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2021 Fall Technical Forum
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Cloud & Virtualization

Software Reliability Engineering
Scaling the Cloud with Automation

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2021 Fall Technical Forum
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SRE in a Nutshell

- Site/Software/Service Reliability Engineering (SRE) is what happens when you put software engineers in charge of operations:
  - Everything becomes a software challenge
  - Repeated manual tasks (toil) are annoying, and must be automated away
- Examples of toil:
  - Manual deployments
  - Scaling clusters
  - Failover during a network partition
  - Database replication
- SRE is directly analogous to the trend from manual to automated testing, but for operations

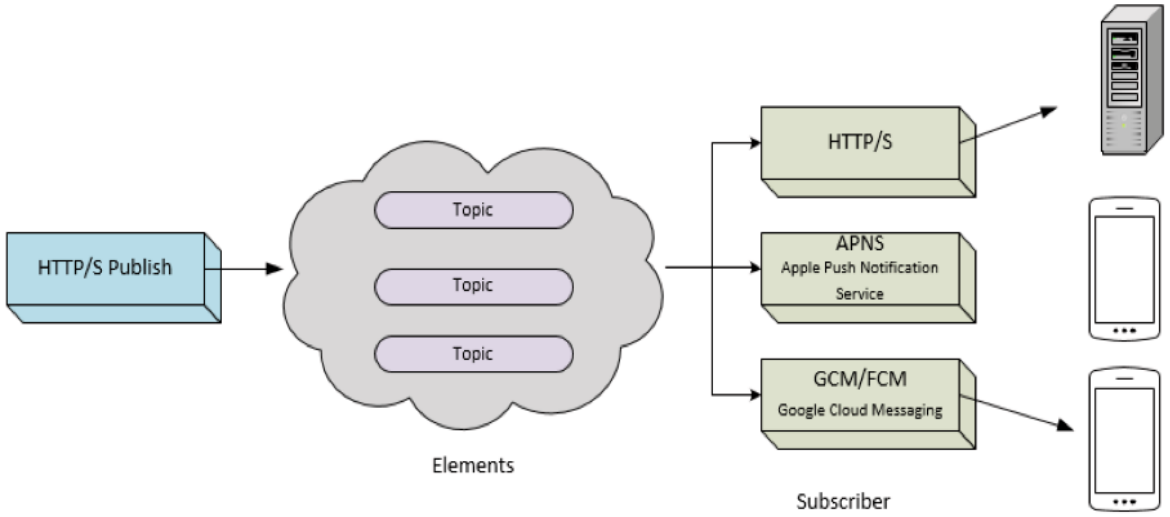
More about SRE

- There is so much more than automation to SRE, which greatly exceeds the scope of this presentation
  - SLIs, SLOs, Error Budgeting
  - 4-Golden-Signals dashboarding
  - Release Engineering
- Read the definitive book on the topic online for free:
  - Site Reliability Engineering

Comcast's Elements

A Push Notification Service

- There are many publish-subscribe solutions, including open-source options (Kafka, RabbitMQ)
- Comcast had need of one which could traverse public clouds and our plant and publish to heterogeneous consumers, including set-top boxes and mobile devices



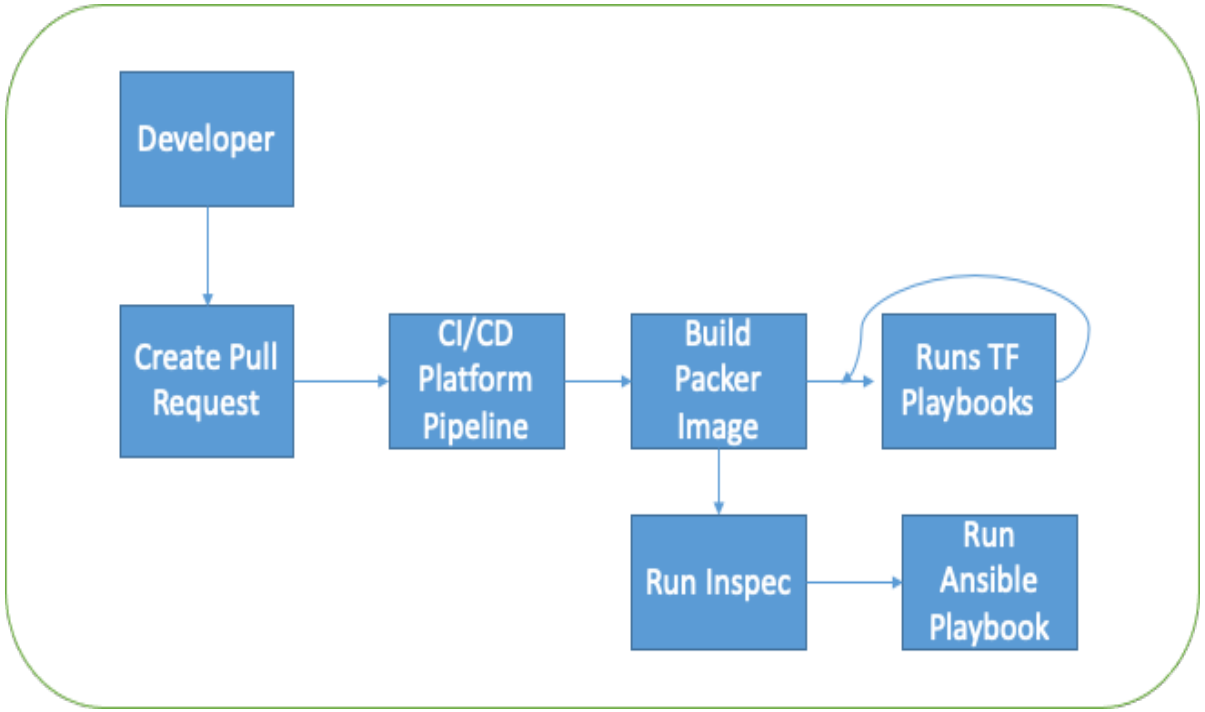
Elements Starting Point

- Before SRE, Elements was operated manually, requiring human intervention to accomplish regularly required tasks:
  - Mesosphere DC/OS
    - Compute scaling, health checks, geographic redundancy, upgrading
  - Consul
    - Service discovery scaling, upgrading
  - Couchbase
    - Database scaling, geographic redundancy, mirroring, failover, schema management, upgrading
  - HAProxy
    - Health checks, scaling, intercommunication

Elements End State

Automated Playbooks

- The end state is built on Infrastructure-as-Code (IaC), with Ansible triggered by the CI pipeline, which is in turn triggered by Git pull requests
- In place of one-off playbooks written for a specific task, playbooks are written by templated category intersections
  - Scale x DC/OS: specifies the general scaling template to know about DC/OS
  - Failover x Couchbase: specifies agent promotion to primary database during network partition



Financial Tools, Reimagined to Drive Automation

NPV, IRR, and Cost of Capital

- We can leverage the language of finance to support the prioritization of automation efforts by swapping out dollars with time
- The result is an ordered list of potential stories / features / tasks based on their efficacy at trading time now for time later
- The financial concepts:
  - Net Present Value (NPV)
  - Cost of Capital
    - Weighted Average Cost of Capital (WACC)
  - Internal Rate of Return (IRR)

Financial Calculations

- Net Present Value (NPV)
  - The current value of a series of future events, discounted by a defined rate to account for the time value of money
  - A single event: $\frac{R_t}{(1+i)^t}$
  - The entire series: $\mathrm{NPV}(i, N) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$

Financial Calculations (cont.)

- Cost of Capital
  - The required return necessary to make an investment worthwhile
  - When the business has multiple default options, all can be combined into the Weighted Average Cost of Capital (WACC)
- Internal Rate of Return (IRR)
  - The discount rate that when applied to a NPV calculation would make the answer be zero
  - Factors out everything external to the investment
  - Easily compared against your cost of capital to identify non-starter investments
  - Formula: $$\mathrm{NPV} = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n} = 0$$

The Evaluation Process

1. Do a task the first time, and remember you did it
2. Notice that a task is toil, by virtue of having to do it a second time
3. Record how long it takes to do it by hand
4. Mentally break down the process into automatable chunks
5. Estimate how many dev-hours would go into coding the automation, along with how often and when this toil would have to be done in the future
6. Enter #5 into a spreadsheet (as a negative value), and #3 whenever you expect to have toil replaced by automation in the future (accounting for the fact that until the automation is complete, you'll still have to do it by hand)

Example Data Tab

Discount Rate:	10.00%	Development Hours (Month 0)	Hours of Toil Avoided																			
Opportunity Name			Year 1											Year 2								
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
OpenStack Usage Accounting		-100		6	6	6	6	6	6	6	6	6	6	6								
xCloud Usage Accounting		-100				6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Big Good Project		-1600			75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
Small Borderline Project		-40						8						8						8		
Medium Good Project		-240												120								
Big Bad Project		-2800													120	120	120	120	120	120	120	120
Doesn't Even Make Back Investment		-480				10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Example Dashboard

Opportunity Name	IRR	NPV (hrs)	Breakeven	Idx
OpenStack Usage Accounting	-49.40%	(37.57)	Never	1
xCloud Usage Accounting	56.24%	69.35	Jan 2022	2
Big Good Project	35.71%	590.14	May 2022	3
Small Borderline Project	11.23%	0.75	Mar 2023	4
Medium Good Project	23.38%	58.42	Mar 2023	5
Big Bad Project	1.39%	(426.32)	Never	6
Doesn't Even Make Back Investment	-19.40%	(197.74)	Never	7

The Excel Calculations

- To create the dashboard, you'll need the following calculations:
- Discount Rate: Enter yourself (we use 10%)
- IRR:
  - `=IF(Data!C4 <> "", XIRR(Data!C4:AM4, Months!$A$1:$A$37), "")`
- NPV:
  - `=IF(Data!C4 <> "", XNPV(Data!$B$1, IF(ISNUMBER(Data!C4:AM4),Data!C4:AM4, 0), Months!$A$1:$A$37), "")`
- Or… adapt the sample spreadsheet included with this paper & presentation

Bonus!

- Once you're familiar and comfortable with these concepts, you can put dollars back on the menu
- Propose projects, offering a documented business case that uses NPV and an IRR in excess of WACC to make its argument
- Impress people, get promoted

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Thank You!

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