Tolga O. Atalay

Graduate Research Assistant
Virginia Tech
Department of Electrical and Computer Engineering

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Skills

Programming Languages: C++, C, Go, Python, Matlab
Platforms and Tools: AWS, OpenStack, Kubernetes, Docker, Linux, shell scripting, OpenTelemetry, TTCN-3
Areas of Expertise: 5G/OpenRAN architecture, 3GPP/ETSI/O-RAN standardization, microservices, side car proxies, system design/architecture, networking, cybersecurity, eBPF, software-defined radios, conformance testing

Research Summary

I am the architect of a full-stack 5G testbed comprised of different open-source Radio Access Network and Core network solutions. Primarily, I specialize in experimenting with, analyzing, and enhancing 5G core deployments to create more secure and scalable 5G deployments.

- System design, implementation and evaluation of a novel discovery framework for the authentication and authorization of xApps in the O-RAN architecture. (**https://github.com/tolgaoa/xrfoauth**)
- Analysis of 5G core computational resource consumption patterns under different user and control plane traffic loads. Experimenting with modern-day use cases such as Virtual Reality, Streaming, Internet of Things, Voice over IP, to observe the impact of different use cases on the 5G core computational resource utilization across different 5G core VNFs.
- Isolation of critical microservices (ARPF, SIDF, SEAF) for the 5G core control plane using different isolation strategies including Intel SGX. (**private repo - please contact me for details**)
- Creating a distributed tracing framework for end-to-end 5G core deployments (OAI) by augmenting VNFs with Side Car Proxies that enable indirect communication. Collecting context spans using OpenTelemetry to forward to a Jaeger collector. (**https://github.com/tolgaoa/monitor5G**)
- 5G core deployments with different network slice topologies. User traffic recreation over AWS edge zones in 7 different countries and 18 different edge zones. Assessing the 5G control plane latency and user plane throughput for large scale network slice deployments.(**https://github.com/tolgaoa/devdep5g**)
- Design of a Service mesh Tailored for Rapid, Efficient and Authorized Microservices (STREAM) in a decentralized 5G core deployment to reduce control plane processing latency. Refactoring the monolithic 5G core VNFs to be deployed as finer-grained microservices. (**private repo - please contact me for details**)

Experience

2021–May-Dec **5G R&D Intern** at *Kryptowire Labs*
2022–May-Aug **Project:** *DARPA Open, Programmable, Secure 5G (OPS-5G) - Technical Area 4 - Principled programmable defences*

- Construction of a state-of-the-art open source 5G testbed for integration and testing of cybersecurity primitives.
- Design and evaluation of large-scale 5G deployments for DDoS mitigation and malware detection.
- Implementation and evaluation of OpenRAN security frameworks for 5G integration.
- Large scale 5G core deployments in the AWS public cloud to assess real-life performance of next generation infrastructure deployments.
- Prepared/presented presentations and demos at DARPA PI meetings and site-visits.

Education

2018 – 2024 (May) **Doctor of Philosophy** in Computer Engineering, *Virginia Tech*
2016 – 2018 **Master of Science** in Telecommunications, *Danmarks Tekniske Universitet (DTU)*
2012 – 2016 **Bachelor of Science** in Electrical and Electronics Engineering, *Bilkent University*

Publications (* denotes co-primary authorship)

17. [**MOBICOM '24**] Tolga O. Atalay, Alireza Famili, Sudip Maitra, Dragoslav Stojadinovic, Angelos Stavrou, Haining Wang. "**5G-STREAM: 5G Service Mesh Tailored for Reliable, Efficient and Authorized Microservices in the Cloud**." *Annual International Conference On Mobile Computing And Networking* ***(In Submission)***

16. [**USENIX ATC '24**] Tolga O. Atalay, Dragoslav Stojadinovic, Alireza Famili, Angelos Stavrou, Haining Wang. "**A First Look At 5G Core Deployments on Public Cloud: Evaluating the Control and User Plane**." *USENIX Annual Technical Conference.* ***(In Submission)***

15. [**ICCCN '24**] Alireza Famili, Amin Tabrizian, Tolga O. Atalay, Angelos Stavrou, Peng Wei. "**RAPID: Reinforcement Learning-Aided Femtocell Placement for Indoor Drone Localization** ." *IEEE International Conference on Computer Communications and Networks* ***(In Submission)***

14. [**VNC '24**] Alireza Famili, Amin Tabrizian, Tolga O. Atalay, Angelos Stavrou, Peng Wei. "**RADIO: Reinforcement Learning-Aided Deployment of Wi-Fi Routers in 5G Networks for Indoor Drone Orchestrating**." *IEEE Vehicular Networking Conference* ***(In Submission)***

13. [**METACOM '24**] Alireza Famili, Tolga O. Atalay, Angelos Stavrou, Haining Wang. "**GREEN: Precise Geolocation in Metaverse using Reinforcement Learning-Enabled Sensor Placement**." *IEEE International Conference on Metaverse Computing, Networking, and Applications* ***(In Submission)***

12. [**TDSC '24**] *Tolga O. Atalay, *Sudip Maitra, Dragoslav Stojadinovic, Angelos Stavrou, Haining Wang. "**An OpenRAN Security Framework for Scalable Authentication, Authorization and, Discovery of xApps with Isolated Critical Services**." *IEEE Transactions on Dependable and Secure Computing.* ***(In Submission)***

11. [**DSN '24**] *Sudip Maitra, *Tolga O. Atalay, Angelos Stavrou, Haining Wang. "**Shielding Critical 5G Control Plane Functions in Public Cloud with TEEs**." *IEEE/IFIP International Conference on Dependable Systems and Networks.*

10. [**INFOCOM '24**] Pragya Sharma, Tolga O. Atalay, Dragoslav Stojadinovic, Hans Andrew Gibbs, Angelos Stavrou, Haining Wang. "**5G WAVE: A Core Network Framework with Decentralized Authorization for Network Slices**." *IEEE Conference on Computer Communications.*

9. [**ICNC '24**] Alireza Famili, Tolga O. Atalay, Angelos Stavrou. "**5GPS: 5G Femtocell Placement Strategies for Ultra-Precise Indoor Localization in the Metaverse**." *IEEE International Conference on Computing, Networking and Communications.*

8. [**JSAC '23**] Alireza Famili, Tolga O. Atalay, Angelos Stavrou, Haining Wang, Jung-min (Jerry) Park "**OFDRA: Optimal Femtocell Deployment for Accurate Indoor Positioning of RIS-Mounted AVs**." *IEEE Journal on Selected Areas in Communication Special Issue on 5G/6G Precise Positioning on Cooperative Intelligent Transportation Systems (C-ITS) and Connected Automated Vehicles (CAV).*

7. [**GLOBECOM '23**] Tolga O. Atalay, Alireza Famili, Dragoslav Stojadinovic, Angelos Stavrou, Haining Wang. "**Demystifying 5G Traffic Patterns with an Indoor RAN Measurement Campaign**." *IEEE Global Communications Conference.*

6. [**METACOM '23**] Alireza Famili, Tolga O. Atalay, Angelos Stavrou, Haining Wang. "**Wi-Six: Precise Positioning via Optimal Wi-Fi Router Deployment in 6G Networks**." *IEEE International Conference on Metaverse Computing, Networking, and Applications* (**BEST PAPER AWARD**)

5. [**VTC '23**] Alireza Famili, Tolga O. Atalay, Angelos Stavrou, Haining Wang. "**Wi-Five: Optimal Placement of Wi-Fi Routers in 5G Networks for Indoor Drone Navigation**." *IEEE Vehicular Technology Conference.*

4. [**INFOCOM '23**] Tolga O. Atalay, Sudip Maitra, Dragoslav Stojadinovic, Angelos Stavrou, Haining Wang. "**Securing 5G OpenRAN with a Scalable Authorization Framework for xApps**." *IEEE Conference on Computer Communications.*

3. [**GLOBECOM '22**] Tolga O. Atalay, Dragoslav Stojadinovic, Alireza Famili, Angelos Stavrou, Haining Wang. "**Network-Slice-as-a-Service Deployment Cost Assessment in an End-to-End 5G Testbed**." *IEEE Global Communications Conference.*

2. [**LATINCOM '22**] Alireza Famili, Mahsa Foruhandeh, Tolga O. Atalay, Angelos Stavrou, Haining Wang. "**GPS Spoofing Detection by Leveraging 5G Positioning Capabilities**." *IEEE Latin-American Conference on Communications.*

1. [**WCNC '22**] Tolga O. Atalay, Dragoslav Stojadinovic, Angelos Stavrou, Haining Wang. "**Scaling Network Slices with a 5G Testbed: A Resurce Consumption Study**." *IEEE Wireless Communications and Networking Conference.*

Service

2024	**USENIX WOOT Conference on Offensive Technologies**	*Artifact Eval. Committee*
2024	**IEEE Journal on Selected Areas in Communications**	*Reviewer*
2024	**IEEE Conference on Dependable Systems and Networks (DSN)**	*Artifact Eval. Committee*
2023	**ACM ASIA CCS**	*External Reviewer*
2023	**IEEE Open Journal of the Communications Society**	*Reviewer*
2023	**Journal of Computer Security**	*Reviewer*
2023	**Computer Networks Journal**	*Reviewer*
2023	**iMETA Conference**	*Program Committee*
2021	**IEEE Transactions on Cloud Computing**	*Reviewer*
2021	**USENIX Security Symposium**	*External Reviewer*
2020	**IEEE Transactions on Information Forensics and Security**	*Reviewer*

Talks

1. [**August 2023**], IEEE Standards Association OpenRAN Rapid Reaction Standardization Activities, **OpenRAN Security Standardization Efforts for xApp Security** (**session**)