

Army Cyber Institute (ACI)  
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## Education

COLUMBIA UNIVERSITY, ELECTRICAL ENGINEERING 2017 – 2020 Ph.D., October 2020 M.Phil., February 2020 Thesis: <i>"Understanding Cloud Network Performance"</i> Advisor: Ethan Katz-Bassett	New York, NY
PENNSYLVANIA STATE UNIVERSITY, COMPUTER SCIENCE & ENGINEERING, 2006 – 2008 M.S., May 2008 Thesis: <i>"A Traffic Engineering Attribute for BGP"</i> Advisor: George Kesidis	State College, PA
UNITED STATES MILITARY ACADEMY, COMPUTER SCIENCE, 1997–2001 B.S., June 2001	West Point, NY

## Work Experience

2025 – Present West Point, NY	<i>Technical Director, ACI</i> <i>Associate Professor, EECS, USMA</i> Supervise and direct the ACI's research team of over 30 military and civilian personnel.
2020 – 2025 West Point, NY	<i>Cyber Operations – Research &amp; Engineering (CORE) Research Team Lead, ACI</i> <i>Assistant / Associate Professor, EECS, USMA</i> Lead research scientist for the ACI's CORE Team, focused on improving the Army's Electronic Warfare (EW) and cyber (offensive and defensive) capabilities for both the Army's operational and cyber forces. Supervise, direct, and assign all team research projects, including EW and Cyber professional development and tradecraft, updating Army doctrine (e.g., FM 3-12), and research projects. Serve as a subject matter expert (SME) for the DoD's and Army's cyber force structure, career progression, policy, and doctrine in various working groups. Conduct research in Internet networking, routing, performance, and measurements (see Publications).
2016 – 2017 Ft. Meade, MD	<i>Lead Developer, Cyber Solutions Development Detachment, 781st MI Battalion</i> First lead developer for the Army's cyber capability development organization. Recruited, supervised, directed, and assigned all team projects and personnel. Led the Army's efforts to identify, assess, and mentor developers and created the developer specialty framework which is now codified as the 17D and 170D MOS's.
2014 – 2016 Ft. Meade, MD	<i>Director, Capability Development Branch, Army Cyber Command</i> Served as a SME on the Army's planning team for designing and creating the Army Cyber branch, and as the network design and security SME on multiple joint crisis action/incident response teams. Worked to expand opportunities for Army capability developers. Served as the lead for the Army's initial major weapon systems cyber vulnerabilities evaluation which resulted in a DoD-wide initiative (FY 16 NDAA §1647) and was recognized by the Secretary of Defense.

2011 – 2014 West Point, NY	<i>Instructor / Assistant Professor, EECS, USMA</i> <i>Research Scientist, Cyber Research Center, USMA</i> Conducted research in network systems design and security, cyberspace operations, and capabilities. Was recruited by the NSA and OSD to conduct classified research on intelligence collection, communications, and cyberspace capabilities. Created the model for the Cyber branch officer career path and the Army's Cyber Leader Development Program. Taught and designed courses on computer and network security, computer exploitation, and digital forensics.
2008 – 2011 Ft. Belvoir, VA	<i>Chief of Network Services, Army Cyber Command/Network Enterprise Technology Command</i> Served as the technical expert at the Army's Global NOSC and Army Cyber Command for engineering and troubleshooting of routing and switched networks, VoIP, ACL configuration, and firewall settings across the Army's 200+ network enclaves. Designed and implemented multiple tools to simplify configuration and resource tracking, which are still in use by the command.
2002 – 2006 Darmstadt, DEU Baghdad, Iraq	<i>Network Engineer, 22d Signal Brigade</i> Designed and implemented all tactical data and VoIP networks for V Corps training exercises, Operation Iraqi Freedom (OIF) I, and OIF 05-07 with a customer base of over 130,000 service members. Planned and executed the initial OIF network installation and a subsequent network redesign to improve network performance throughout the entire theater.
2002 – 2002 Darmstadt, DEU	<i>Platoon Leader, 32d Signal Battalion</i>

## Publications

### Refereed Conference Publications

#### **Tiered Cloud Routing: Methodology, Latency, and Improvement**

S Lin, Y Zhou, X Zhang, **T Arnold**, R Govindan, X Yang

in *Proceedings of the Association for Computing Machinery (ACM) SIGMETRICS (SIGMETRICS '25)*, July 2025 (17.5% acceptance rate)

#### **ABSTRACT: Tiered Cloud Routing: Methodology, Latency, and Improvement**

S Lin, Y Zhou, X Zhang, **T Arnold**, R Govindan, X Yang

in *Abstracts of the ACM SIGMETRICS (SIGMETRICS Abstracts '25)*, July 2025

#### **What's in the Dataset? Unboxing the APNIC per AS User Population Dataset**

L Salmatian, C Ardi, V Giotsas, M Calder, E Katz-Bassett, **T Arnold**

*Proceedings of the ACM Internet Measurement Conference (IMC) (IMC '24)*, November 2024 (22% acceptance rate)

#### **Cloud Provider Connectivity in the Flat Internet**

**T Arnold**, J He, W Jiang, M Calder, I Cunha, V Giotsas, E Katz-Bassett

*Proceedings of the ACM IMC*, October 2020 (25% acceptance rate)

#### **(How Much) Does a Private WAN Improve Cloud Performance?**

**T Arnold**, E Gürmeriçliler, G Essig, A Gupta, M Calder, V Giotsas, E Katz-Bassett

*Proceedings of the Institute of Electrical and Electronics Engineers (IEEE) Conference on Computer Communications (INFOCOM '20)*, July 2020 (20% acceptance rate)

#### **PEERING: Virtualizing BGP at the Edge for Research**

B Schlinker, **T Arnold**, I Cunha, E Katz-Bassett

*Proceedings of the 15th International Conference on emerging Networking EXperiments and Technologies (CoNEXT '19)*, December 2019. (17% acceptance rate)

Supported over 60 publications to date at top networking and security conferences, including SIGCOMM, IMC, CCS, NSDI, NDSS, and Usenix Security.

### **Beating BGP is Harder Than We Thought**

**T Arnold**, M Calder, I Cunha, A Gupta, HV Madhyastha, and M Schapira, and E Katz-Bassett  
*Proceedings of the 18th ACM Workshop on Hot Topics in Networks (HotNets '19)*, November 2019 (20% acceptance rate)

### **Using Virtual Machines to Improve Learning and Save Resources in an Introductory IT Course,**

G Stoker, **T Arnold**, P Maxwell  
*Proceedings of the 14th Annual Conference on Information Technology Education (SIGITE '13)*, October 2013. (40% acceptance rate)

### **Extending Drive-Thru Data Access by Vehicle-to-Vehicle Relay**

J Zhao, **T Arnold**, Y Zhang, G Cao  
*Proceedings of the Fifth ACM International Workshop on VehiculAr Inter-NETworking (VANET '08)*, in conjunction with MOBICOM, September 2008. (26% acceptance rate)

### **IP Address Passing for VANETs**

**T Arnold**, W Lloyd, J Zhao, G Cao  
*Proceedings of the Sixth Annual IEEE International Conference on Pervasive Computing and Communications (PerCom '08)*, March 2008 (12% acceptance rate)

## **Refereed Journal Publications**

### **Who Squats IPv4 Addresses?**

L Salamatian, **T Arnold**, I Cunha, J Zhu, Y Zhang, E Katz-Bassett, M Calder  
*SIGCOMM Computer Communications Review (CCR)*, April 2023.  
Awarded Best of CCR at [SIGCOMM 2023](#)

### **Assessing the Army's Cyber Force Structure**

JC Fernandes, N Starck, R Shmel, C Suslowicz, J Kallberg, **T Arnold**  
*US Army War College (USAWC) Quarterly: Parameters*, August 2022.

### **The Tactical Considerations of Augmented and Mixed Reality Implementation**

J Kallberg, V Beitelman, V Mitsuoka, J Pittman, M Boyce, **T Arnold**  
*Military Review: the Professional Journal of the U.S. Army*, April 2022

### **POWs in the Age of the Internet**

J Kallberg, **T Arnold**, S Hamilton, M Visger  
*Air and Space Operations Review*, March 2022

## **Magazine & Others Publications**

### **Beyond Binaries: Cyber Force Generation and the SOCOM-like Model**

S Onken, N Starck, E Lonergan, JC Fernandes, **T Arnold**, M Smith  
*Irregular Warfare Initiative, Modern Warfare Institute*, November 2024

### **The Case for a Prospective U.S. Cyber Force**

E Lonergan, **T Arnold**, N Starck  
*War on the Rocks*, May 2024

### **Sharing Cyber Capabilities within the Alliance: Interoperability through Structured Pre-Authorization Cyber**

J Kallberg, **T Arnold**, S Hamilton  
*Joint Air Power Competence Centre (JAPCC), Joint Air & Space Power Conference 2022*, June 2022.

### **Prisoners of War: A Returned Reality**

J Kallberg and **T Arnold**  
*Military Times*, Commentary, June 2021.

### **In Great Power Wars, Americans Could Again Become POWs**

J Kallberg and **T Arnold**  
*Defense One*, Opinion, March 2021

### Eroding America from within: Marketing Data Threatens Military Cohesion

J Dawson and **T Arnold**

*C4ISRNET*, Opinion, February 2021

### Government Cyber Breach Shows Need for Convergence

C Suslowicz, J Kallberg, and **T Arnold**

*C4ISRNET*, Opinion, December 2020.

### Unpacking a Flattened Internet

**T Arnold**

*Asia Pacific Network Information Centre (APNIC) Blog*, guest contributor, December 2020.

### Footprint and Performance of Large Cloud Networks

J He, W Jiang, E Gürmeriçliler, G Essig, A Gupta, M Calder, V Giotsas, I Cunha, E Katz-Bassett, **T Arnold**

10th SIGCOMM Networking Networking Women Professional Development Workshop (N2Women'20), August 2020, **Best Poster Runner-up**.

### Controlling Real Cloud Experiments from BGP to the Server (and Back)

**T Arnold**, B Schlinker, I Cunha, E Katz-Bassett

*Proceedings of the ACM SIGCOMM Conference Posters and Demos*, August 2018 (43% acceptance rate)

### Shaping the Army's Cyber Operations Force: the Human Dimension

**T Arnold**, R Harrison, D Raymond, G Conti

*The Cyber Defense Review*, February 2015

### Towards A Career Path in Cyberspace Operations for Army Officers

**T Arnold**, R Harrison, G Conti

*Small Wars Journal*, August 2014

### Towards a Cyber Leader Course: Not for the Weak or Faint Hearted

G Conti, M Weigand, DR Skoudis, D Raymond, T Cook, **T Arnold**, D Ragsdale

*Report, Army Cyber Center, Vol. 1337 No. III*, May 2014

### Towards a Cyber Leader Course Modeled on Army Ranger School

G Conti, M Weigand, DR Skoudis, T Cook, **T Arnold**

*Small Wars Journal*, April 2014

### Professionalizing the Army's Cyber Officer Force

**T Arnold**, R Harrison, G Conti

*Report, Army Cyber Center, Vol. 1337 No. II*, November 2013

## Teaching

\*Indicates course director, °Indicates deputy course director

Spring 2025 (USMA)	CS388: Computer Science Independent Study, Advisor/Sponsor (x1) CS380: Computer Systems* (1 section) CY387: Cyber Science Independent Study, Advisor/Sponsor (x3)
Fall 2024 (USMA)	CS389: Computer Science Independent Study, Advisor/Sponsor (x1) CS388: Computer Science Independent Study, Advisor/Sponsor (x1) CY388: Cyber Science Independent Study, Advisor/Sponsor (x2) CY387: Cyber Science Independent Study, Advisor/Sponsor (x1)

Spring 2024 (USMA)	CS388: Computer Science Independent Study, Advisor/Sponsor (x1) CS387: Computer Science Independent Study, Advisor/Sponsor (x1) CS380: Computer Systems* (1 section) CY389: Cyber Science Independent Study, Advisor/Sponsor (x1) CY388: Cyber Science Independent Study, Advisor/Sponsor (x1) XE402: Integrative System Design II, Capstone Advisor (x2)
Fall 2023 (USMA)	CS489: Computer Science Honors Research, Advisor/Sponsor (x1) CS389: Computer Science Independent Study, Advisor/Sponsor (x1) CS388: Computer Science Independent Study, Advisor/Sponsor (x3) CS387: Computer Science Independent Study, Advisor/Sponsor (x2) CS380: Computer Systems° (1 section) CY389: Cyber Science Independent Study, Advisor/Sponsor (x1) XE401: Integrative System Design I, Capstone Advisor (x2)
Spring 2023 (USMA)	CS388: Computer Science Independent Study, Advisor/Sponsor (x3) CS387: Computer Science Independent Study, Advisor/Sponsor (x1) CY388: Cyber Science Independent Study, Advisor/Sponsor (x2) XE402: Integrative System Design I, Capstone Advisor (x1)
Fall 2022 (USMA)	CS389: Computer Science Independent Study, Advisor/Sponsor (x1) CS388: Computer Science Independent Study, Advisor/Sponsor (x3) CS380: Computer Systems° (1 section) CY388: Cyber Science Independent Study, Advisor/Sponsor (x1) EE388: Electrical Engineering Independent Study, Advisor/Sponsor (x1) XE401: Integrative System Design I, Capstone Advisor (x1)
Spring 2022 (USMA)	CS489: Computer Science Honors Research, Advisor/Sponsor (x1)
Fall 2021 (USMA)	CS489: Computer Science Honors Research, Advisor/Sponsor (x3) CS380: Computer Systems° (1 section)
Spring 2021 (USMA)	CS489: Computer Science Honors Research, Advisor/Sponsor (x1)
Fall 2020 (USMA)	CS380: Computer Systems° (1 section)
Spring 2014 (USMA)	CS489: Computer Science Honors Research, Advisor/Sponsor (x1) CS483: Digital Forensics* (1 section) CS482: Information Assurance° (1 section) – Cyber Defense eExercise (CDX) winners CS402: Integrative Systems Design II, Capstone Advisor IT402: Integrative Systems Design II, Capstone Advisor
Fall 2013 (USMA)	CS401: Integrative Systems Design I, Capstone Advisor IT401: Integrative Systems Design I, Capstone Advisor IT305: Theory and Practice of Military Information Systems (1 section)
Spring 2013 (USMA)	CS485F: Digital Forensics* (1 section) CS482: Information Assurance° (1 section) CS402: Integrative Systems Design II, Capstone Advisor IT402: Integrative Systems Design II, Capstone Advisor
Fall 2012 (USMA)	CS401: Integrative Systems Design I, Capstone Advisor IT485E: Computer Systems Exploitation* (2 sections) IT401: Integrative Systems Design I, Capstone Advisor

Spring 2012 (USMA)    CS485F: Digital Forensics\* (1 section)  
                                 IT305: Theory and Practice of Military Information Systems (1 section)

Fall 2011 (USMA)    IT305: Theory and Practice of Military Information Systems (3 sections)

## Service

### Professional Service

ACM SIGCOMM Poster and Demo Program Committee Member, 2025  
ACM IMC, Technical Program Committee Member, 2025  
ACM IMC, Technical Program Committee Member, 2024  
ACM SIGCOMM Poster and Demo Program Committee Member, 2024  
Student Research Competition (SRC) Co-Chair, ACM SIGCOMM 2024  
IEEE Access, Reviewer, 2024–Present  
Æther: A Journal of Strategic Airpower & Spacepower; Air & Space Operations Review (Æther-ASOR)  
    Reviewer, 2023 – Present;  
    Perspectives External SME, 2024 – Present  
SRC Co-Chair, ACM SIGCOMM 2023  
Military Cyber Professionals Association (MCPA) HammerCon: State of Military Cyber Career Fields, Panel Member  
ACM IMC 2021, External Reviewer  
ACM SIGCOMM CCR, reviewer, 2021 – Present  
Cyber Defense Review, Area Editor, 2020 – Present  
SRC, Judge, ACM SIGCOMM 2020

### Professional Memberships

ACM, member  
ACM SIGCOMM, member  
ACM Special Interest Group on Security, Audit and Control (SIGSAC), member  
IEEE, member  
IEEE Communications Society (COMSOC), member  
IEEE Computer Society, member  
MCPA, member  
Association of Old Crows (AOC), member  
Upsilon Pi Epsilon–Computer Science Honor Society, member

### Departmental and Academy Service

EECS Core Program Steering Committee Member, 2024 – Present  
Faculty Council, 2021 – Present  
Academic Counselor for Information Technology (EECS USMA), 2011 – 2014

## Awards and Honors

Best of ACM SIGCOMM CCR, 2023: *Who Squats IPv4 Addresses?*

Columbia University Electrical Engineering PhD Collaborative Research Award for 2020.

Armed Forces Communications and Electronics Association (AFCEA) Silver Saint Isidore Cyber Award, 2018

Clark K Ray Award for Excellence in Education, Computer Science for 2014.

Army Chief Information Officer/G-6 Excellence Award for Innovation for 2010.

## Grants

**National Science Foundation (NSF) Resilient & Intelligent NextG Systems (RINGS): Deployable End-to-End Resilience for Critical Internet Applications via Modular Redundancy (CNS-2148275)**

\$70,000 (total budget \$1,000,000). 2022 – 2025. With Dan Rubenstein, Ethan Katz-Bassett, Henning Schulzrinne (Columbia University).

Principal Investigator (PI) on research project to take an overarching multi-layered, systems-level approach to prepare applications for inevitable component failures by providing a shadow network: pre-planned alternatives ready to deliver critical services should the primary services, networks, or paths fail. The shadow network continually seeks out and analyzes applications and services to identify resilience and combine end-to-end services using a mix of primary and specifically designed shadow components, such that should failures occur, the shadow components can take effective action. By increasing reliability of the network-at-large, users of all Internet applications will benefit by reducing the frequency in which the, “network is down.”