NSF · CYBERSECURITY INNOVATION FOR CYBERINFRASTRUCTURE (CICI) · TCR · AWARD # 2319959

STARNOVA - Scalable Technology to Accelerate Research Network Operations Vulnerability Alerts

Extending the UCSD Network Telescope with greynet coverage and ML-based anomaly detection to protect NSF scientific cyberinfrastructure at SDSC

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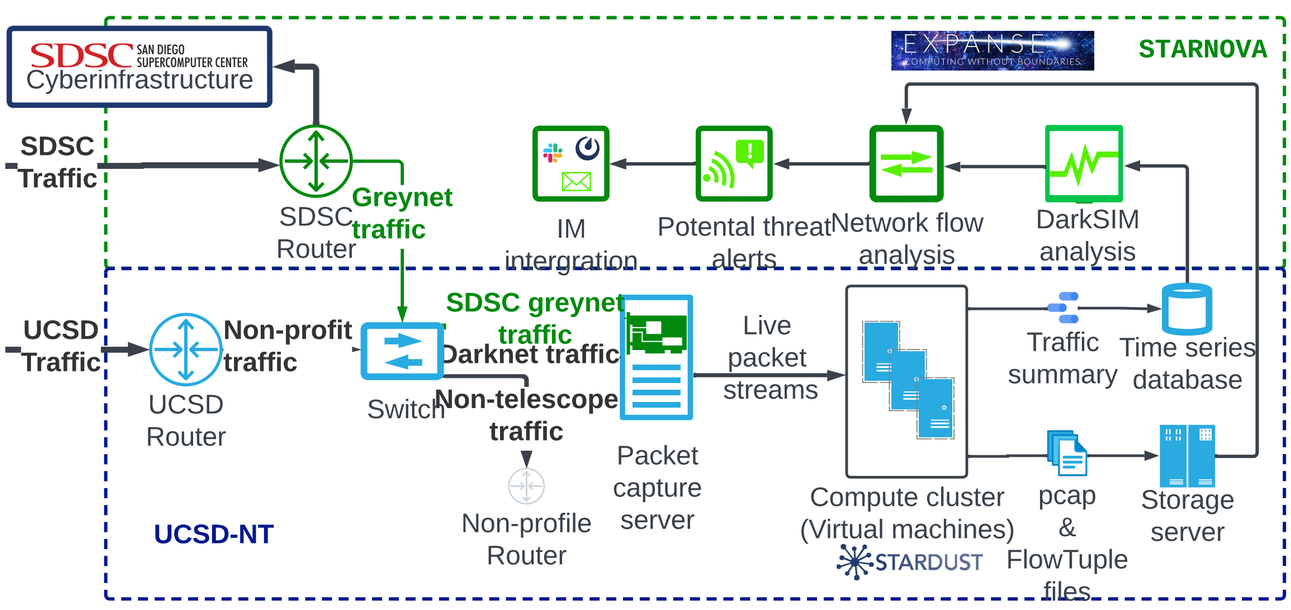
Motivation

- Derive threat intelligence from Internet Background Radiation (IBR) sent toward UCSD network telescope (UCSD-NT) and San Diego Supercomputer Center (SDSC)'s production network to improve the robustness, integrity, and resilience of SDSC's cyberinfastructure
- Expand the capability of UCSD-NT infrastructure to
  1) cope with new traffic source and growing IBR traffic volume
  2) facilitate the sharing of data with researchers and industry partners

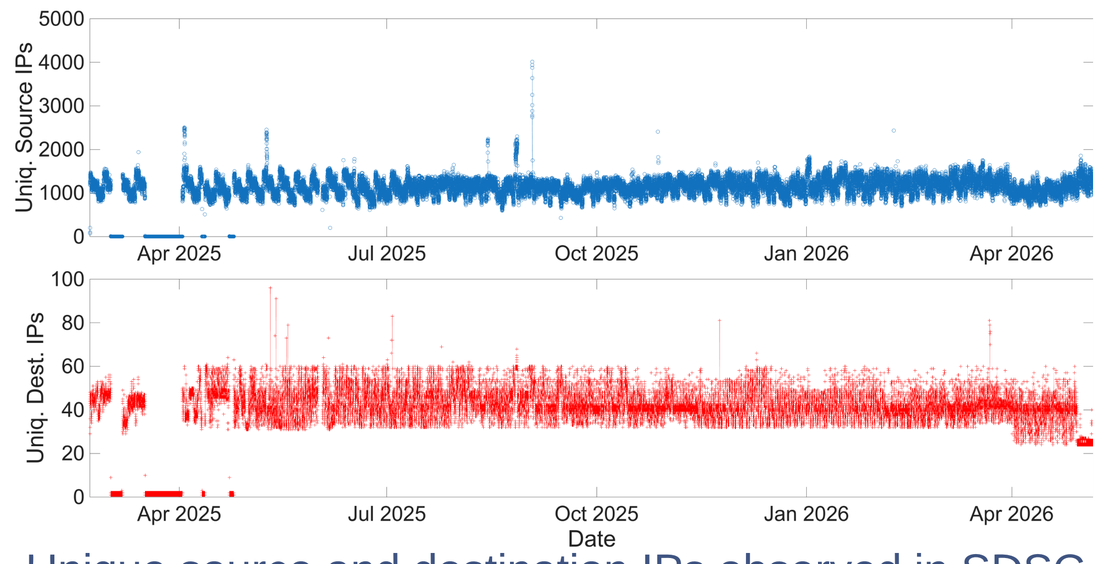
Progress

- Deployed 400Gbps traffic aggregators to SDSC production networks
- Developed software tools to automatically identify usable addresses for monitoring wi th iBGP tables
- Migrated traffic processing to new infrastructure supported by this award
- Developed DarkSIM, a timeseries-based ML method to detect anomalies in IBR

STARNOVA Infrastructure

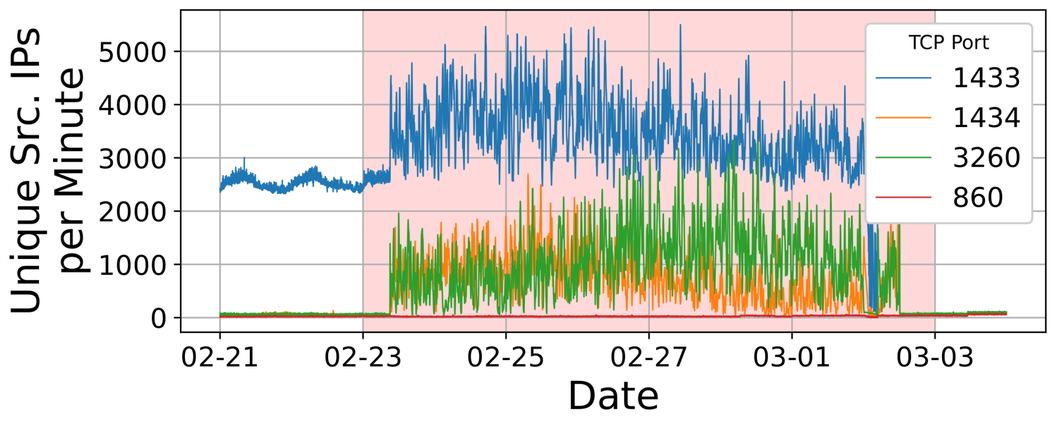


SDSC Greynet



Unique source and destination IPs observed in SDSC greynet

DarkSIM in action



DarkSIM detected concurrent anomalies in all ports but TCP/860 (for the subset pictured) roughly 9 days after high-severity RCE vulnerabilities were released on Feb. 14, 2023.

Publications

Gao et al., "DarkSim: A Similarity-Based Time Series Analytic Framework for Darknet Traffic", Proc. ACM IMC 2024.

Sultana et al., "Survey on Packet Filtering", ACM CCR Vol. 54 (3) p. 2-9, 2024.

Chan et al., "Analyzing Internet Background Radiation with Reflective Network Telescopes", Proc. ACM/IRTF ANRW 2025.

Männel et al., "Lessons Learned from Operating a Large Network Telescope", Proc. ACM SIGCOMM 2025.

Männel et al., "Hilby: Hilbert Interactive Prefix Plots", Proc. ACM SIGCOMM Demo 2025.

Degen et al., "Through a Smaller Lens: Revisiting Opportunistic Analysis using Network Telescopes", Proc. Passive and Active Meaasurement Conference, 2026.

Learn more about the project: https://www.caida.org/funding/cici-starnova/
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