Toby Lorne Welch-Richards

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Toby is a highly-motivated and process-driven systems engineer who has experience architecting, developing, and operating complex systems. He has strong written communication skills, and works well both as an individual contributor and as a technical lead.

Toby is passionate about automation, networking, engineering reliability and resilience, safe and repeatable releases to production, and teaching people how to code. He is an advocate for open-source software and is looking to provide a meaningful and positive contribution to society.

Recent roles

- Booking.com - Senior Site Reliability Engineer (2021-)
- Foreign, Commonwealth, Development Office (2020-2021)
- Government Digital Service - Senior Site Reliability Engineer (2017-2020)
- Government Digital Service - WebOps Engineer (2017-2017)
- Macromeasures - Co-founder (2014-2017)

Programming languages and technologies

- Proficiency with Go, Python, Ruby, JS, Bash, Terraform, Puppet
- Proficiency with Kubernetes, OpenStack, AWS, VMware, and BOSH
- Proficiency with Prometheus, Grafana, ELK, AWS CloudWatch, Graphite
- Familiarity with SML, F#, Rust, Crystal, GCP, Splunk
- Networking:
    - Multi-site (IPSec Prime/Foundation/CATAPANs, Strongswan, routing protocols, wireguard)
    - Software-defined (CNI, Silk, Istio, MetalLB, bird)

Recent projects

Booking.com Service Mesh

Booking.com has a large geographically distributed tech footprint that spans on-premise bare-metal servers, a OpenStack private cloud, and public cloud (mainly AWS). All applications have to discover and communicate with each other reliably with low latency. Booking.com's service mesh supports communication between thousands of proprietary microservices and provides capabilities for defining SLOs. Traffic is millions of requests per second and additionally handles ingress for requests from the mobile app.

- Led project to upgrade ZooKeeper deployment through a 5 year backlog of releases without impact to reliability.
    - Yearly incident volume reduced by >60% due to improvements and fixes from upgrades

    - ZooKeeper not only acts as coordination layer for service mesh but also supports edge traffic, and service discovery and coordination for data services like Kafka, Cassandra, and MySQL
- Architected and implemented interoperability gateways to
    - ensure reliability communication from AWS serverless substrates (eg Lambda and Step Functions) to services deployed on bare-metal, OpenStack, and kubernetes
    - enable composition of HTTP APIs (like an API Gateway) composed of AWS Lambda functions, to seamlessly integrate into existing service mesh
    - ensure traffic can be shifted via the gateways according to business requirements (eg for disaster prevention and recovery)
- Set up infrastructure for productionising new Service Mesh implementation
    - Istio based, using Kubernetes on AWS EKS deployed via Terraform and kubefed/kustomize
- Development and maintenance of proprietary kubernetes controllers, functionality includes:
    - Integration with proprietary load balancer and service mesh (discovery and failover)
    - Management of firewall entries
    - Compliance (eg compensating controls for PCI-DSS and SOx)
- Maintainer of internal CLI (plugin) to interact and administer the service mesh. Functionality includes end users bootstrap and deploy their traffic management configuration

Booking.com Private Cloud

Booking.com is adopting public cloud, and containerising infrastructure. Some highly-optimised legacy workloads cannot be containerised for ergonomic reasons and cannot be run on public cloud for performance reasons. Multiple OpenStack clouds in geographically distributed, first-party data centers were the migration targets.

- Wrote integrations between first-party tools and OpenStack (provisioning projects)
- Architected and implemented service for exposing OpenStack inventory to users and downstream systems
- Capacity and timeline analysis/planning of migration of workloads (from proof-of-concept to serving live Booking.com traffic)
- Supported client teams (storage: MySQL, Kafka, Elasticsearch) doing proof-of-concept work to evaluate low latency storage options (SAN, local NVMe, NVMe-over-Fabrics etc) and inform procurement of suitable storage devices

GOV.UK Emergency Alerts

GOV.UK Emergency Alerts is the UK emergency alerting infrastructure which sends emergency alerts to mobile phones using cell infrastructure via the four UK mobile telecommunication providers

- Architected and built initial connectivity integration with mobile telecommunication providers
    - (O2, British Telecom, Vodafone, Three)
- Collaborated with UK NCSC to evaluate set cryptographic standards for telecom partners
    - Secure connectivity between cell infrastructure management components
    - Site-to-site connectivity using IPSec VPNs
    - Digital signing and verification using CAP with XMLDSig
- Implementation using Python, Concourse, Cloud Foundry, AWS Lambda and networking services

GOV.UK Platform-as-a-Service

GOV.UK PaaS is a hosting provider for the UK public sector which supports hundreds of developers from over a hundred teams across the UK public sector

- Core platform operations using BOSH, Cloud Foundry, Concourse, Terraform, Go, Ruby, Bash, Docker, Prometheus + Grafana
- In/out-of-hours support and incident remediation
- Reducing expenditure of core platform through the implementation of reserved instances and spot instances
- Significantly expanded test coverage using RSpec (Ruby) and Ginkgo/Gomega (Go)
- Release engineering to speed up pipelines and run availability tests during deployments to improve reliability
- Implemented billing and reporting features to track currency changes and to aid the generation of purchase orders
- Component lead on implementing single-sign on to increase security of the platform
- Component lead on reimplementing and migrating the database engine of the GOV.UK Performance Platform from MongoDB to Postgres. This was part of the work to decommission IBM Compose.io as a GOV.UK PaaS supplier
- Open-source collaboration with upstream Cloud Foundry Foundation teams
- International open-source collaboration with 18F (GDS USA counterpart)

GDS CI/CD tooling

Architected and implemented multi-tenant deployment of Concourse. Users are across >12 teams across multiple government organisations and manage >100 deployment pipelines.

Concourse is a distributed system which GDS deploy to AWS via Terraform, the control plane is shared but each team uses isolated pools of compute resources and has separate network egress.

A self-hosted solution was necessary because of security and information assurance concerns.

Across GDS

- Management of central AWS organisation: account management, and access to billing data
- Management of central SaaS procurements: PagerDuty, Cronitor, Pingdom
- Organisation of "Infrastructure weekly" meeting for cross-GDS incident communications
- Technical engagements and evangelism with other government departments (NCSC, Home Office)
- Development and evangelism of shared GDS tooling: e.g. GDS CLI, Rotas app

GDS CLI tooling

Implemented an internal, cross-platform, Go CLI tool for use by developers and engineers at GDS. It:

- automates the configuration for AWS access with AWS Vault
- is a self-documenting, interactive interface for each team to automate individual tasks
- assists GPG signing merge commits with GitHub to support cryptographically verified continuous deployment
- has an automated release pipeline managed by Concourse

GOV.UK Verify replatforming

GOV.UK Verify is an online identity verification platform for UK residents. Technical lead - responsible for planning and delivery against a large backlog of organisation wide technical debt

- Challenged assigned objectives to deliver more value for reduced cost (>$150k USD annual savings) through the redesign and implementation of GOV.UK Verify's cloud architecture. Implemented a new

infrastructure that is continuously deploying using Concourse, Terraform, Amazon Elastic Container Service (ECS), and Prometheus + Grafana
- Retooled GOV.UK Verify's existing monitoring, alerting and deployment infrastructure with an internal ECS Platform running Grafana, in-house dashboarding, and Concourse.
- Managed and rolled out best practice for centrally procured alerting SaaS: - PagerDuty and Cronitor
- Threat modelling, penetration testing, and security architecture
- Training developers in how to support and observe their apps, and how to operate the new continuous deployment pipelines

GOV.UK Pay replatforming

GOV.UK Pay is an online payments platform for UK residents.

- Onboarded onto the team to implement Amazon ECS and migrated existing application deployment from Ansible
- Re-engineering deployment automation to ensure that deployment was more visible and safer (Jenkins, Ruby scripts, and custom Ruby-on-Rails deployment visualisation tool)
- Created CLI tooling to help developers develop/operate/support the platform
- Created back-office web application to assist with onboarding of new services
- Reimplemented performance reporting: the previous reporting system relied on parsing logs, as a result financial information was incorrectly reported. Added new endpoints on internal microservices to support public reporting functionality
- Implemented frontend A/B testing resulting in reduction of payment completion drop-off by 25%

Automation of support rotas at GDS

The rotas app is a Ruby-on-Rails web application which replaced the plethora of spreadsheets used to manage on-call and support rotas. It is used by over 10 teams and:

- integrates with PagerDuty and calendars (eg Google, Apple, Outlook)
- implements an audit trail to track usage of contact details
- tracks annual leave to find conflicts between support rotas and annual leave

Macromeasures

Toby co-founded Macromeasures in 2011. Macromeasures was a data company based in Montreal and New York, now owned by StatSocial

Technical work

- Built initial infrastructure on-premise infrastructure at McGill university
- Migrated infrastructure to IBM SoftLayer, and then to AWS
- Re-architected from raw EC2 architecture to ECS - to achieve a 30% reduction in infrastructure costs
- Design, implementation, operation of large database clusters: Riak, Postgres, MongoDB, Redis
- Large scale database migrations to reduce cost savings
- Management of > $100,000 (USD) annual infrastructure budget and spending
- Built internal CLI, web applications, data pipelines
- Developed and operated customer and partner facing web apps
- Created customer facing software integrations and tools - Google Sheets, Hootsuite, Twitter API, Instagram API

Non-technical work

- Introduced and managed reproducible sales pipeline using Salesforce CRM and Persist-IQ

- Built semi-automated system for lead-sourcing using proprietary and third-party data sources and tools
- Created sales decks, marketing materials, and contracts
- Grew annual recurring revenue from $0 to $150k USD in 12 months
- Sold software and services to both startups and large companies (Fortune 1000)
- Managed technical and non-technical relations with revenue-share data partners

Line management, and recruitment at GDS

- Line managed site reliability engineers, developed curriculum to improve coding ability of line reports
- Designed and ran an interactive training/gameday for 60 technical staff using AWS, Concourse, Splunk, and post-it notes
- CV sifting, phone interviews, chairing in-person interviews (civil servants and contractors)
- Wrote SRE interview code-comprehension question to ensure all SREs were screened for coding proficiency
- Participated as a coach in internal programme within GDS to teach programming to non-technical staff
- Frequently attended codebar as a coach - codebar is a charity that seeks to make tech more diverse by running programming workshops

Open Source Software

Contributor to Cloud Foundry - an open source, multi-cloud application platform
Contributor to Concourse - a distributed system for continuously doing things
Contributor to GCHQ CyberChef - an intuitive web app for data analysis, encryption, and other "cyber" operations
Maintainer of petitions exporter - a Prometheus exporter for the UK government petitions website
Maintainer of some gallery thing - a serverless web app for finding art exhibitions in London and Amsterdam
Misc. contributions to CNCF projects: CNI, Istio

Recent public speaking

- Cloud Foundry Europe Summit 2020 - How Cloud Foundry Goes Bang
- FOSDEM 2020 - From a Pipeline to a Government Cloud
- Concourse London User Group - Operating a multi-tenant Concourse

Education

- Software Engineering B.Sc. from McGill University (Montreal, QC, Canada)
- Undergraduate exchange at MIT (Cambridge, MA, USA)