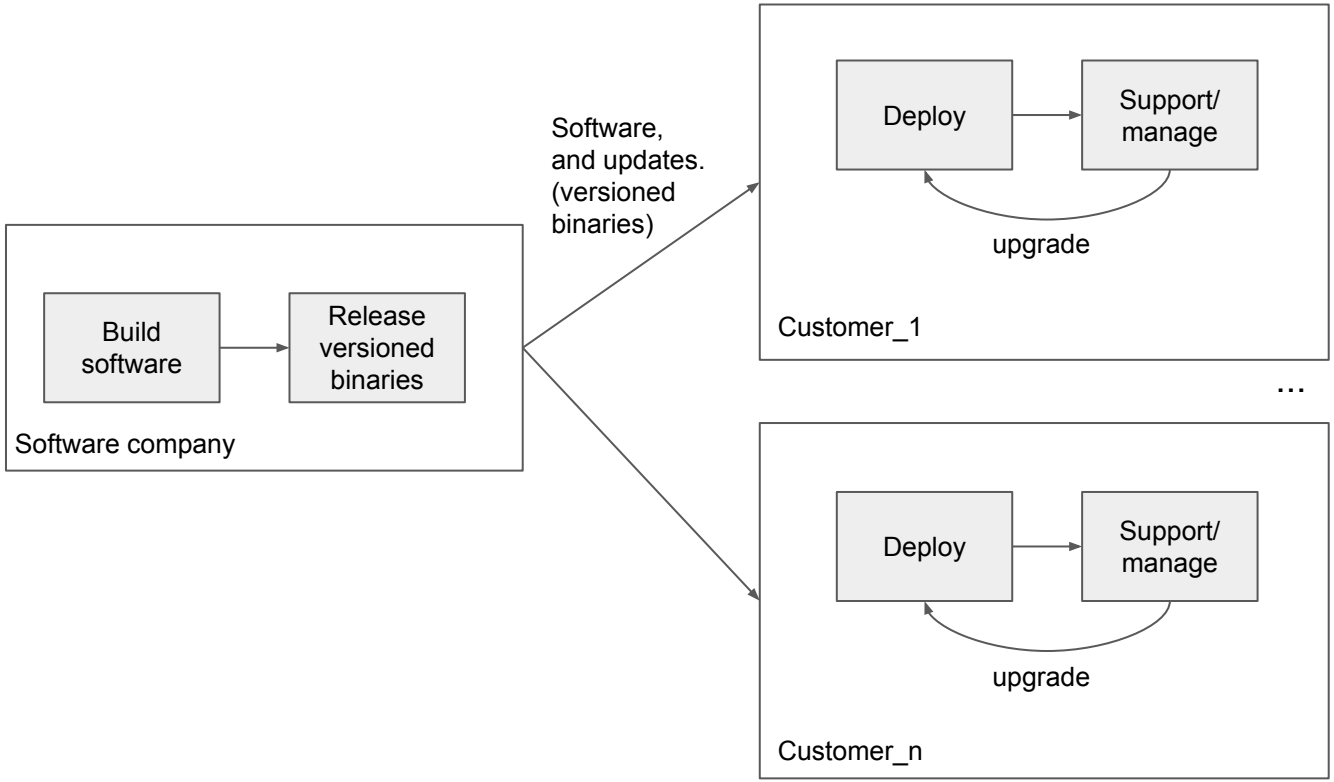
What is SaaS?

SaaS (Software as a Service) refers to software that is

hosted centrally and *licensed to customers on a subscription basis*.

Users access SaaS software via *thin clients*, (often web browsers).

Traditional software distribution (pre SaaS)



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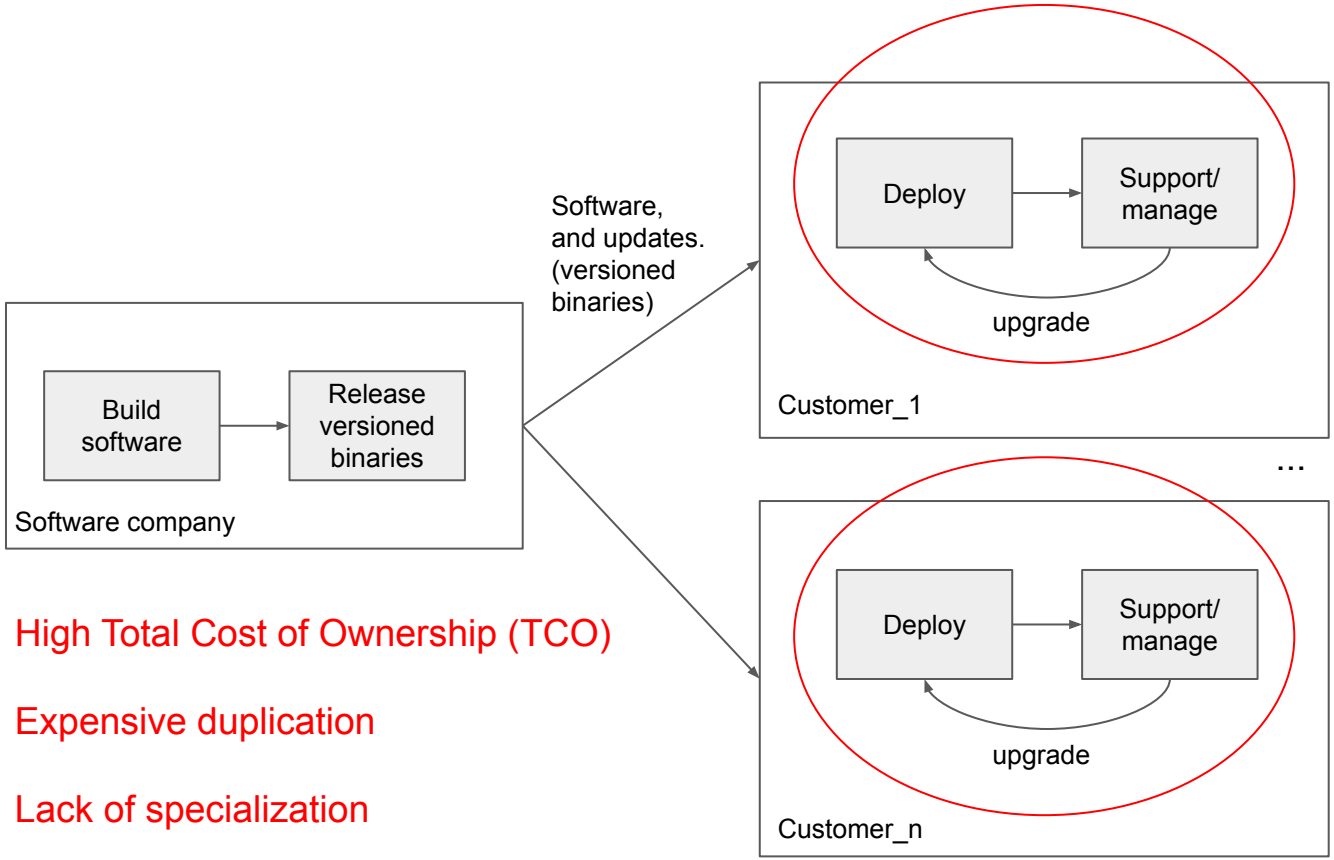
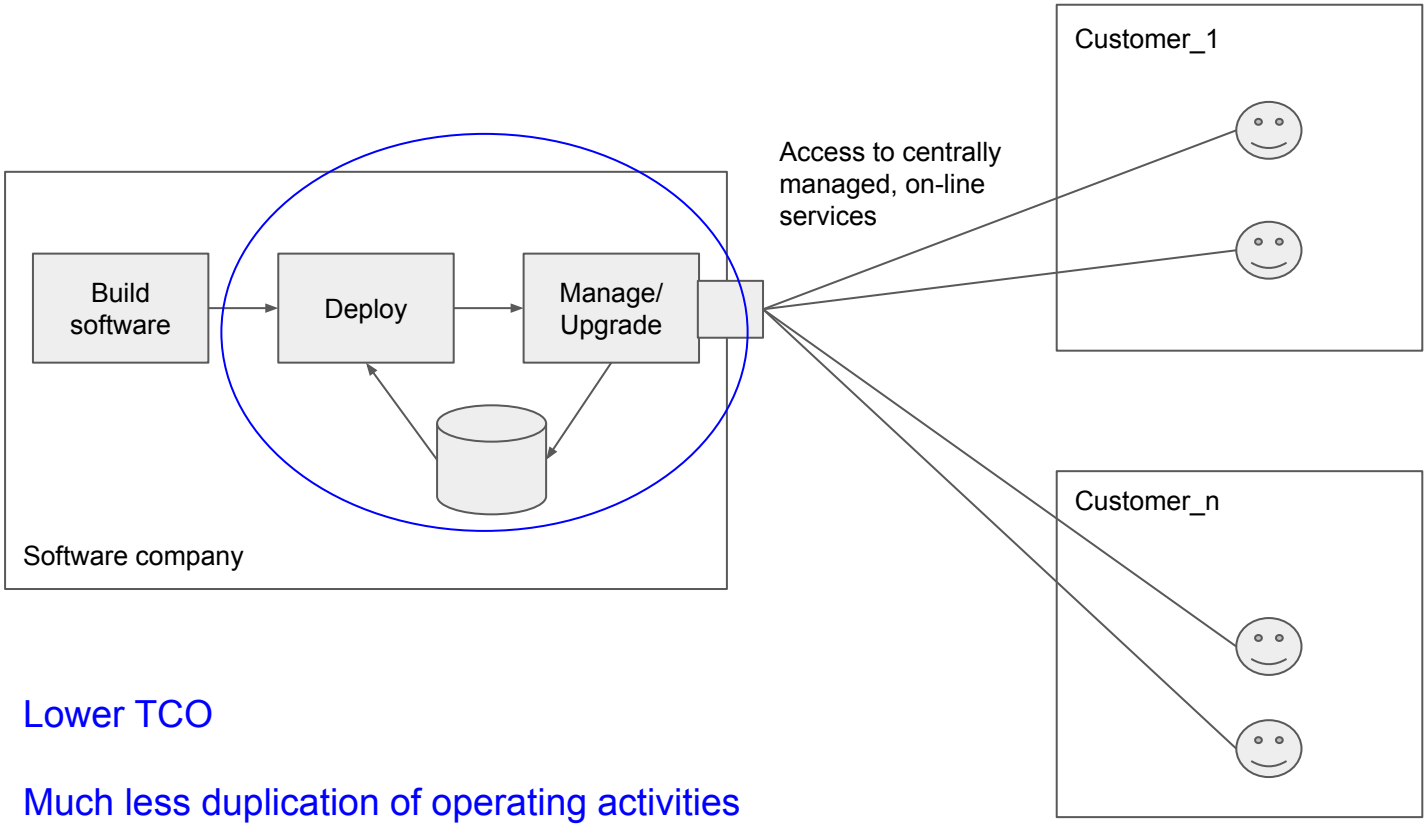


High Total Cost of Ownership (TCO)

Expensive duplication

Lack of specialization

SaaS



Lower TCO

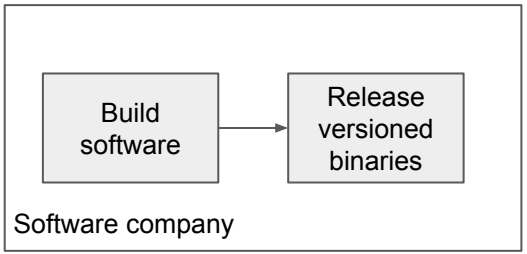
Much less duplication of operating activities

Much better specialisation in this division of labour

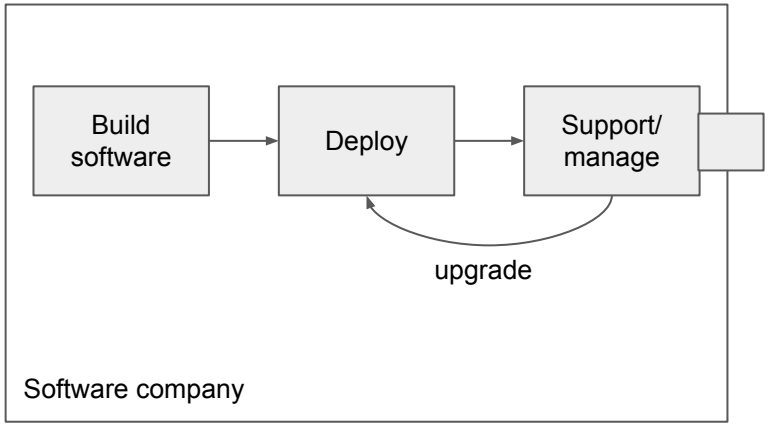
Impact of SaaS on the Software Engineering Process

Impact on the software company

Binary distribution



SaaS



Impact on the software company

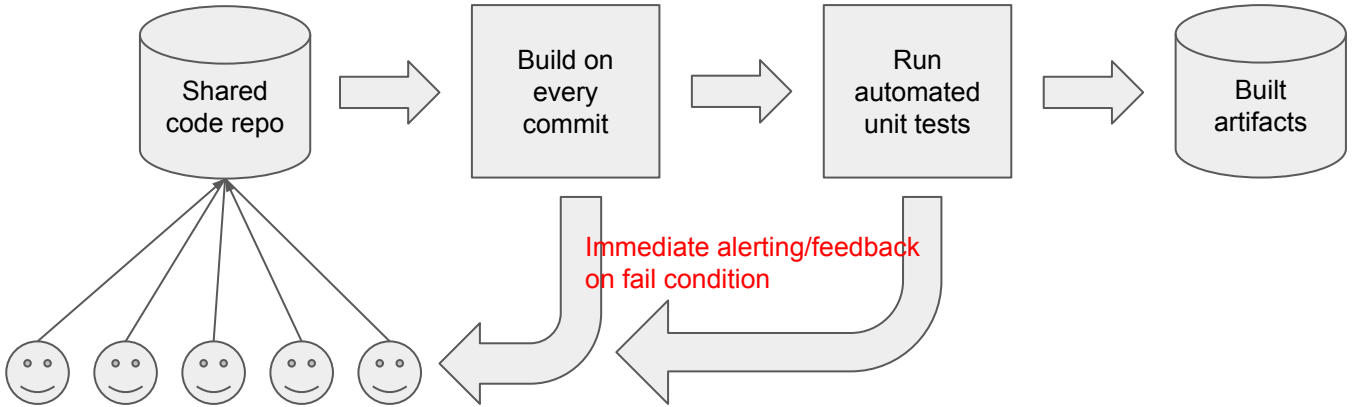
1. *Continuous Deployment* provides new ways to manage quality
    - ‘Software release’ no longer an all-or-nothing discrete event + real-time metrics

2. *Behavioural Analytics* + *Experiments* provide new ways to manage product
    - Continuous user/commercial insights feed back into iterative software development process

3. Use of web services and open standards allows *services to be composed*
    - Can build powerful functionality on top of 3rd party services very quickly

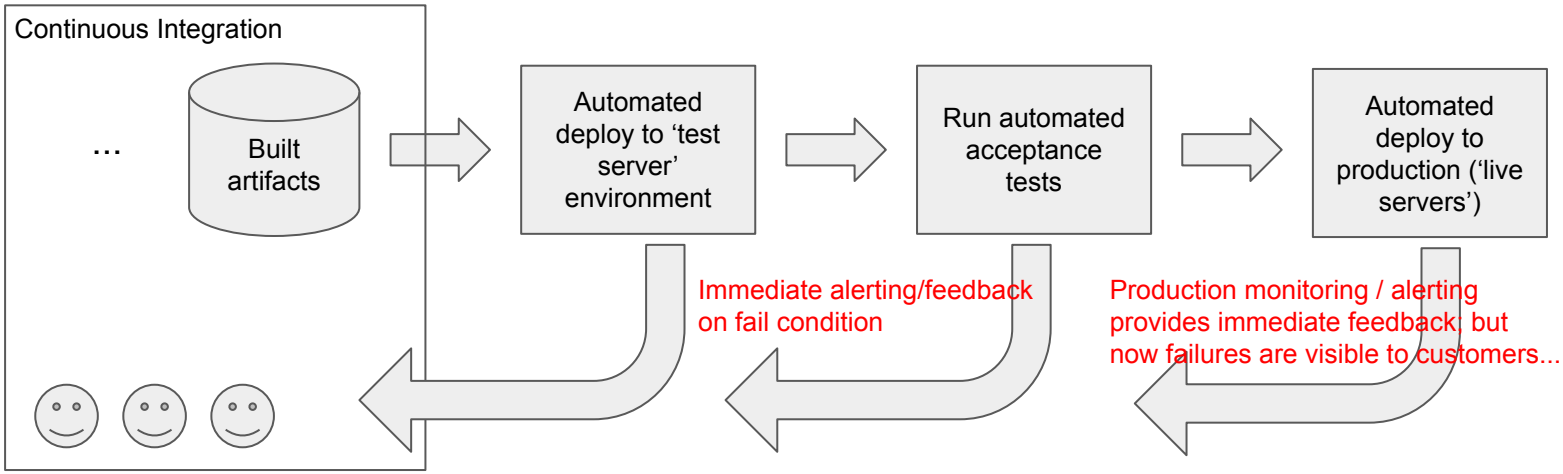
Continuous Deployment

Continuous Integration (CI): short integration cycles lead to greater throughput



Developers commit to shared dev ‘mainline’ branch frequently (e.g. at least once a day)

Continuous Deployment (CD): bring ‘deploy’ into the ‘short cycle’



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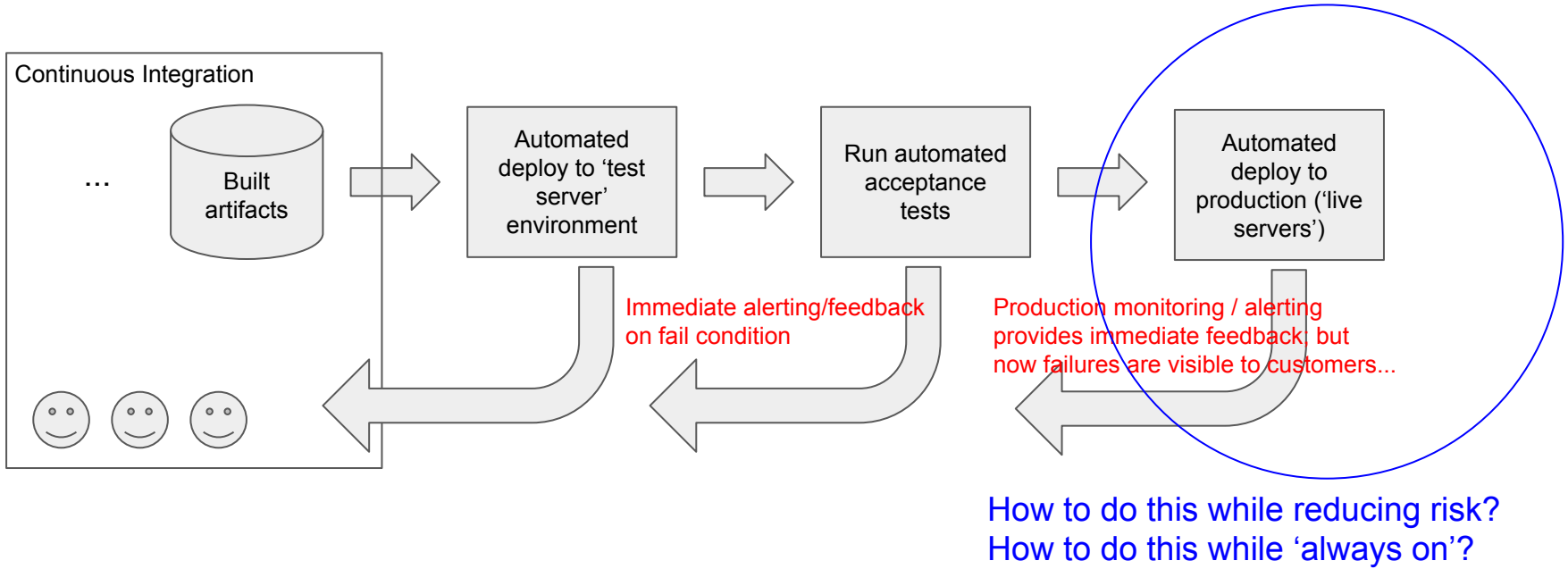
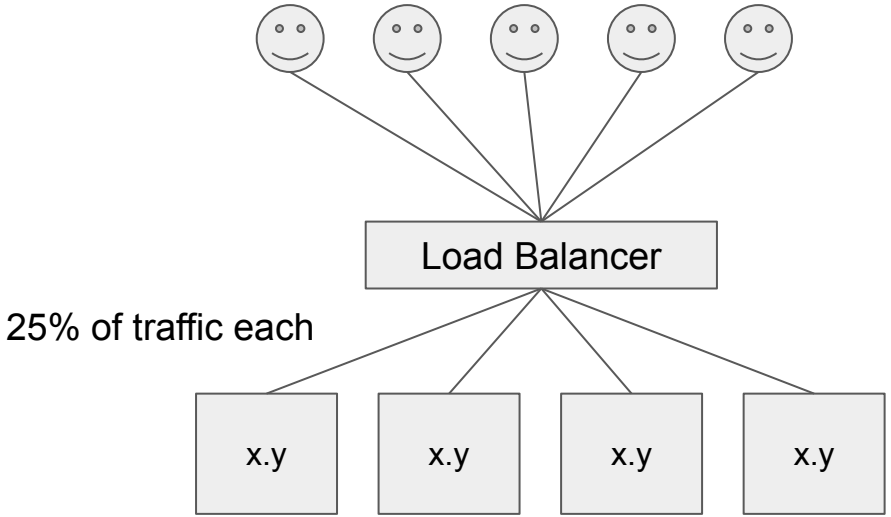
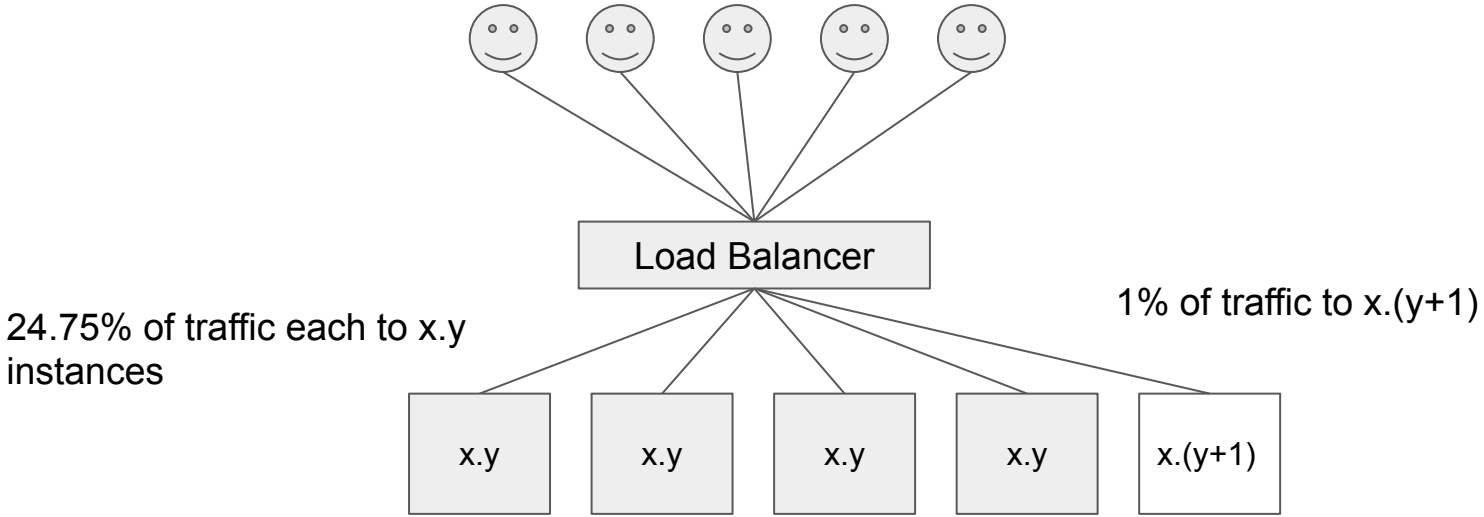


Rolling deploy

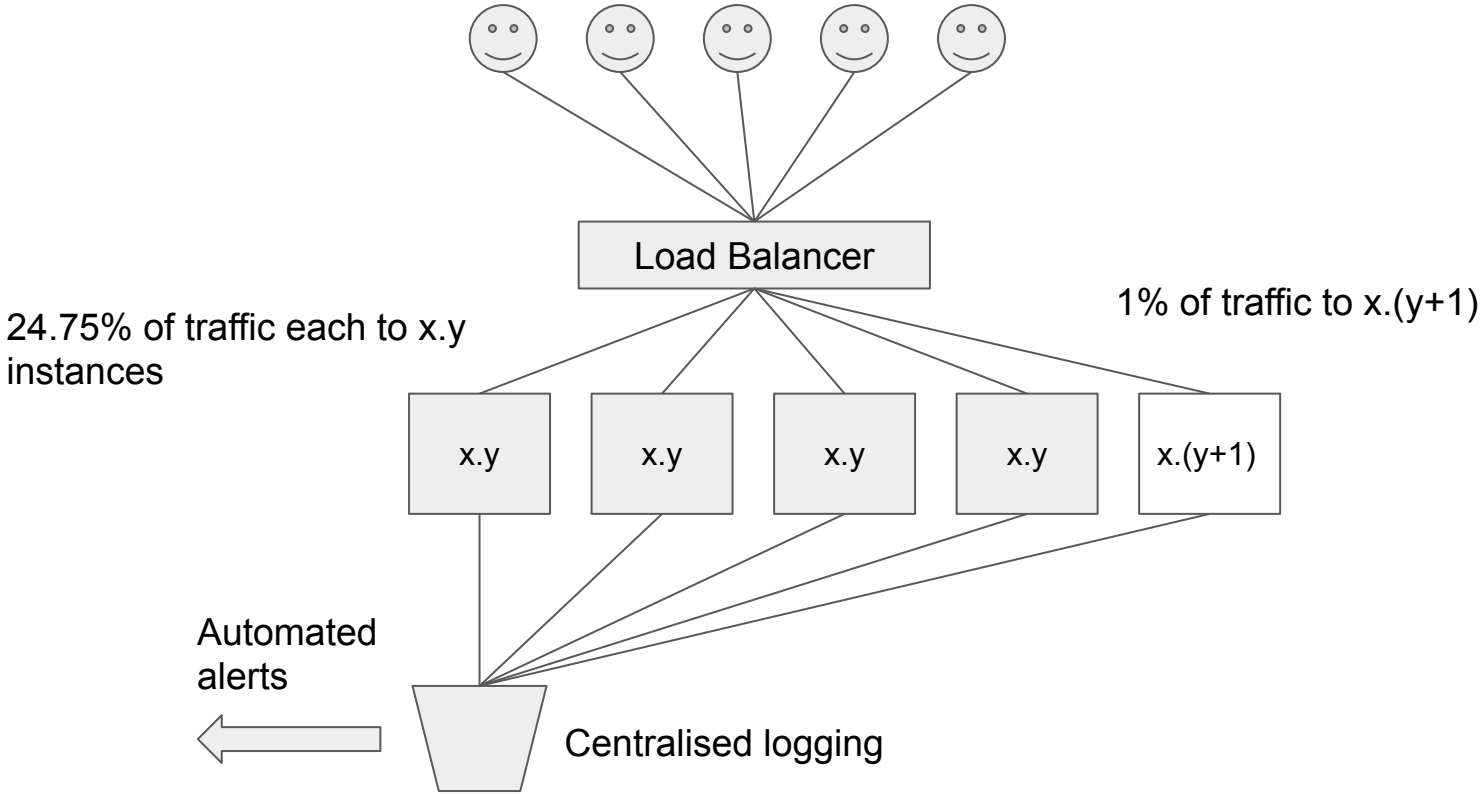


Note: these resources are usually running in a cloud platform. So virtual machines, load balancers, storage, network etc. can all be provisioned and configured through the cloud platform's APIs.

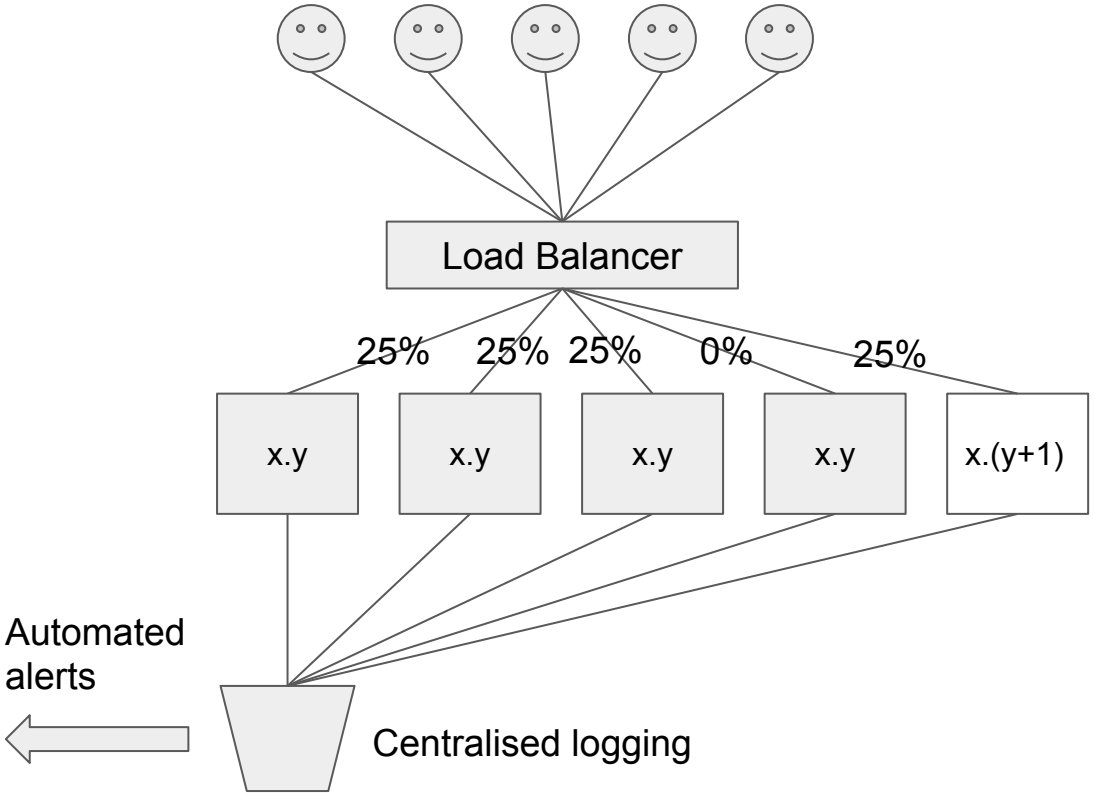
Rolling deploy: 1) Deploy ‘canary’ (limit exposure/risk)



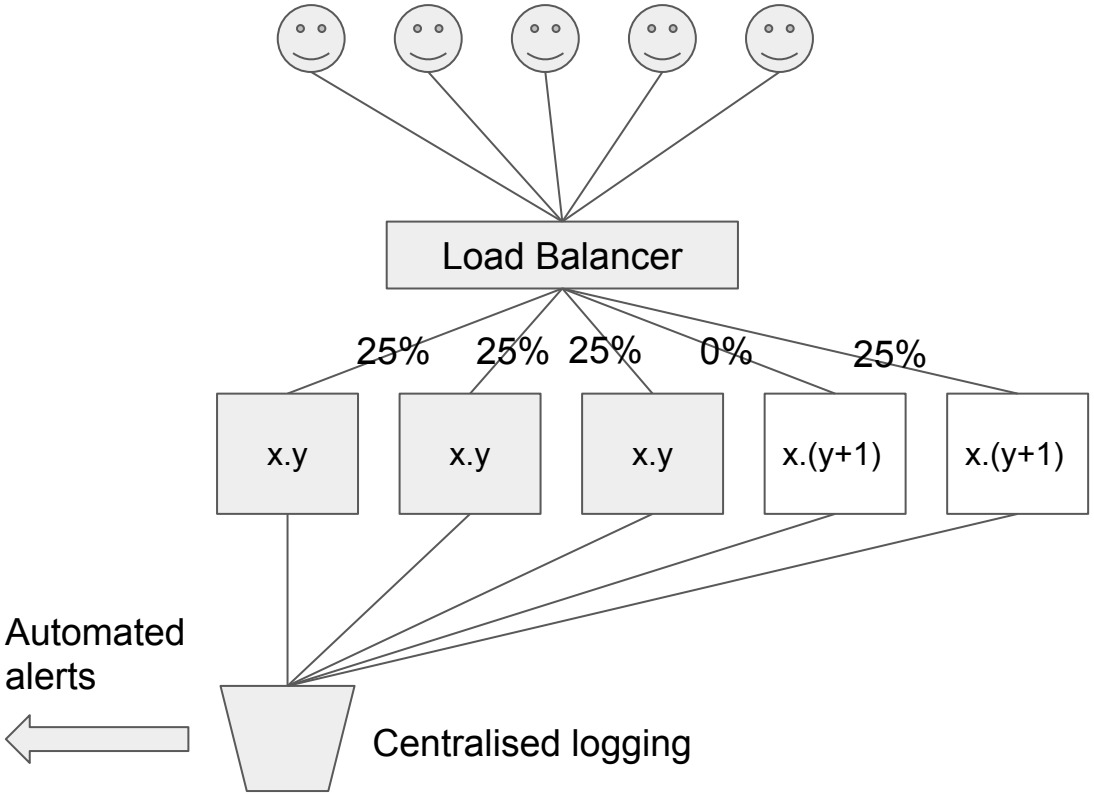
Rolling deploy: 2) Automated monitoring of error rates - OK?



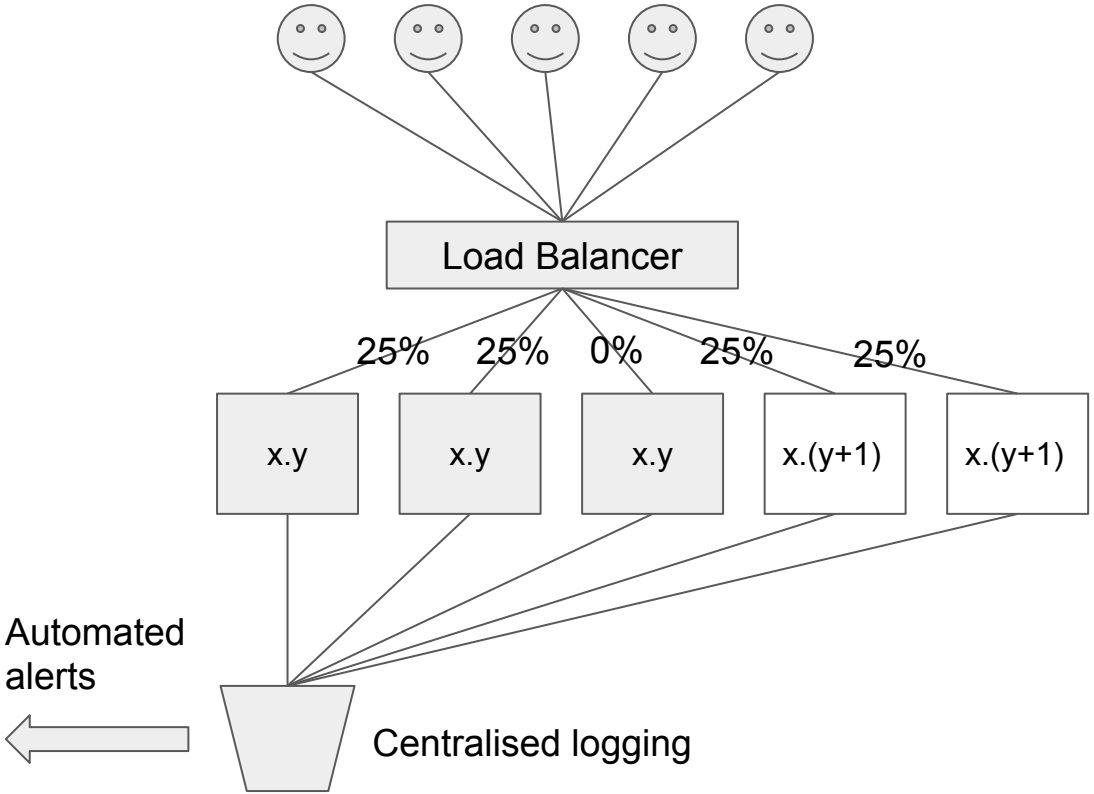
Rolling deploy: 3) Move traffic from old instance to new



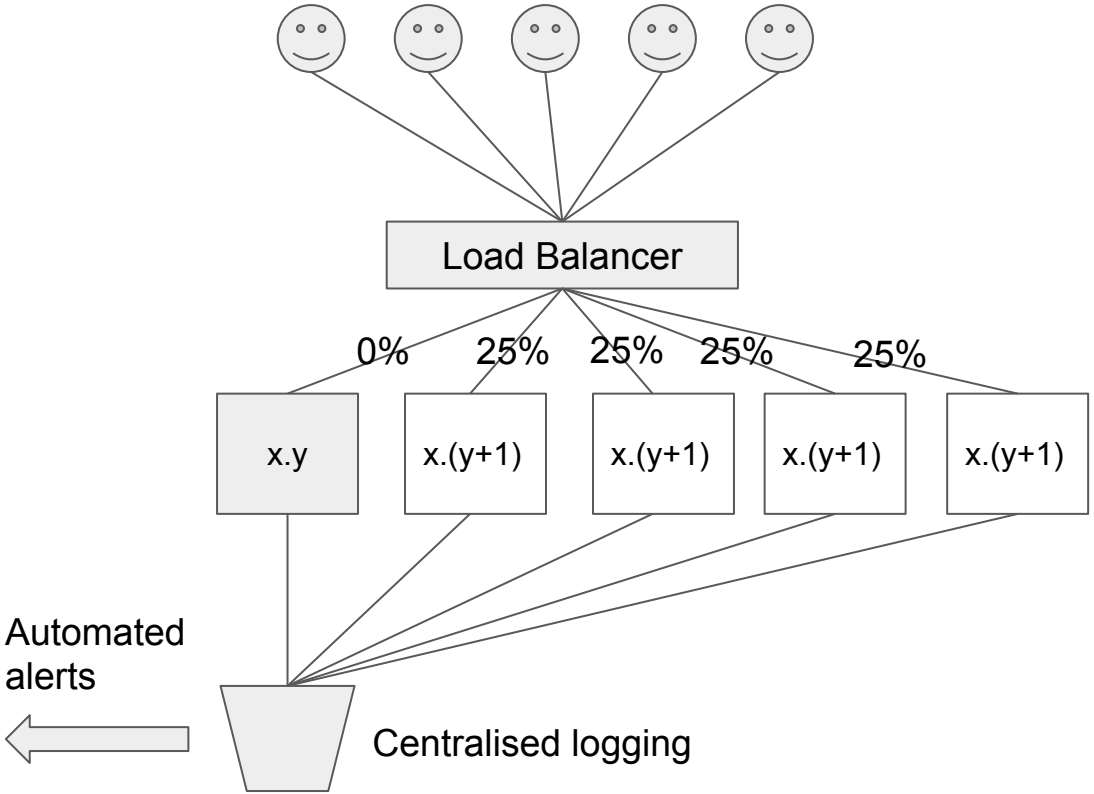
Rolling deploy: 4) Upgrade 0% instance



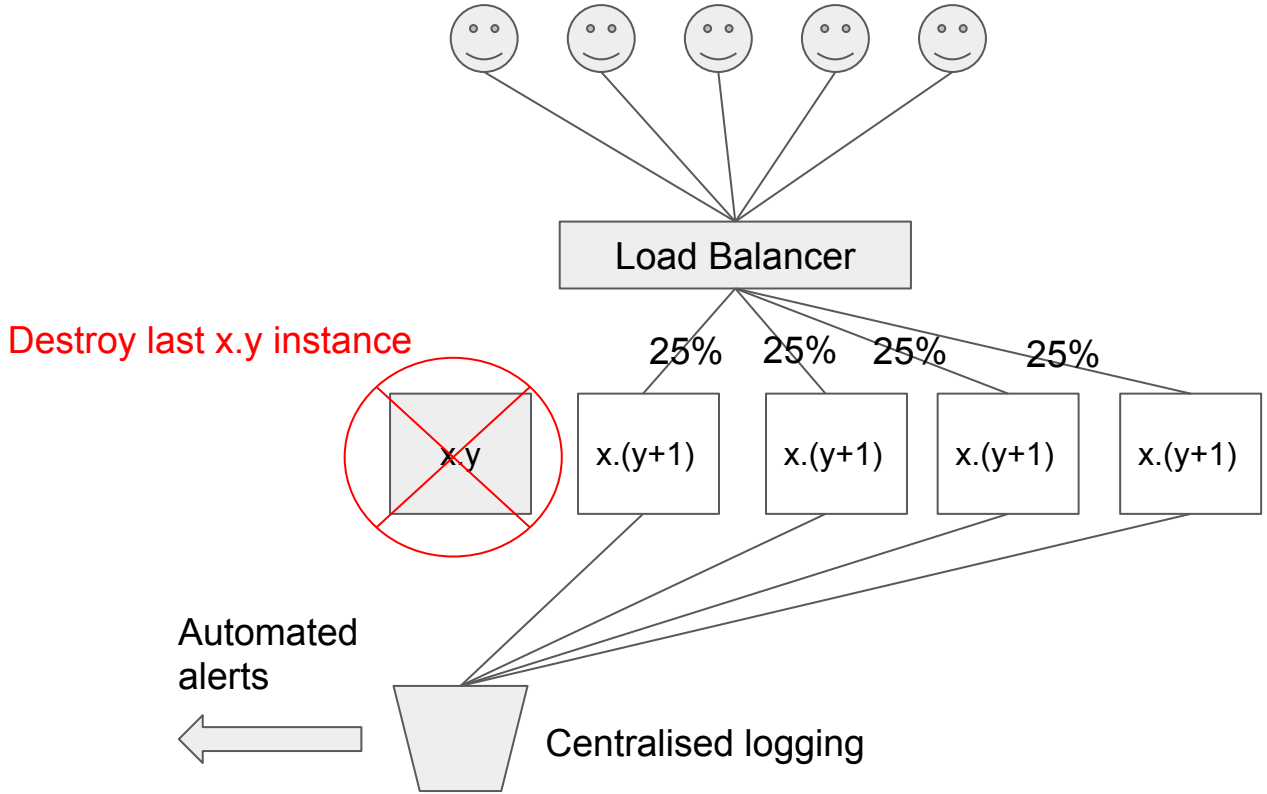
Rolling deploy: 5) Move traffic from old instance to new etc.



Rolling deploy: Repeat {move traffic old->new; upgrade old}



Rolling deploy: …



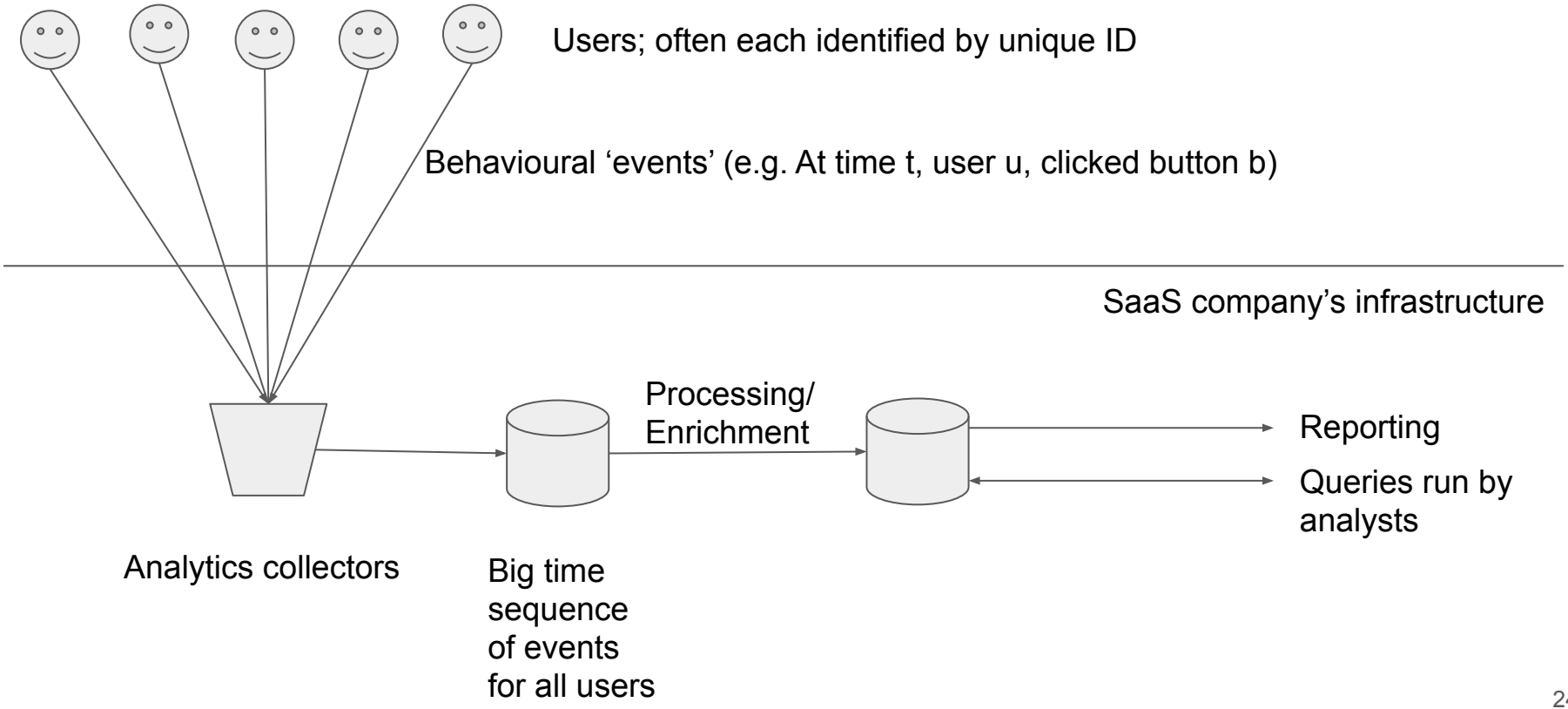
(If anything unexpected happens then can **pause** at any point; aim to ‘roll forward’ rather than ‘rolling back’...)

Review

- Continuous Deployment is the natural extension of Continuous Integration to SaaS, taking advantage of SaaS's low cost of deployment
- Rolling deploy is a technique for upgrading and developing SaaS software with zero downtime
- Enables better ways of managing quality/risk
  - Releasing at low % (with centralised logging + alerting) mitigates effect of production bug that escapes QA
  - Fixes can be distributed to all customers easily and quickly

Behavioural analytics and experiments

A simple behavioural analytics pipeline



What can we learn from the event logs?

- User/growth metrics:
  - Monthly Active Unique Users (MAU); Daily Active Unique Users (DAU)
- Engagement:
  - Time spent using the service
- Feature usage/growth/engagement metrics:
  - X% of users tried feature F at least once in the last month
  - Y% of users used feature F2 for at least 5 minutes last week
  - Feature F3 usage growing at Z% year-on-year
- Insights based on user segmentation:
  - Users who signed up in January 2018 exhibit an average 2% monthly churn
  - Female users aged between 20-25 are X% more likely to use feature F at least once

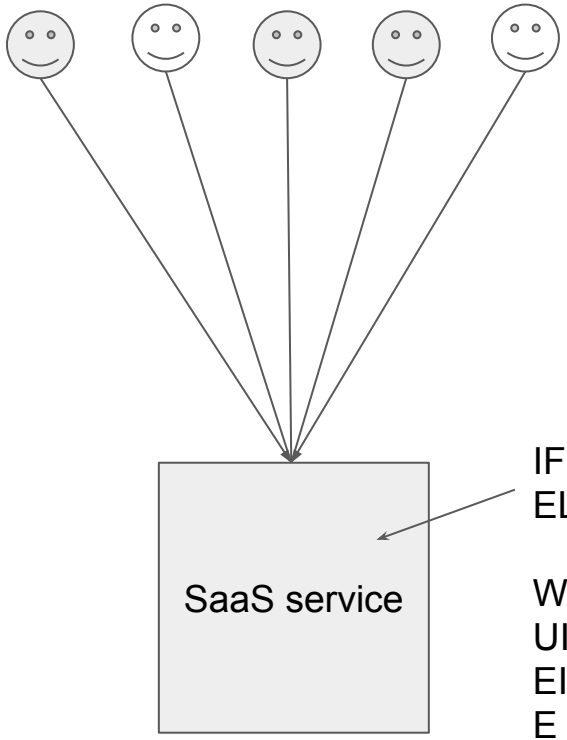
What else can we learn from the event logs?

- Correlations
  - Usage of feature F2 is correlated with usage of feature F1
  - Daily time spent on the platform is correlated with the number of days since sign-up
- But NOT cause and effect… At least not without an experiment framework.

How can we move from correlations to cause/effect?

- Run controlled experiments:
  - Determine hypothesis to test
  - Determine level of exposure, E, (% of users that will go into experiment group)
  - Bucket users into either experiment group (E%) or control group (100-E)%
  - Release a change to the experiment group only
  - Measure relevant metric(s) in both control group and experiment group and determine whether the observed **difference** is statistically significant
- By measuring difference between control and experiment groups we can have some confidence that the difference is due to our ‘change under test’
- Often pick low E and ramp up (e.g. 1%, 10%, 25%, 50%)
  - Similar to phased deploy alerting, but measures ‘do users like it’ rather than ‘are there errors’
- Experiment throughput can quickly become limited by traffic volume

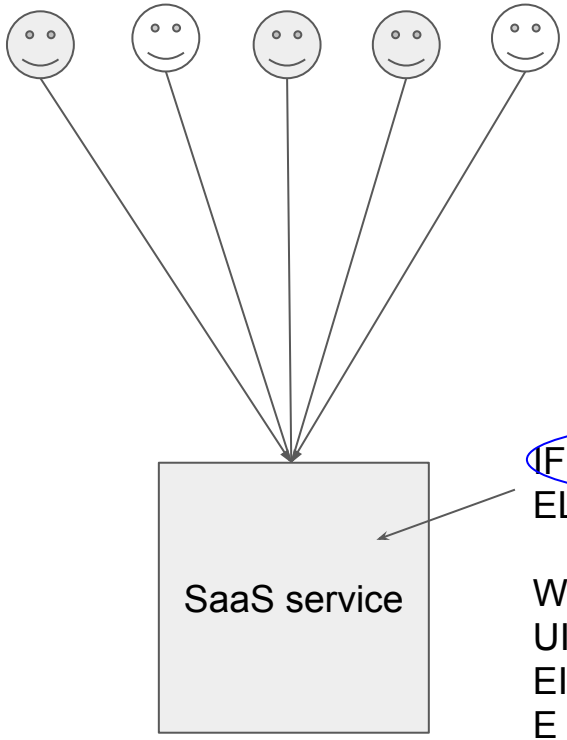
A/B test architecture



IF (hash(UID.EID) mod 100) < E THEN serve experiment variant
ELSE serve control variant

Where:
UID = User ID
EID = Experiment ID (one per experiment)
E = size of experiment group for experiment EID

A/B test architecture



- Stateless
- Users *persistently* in a control or experiment group; don't 'flap'
- Users in existing experiment group remain in experiment group as E increased
- Works for multiple concurrent experiments (but be careful of independence assumptions)

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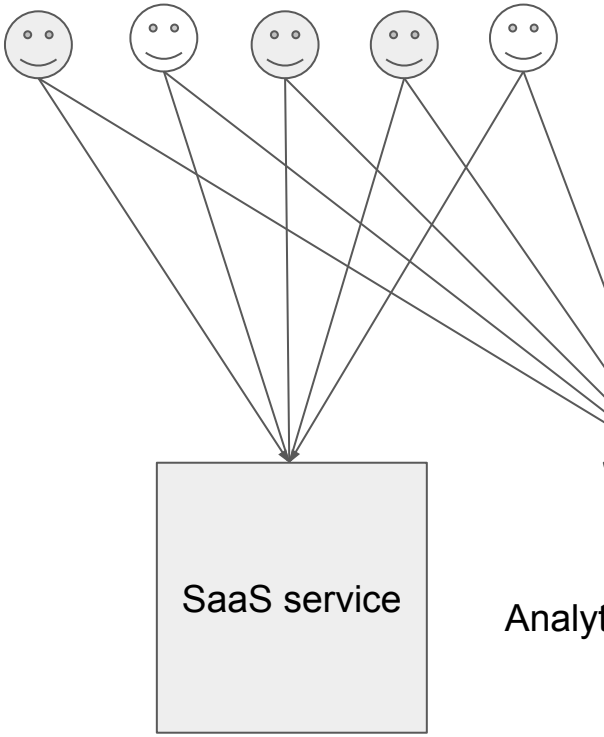


Users

Behavioural ‘events’:
At time t, user u, **in experiment groups for EID1, EID5,** clicked button b

SaaS service

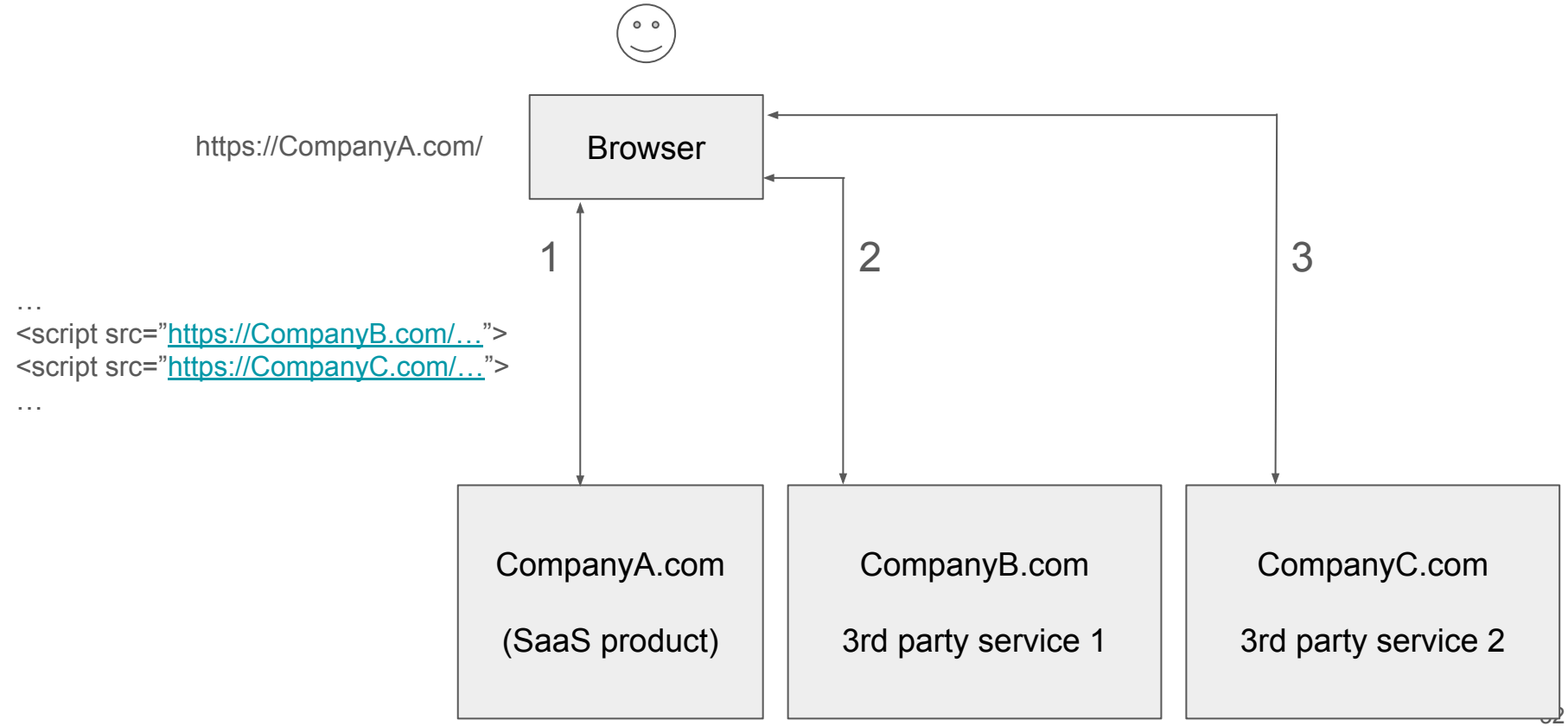
Analytics collectors

Big time-sequence of events for all users

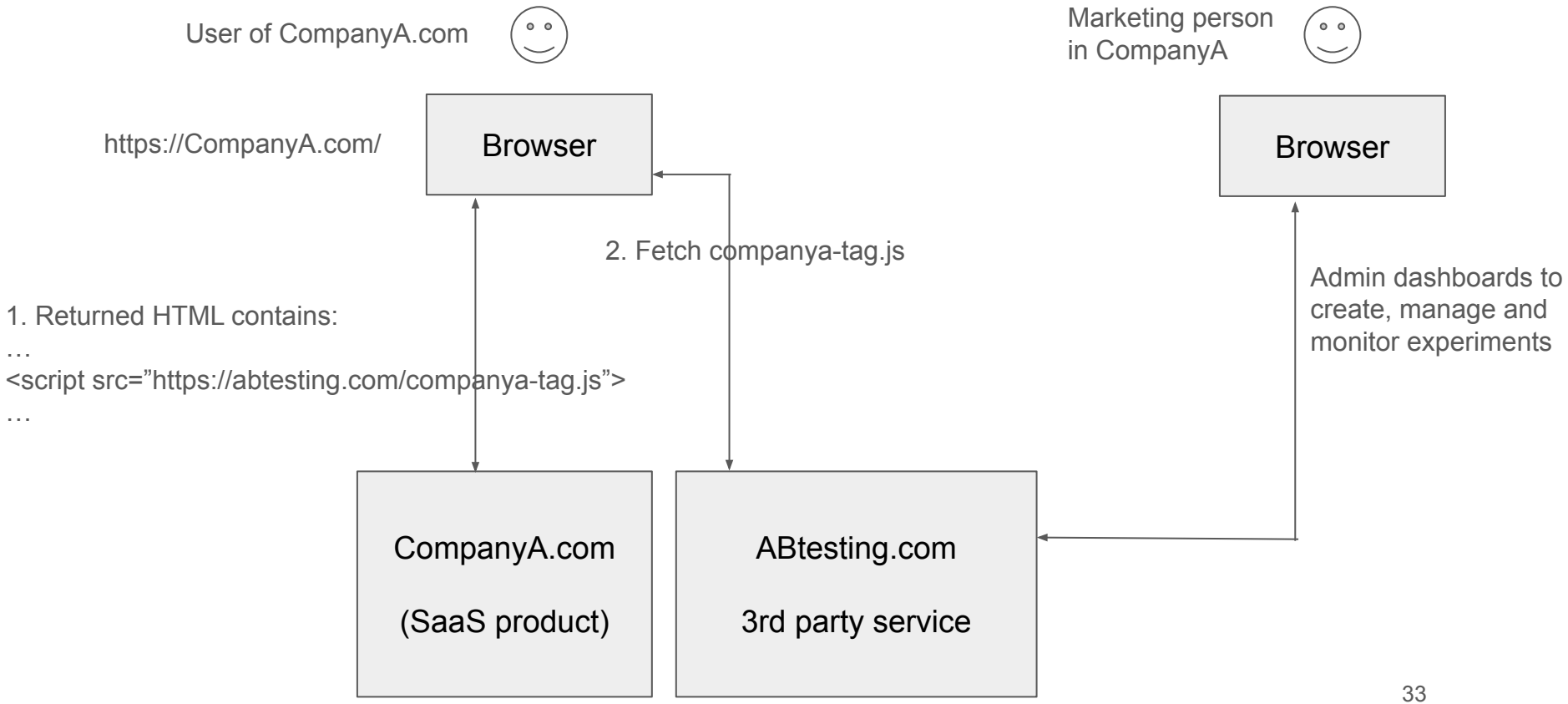
For each experiment, e, generate reports for metrics of interest segmented by (i) ‘in EID_e’; and (ii) ‘not in EID_e’. Compare these results for each metric and test statistical significance.

Service composition

HTML + HTTP + Javascript => easy integration



Example: integration of 3rd party A/B testing platform



But be careful…

1. Easy integration: Can !=> Should
2. Delegated all control of versioning/deployment
3. Data privacy?
4. User tracking?
5. Security?

Summary

Summary

- Putting the manage/deploy/upgrade cycle into the software company is a profound change with far-reaching consequences:
  - Economically:
    - Reduces customer TCO and barriers to purchasing
    - Leads to better specialisation, and less duplication; creates new business models
  - Operationally:
    - Enables new ways of doing QA, which changes the economics of testing
    - Phased releases (which can take place over days if required, with flexibility to pause and fix at any time); live monitoring/alerting
    - Can build higher quality software due to increased visibility of user behavior
    - Can compose existing services quickly and easily