Prateek Jain

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Research Interests

Transport-layer protocols, network reliability, QUIC, recursive communication architectures, challenged networks, large-scale file transfer, and systems evaluation on realistic testbeds.

Education

Boston University Jan 2024 – Present
PhD in Computer Science *Boston, MA*
GPA: 4.0/4.0 Advisor: Dr. Abraham Matta
Focus: transport-layer protocols, QUIC, and recursive architectures for challenged networks.

Boston University Sep 2022 – Dec 2023
MS in Computer Science with Specialization in Cybersecurity *Boston, MA*
GPA: 3.96/4.0
Relevant coursework: Distributed Systems, Computer Networks, Network Security, Advanced Algorithms, Cybersecurity, Streaming and Event-Driven Systems.

Delhi College of Engineering (now DTU) Aug 2006 – Jul 2010
Bachelor of Engineering in Information Technology *Delhi, India*
Percentage: 73.45%

Publications

1. Prateek Jain, Arash Sarabi, Abraham Matta, and Violet R. Syrotiuk. 2025. *Design and Modeling of a New File Transfer Architecture to Reduce Undetected Errors Evaluated in the FABRIC Testbed.* **Proceedings of the ACM on Measurement and Analysis of Computing Systems (POMACS)**, 9(2), Article 19. doi:10.1145/3727111
2. Prateek Jain, Arash Sarabi, Abraham Matta, and Violet R. Syrotiuk. 2025. *Design and Modeling of a New File Transfer Architecture to Reduce Undetected Errors Evaluated in the FABRIC Testbed.* In **Abstracts of the 2025 ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS Abstracts '25)**. doi:10.1145/3726854.3727281

Research Experience

Boston University Dec 2024 – Present
Doctoral Researcher *Boston, MA*

- Conducting research on **recursive communication architectures**, **space networking**, and **transport-layer reliability** for challenged environments.
- Studying advanced **QUIC** features including connection migration, port migration, and 0-RTT for robust communication under dynamic network conditions.
- Developing **ReSpaN**, a recursive space-networking architecture using scoped **Distributed IPC Facilities**, **service intent**, and structured **control/service/data-plane** separation.
- Extending reliability-oriented transport and architecture ideas through implementation, modeling, and testbed-driven evaluation.
- Studying **heterogeneity-aware adaptive routing** in hybrid edge–cloud stream-processing systems, using **Apache Flink** to support dynamic operator placement and low-disruption adaptation under changing bandwidth, workload, and compute conditions.

Google May 2025 – Oct 2025
Research Intern *Boston, MA*

- Performed an **end-to-end WAN study** of **QUIC** over the Internet, analyzing how **path degradation**, **PTO changes**, **4-tuple variation**, and **IPv6 flow-label-based ECMP route manipulation** affect connection behavior.
- Evaluated the impact of **multi-port migration** and route variation on **latency**, **recovery**, and **connection stability**, highlighting behaviors that are visible only through **endpoint observations across WAN paths**.
- Contributed to **QUICHE** by implementing a safeguard preventing acceptance of packets with invalid acknowledgment frames. **(commit)**

Boston University Jul 2023 – Dec 2023
Research Assistant *Boston, MA*

- Worked on the NSF-funded **MLED** project addressing undetected errors in large-scale file transfer.
- Developed a high-performance **C++** application to run MLED experiments on the **FABRIC** testbed and validate reliability improvements in large-scale network settings.

Selected Research Projects

Multi-Layered Error Detection (MLED) Architecture Jul 2023 – Apr 2025

- Built a configurable **recursive error-detection architecture** for large-scale file transfer that uses **in-network computation** to reduce undetected error probability and avoid end-to-end retransmission.
- Implemented and evaluated a high-performance **C++** prototype on the **FABRIC** testbed, showing **100% goodput gain** under adversarial-error conditions and **over 800 Mbps** goodput with minimal delay overhead.

Heterogeneity-Aware Adaptive Event Routing in Hybrid Environments 2025 – Present

- Built an **Apache Flink**-based hybrid edge–cloud stream-processing framework that automatically rewrites applications into independent query segments, enabling transparent execution across edge and cloud resources.
- Developed an **adaptive routing policy** that dynamically shifts stateless operators between **Raspberry Pi edge devices** and the cloud with **near-zero downtime**, and evaluated it under variable bandwidth, workload, and compute conditions on physical and large-scale testbeds.

ReSpaN: Recursive Space Networking Architecture 2025 – Present

- Designing support for **durable object delivery**, **contact-aware scheduling**, and **ephemeral label-based fast forwarding** across challenged interplanetary communication environments.
- Investigating how recursive scope isolation can contain churn locally while preserving end-to-end communication semantics under long delay, intermittent connectivity, and heterogeneous trust conditions.

Patents

- **Systems and Methods for a New Recursive File Transfer Architecture to Reduce Undetected Errors**, U.S. Provisional Patent Application Serial No. 63/864,142, filed Aug. 14, 2025 (*Patent Pending*).

Awards and Recognition

- **Golden Stitch Award – Best Paper**, KNIT 12 Workshop, 2026, for *Design and Modeling of a New File Transfer Architecture to Reduce Undetected Errors Evaluated in the FABRIC Testbed*.
- **Best Presentation/Demonstration Award**, KNIT 7 Workshop, National Science Foundation (NSF), 2023, for the implementation of the **MLED** project on FABRIC.
- **Best Trainee Officer** during CRPF basic training; awarded the **Sword of Honour** and the **Home Minister's Cup** for all-round excellence.

Leadership and Mentoring

- Mentored a senior undergraduate student at Boston University on the design and development of a React-based GUI for MLED configuration generation. **(link)**
- Prior technical leadership experience as **Assistant Commandant (Technical)** in the Central Reserve Police Force (CRPF), including oversight of software development, cybersecurity analysis, and operational technology usage.

Prior Professional Experience

Central Reserve Police Force (CRPF) Feb 2014 – Mar 2022
Assistant Commandant (Technical) *India*

- Led development of Android and web applications for operational data collection, management, and analysis.
- Performed malware analysis, security auditing, and network/system forensics using tools such as Wireshark, Nessus, and OS Forensics.
- Prepared security guidelines for responsible use of electronic devices and social media across the organization.

Technical Skills

Programming Languages: C/C++, Python, Go, Java, JavaScript, SQL
Systems / Networking: QUIC, QUICHE, RINA, Apache Flink, ns-3, Docker, iperf3
Platforms / Testbeds: FABRIC, Chameleon, Linux, Git, Wireshark
Security / Tools: OS Forensics, Nessus, Burp Suite, Acunetix