

Ratnadeep Bhattacharya

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Technical Expertise

I **automated infrastructure and built event-based monitoring pipelines** long before the advent of Kubernetes, Prometheus and IaC. While I assimilated them along with Envoy, WASM, eBPF and many others into my toolkit, during a career and a PhD spanning **17+ years**, my focus has always been on the core principles of infrastructure management. As such my expertise goes beyond the ever-ephemeral tools, allowing me to comfortably **handle challenges** - like automating parts of Kubernetes services, optimizing inter-service communication, manipulating traffic to-and-fro services, getting deeper insights into them - **that require extending COTS tools with specific knowledge of the environment.**

- Designed and built infrastructure using **Kubernetes** and **Linux**. Projects here include active/active data centers, root cause analysis, capacity planning, disaster recovery and associated network topologies.
- **Infrastructure development** experience **building novel tools** for **application monitoring**, VM **deployment automation**, automatic resource accounting/network scanning etc. These projects involved writing Kubernetes operators (**Go**) to watch endpoints and novel solutions (**C**) for automatic application log parsing and event notification (**Python Flask**).
- Building **sidecars** for monitoring, intercepting and manipulating **microservice** traffic (**Go** and **Rust**).
- Deep understanding of **virtualization** and **containerization** including the underlying Linux infrastructure. Projects here include building a **container runtime** (**Go**) as a teaching tool (TA for Operating Systems).
- Built **eBPF (XDP)** and **WASM** (Web Assembly) based security tools to filter traffic at L2/3 and L7 (**Rust, Go & C**).
- **Research experience** includes peer-reviewed papers published in **IEEE** and **ACE** conferences optimizing performance in microservice architectures. This research has been recognized with the **IEEE Karsten Schwan Best Paper Award**. Projects here include contributions to OpenNetVM (**C**), an open-source **DPDK** (kernel bypass) based network function virtualization framework (**NFV**), adding algorithms (**C++**) to the Envoy proxy for better performance in serverless frameworks and custom infrastructure (**Go**) for better load balancing in microservices fan out. Current work involves preserving message ordering in asynchronous streams while load balancing partitions in a state migration cost aware manner (**Kafka & Go**).

Career at a Glance

- Applied researcher on distributed systems performance. Expertise extends to the Linux virtualization stack.
- Software Intern @ Google (Go, Rust, C, Apigee, Envoy proxy, eBPF, GCP).
- Software Intern @ Bosch (Intel SGX, Marblerun, Kubernetes, Azure).
- Senior Engineer @ IMTAC LLC (Linux, Solaris, VMware, C/C++, Go, Python, Kubernetes, AWS).
- Technical Services Specialist @ IBM (VMware, Linux).
- Senior Engineer @ KPIT (VMware, Linux).

- Nowadays primary focus is on building infrastructure. Operations engineer turned infrastructure developer.

Skills

Languages: **C/C++**, **Rust**, **Python**, **Go**

OS and Virtualization: **Linux**, **Solaris**, **VMware**, **Containerization**

Cloud: **Kubernetes**, Google Cloud Services (**GCP**), Amazon Web Services (**AWS**)

Infrastructure as Code: **Terraform**

CI/CD Pipelines: **Jenkins**, **GitHub Actions**

Tracing Framework: **Jaeger**

Databases: **MySQL**, **Redis**, **etcd**

Education and Awards

Ph.D. - Computer Science

George Washington University, Current (till August 2023)

Karsten Schwan Best Paper Award

3rd IEEE International Conference on Autonomic Computing and Self Organizing Systems

Bachelor of Science - Electrical Engineering

West Bengal University of Technology

Government of India National Merit Scholar

Publications

- Mu: An Efficient, Fair and Responsive Serverless Framework for Resource- Constrained Edge Clouds, ACM Symposium on Cloud Computing, 2021. ([pdf](#))
- Smart Proxying for Microservices, Middleware Doctoral Symposium, 2019. ([pdf](#))
- BLOC: Balancing Load with Overload Control in the Microservices Architecture. Karsten Schwan Best Paper Awardee at ACSOS, 2022. ([pdf](#))
- Load Balancing for Microservice Service Meshes. ACSOS 22 Doctoral Symposium. ([pdf](#))

Experience

Research Assistant, George Washington University, Washington, D.C.

08/2018 – Current

- Teaching Assistant in **Operating Systems** and **Databases** classes. Wrote a **container runtime**.
- Published **novel research on distributed systems infrastructure**.
- Recipient of the **IEEE Karsten Schwan Best Paper Award**.
- Built **custom reverse proxy** and **load balancer** (**Go**).
- Added **custom load balancing algorithm** to **Envoy** proxy (**C++**).
- Network programming – **DPDK** (**C**) and **eBPF XDP** (**C** and **Go**, some **Rust** (Aya crate)).
- Building **asynchronous infrastructure** with **Apache Kafka** (**Go**).

- **Asynchronous programming** and some **FFI** (Foreign Function Interface) in Rust.
- Current project focuses on **optimizing** latency sensitive asynchronous applications while **preserving stream ordering** in a **local state aware** manner.

Software Engineering Intern, Google, Sunnyvale, CA 05/2022 – 08/2022

- Worked on an **open-ended project** for Apigee gateway security.
 - Built a Linux **kernel-based tool** that monitored **layer 2/3 network** headers on incoming packets. The **kernel program** was written in **C** using **XDP (eBPF)** hooks. The **user space** program used **Go**. The kernel and user space communicated using **eBPF maps**.
 - The second level of the tool (written in **Rust**) was built using **Envoy's** (Apigee gateway) **WASM** extension. This tool filtered incoming connections based on HTTP(S) metadata. At the tool's lowest layer, I **built a bloom filter** to store IP addresses. Another option was a **custom trie**, which I built specifically to support IPv4 and IPv6 data, **improving memory utilization by 10x**.
 - This tool was tested on the internal version of GCP.

Distributed System Architecture Intern, Bosch LLC, Pittsburgh, PA 06/2021 – 08/2021

- Worked on **securing an ML pipeline** adding protection for personally identifiable data.
 - This project was working on autonomous driving solutions and needed to prevent exposing privacy related data. My work was to figure out how to run **Kubeflow (Kubernetes based ML pipeline)** components inside **Intel SGX** sandboxes using Intel Graphene library (since renamed) and the **Marblerun service mesh**. This work mostly involved figuring out Intel SGX and Marblerun internals to build correct deployment configurations.

Senior Engineer, IMTAC LLC, Muscat, Oman 06/2012 – 08/2018

- **Led project teams** designing and implementing infrastructure and related tooling for various clients.
- Designed and deployed **VMware** based virtual solution to run Citrix virtual apps for Bank Muscat. **Built an ML project**, in Python, **predicting SLA violations**.
- Migrated core banking infrastructure for Bank Sohar to Oracle's Sun Solaris systems.
 - Solution included dev, prod and DR sites.
 - Deployed **Solaris clusters** – both **OS and file system** and designed network access, LDOMs and zones.
 - Wrote **C**, **Python** and **bash** tools to:
 - Automate LDOM and zone deployment.
 - Automate log parsing and triggering notification on certain keywords.
 - Automatic network scanning.
- Designed and deployed several other infrastructure solutions ranging from data centers to **disaster recovery** and **backup**.
- Also experienced in **socket programming** (**Python** and **C**) and **Linux kernel netlink** communication (**C**).

Technical Services Specialist, IBM, Bengaluru, India

02/2011 – 06/2012

- **Led the VMware team** as part of a project supporting **Capital One's infrastructure**.
 - **Started mini training sessions** regarding VMware specific and sometimes generic virtualization concepts. These trainings were beneficial enough for the team to start trainings across specializations.
 - Handled **day-to-day running** of Capital One's virtual infrastructure and assisting fellow engineers.
 - Participated in **root-cause-analysis** of issues and **capacity planning** activities.

Senior Engineer, KPIT Cummins, Bengaluru, India

05/2009 – 02/2011

- Worked as a support engineer for troubleshooting customer issues VMware server products (KPIT was a VMware partner) – ESXi, Veeam, HA/DRS, SRM.
- Promoted to a **Trainer** and **Subject Matter Expert** within a year.
- Promoted to **Team Lead** shortly afterwards leading a team of 6 engineers.
- Was **part of a tiger team** handling escalated issues beyond regular workload.
- Part of my responsibilities was to dig into the system when encountered by difficult issues and **generate knowledge** from the results.

Linux Engineer/Technical Support Specialist, HP Globalsoft, Mumbai and Bengaluru, India

09/2008 – 05/2009

- Supported HP Sales customers by providing installation services to typically with HP-UX and Linux based solutions.
- Later supported HP Proliant servers for HP Globalsoft.

Infrastructure Engineer, Caritor (later Keane and then NTT Data), Bengaluru, India

06/2006 – 07/2008

- Started my career as an infrastructure support engineer.
- Within 6 months, I was supporting internal customer working on Unisys and IBM mainframes on-site.
- Within the year, I was part of a 4-member team that traveled to the UK for knowledge transfer on a project that Unisys UK was handing over to Keane. This involved support British Telecom infrastructure running on Unisys mainframes.