CAE Lecture Series

25 October 2024

Prasad Calyam, University of Missouri - Columbia , Zero Trust for Tactical Edge Network Environments

(2pm EST)

Dr. Marcel Fallet, Technical Director, National Security Agency (NSA), The Life Cycle of High Performance Computing

(3pm EST)

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Abstract 2pm EST:

Tactical Warfighting Edge Network (TEN) environments are critical to deploy applications in the Internet of Battlefield Things (IoBT). With TENs involving dynamic interactions of edge devices and users, cyber attacks aim to disrupt computation and communication (C&C) tasks in a critical mission. Therefore, implementing a suitable Zero Trust (ZT) security architecture is necessary to enforce e.g., the law of least privilege, microsegmentation, and continuous authentication/access verification to limit attack impacts. However, there is a need to transform ZT security principles that are typically developed for unconstrained data center environments with reliable networking and abundant computing power and are not suitable in a TEN setting that is characterized as Denied, Disrupted, Intermittent, and Limited (DDIL). In this talk, we present a novel ZT architecture viz., Arculus with a risk-based ZT scale approach that tailors security measures to scenario-associated risk levels, while having low resource overheads. Specifically, we devise a Bayesian Network model to evaluate communication request risk based on metrics indicating possible attacks. In addition, we formulate a ZT metric based on the evaluated risk, environmental constraints, and entity attributes resulting in an assigned grade reflecting these factors. We tie this ZT architecture to Task-Based Access Control (TBAC) that secures C&C tasks in TENs relating to a collaborative drone swarm (CDS) use case by dynamically assigning and revoking privileges in a just-in-time manner. We also detail how the Arculus-TBAC can handle DDIL constraints (e.g., limited battery, physical hijacking and network partition scenarios) via a sliding-scale ZT approach to ensure mission success in a situation-aware manner. Lastly, we describe the implementation of our Arculus-TBAC approach using a realistic CDS testbed featuring a 'stealthy reconnaissance and resupply mission' in a TEN setting, and demonstrate the efficiency (i.e., without excessive privileges) and efficacy (i.e., ability to handle DDIL constraints) of our Arculus approach to secure TEN-based applications.

Speaker Bio:

Prasad Calyam is the Curators' Distinguished Professor in the Department of Electrical Engineering and Computer Science at University of Missouri-Columbia, and Director of the Center for Cyber Education, Research and Infrastructure (Mizzou CERI). His research and development areas of interest include: Cloud Computing, Machine Learning, Artificial Intelligence, Cyber Security, and Advanced Cyberinfrastructure. He has published over 225 peer-reviewed papers in various conference and journal venues. As the Principal Investigator, he has successfully led teams of graduate, undergraduate and postdoctoral fellows in Federal, State, University and Industry sponsored R&D projects totaling over $40 Million. His research sponsors include: National Science Foundation (NSF), Department of Energy (DOE), National Security Agency (NSA), Department of State (DOS), Army Research Lab (ARL), VMware, Cisco, Raytheon-BBN, Dell, Verizon, IBM and others. His basic research and software on multi-domain network measurement and monitoring has been commercialized as 'Narada Metrics'. He is a Senior Member of IEEE. He currently serves as an Associate Editor for IEEE Transactions on Network and Service Management.

Abstract 3pm EST:

High performance computing (HPC) is a popular buzzword commonly found in the computing industry today. It seems that every organization, vendor, or laboratory has a different approach and definition to HPC. In this talk, Dr. Marcel Fallet will introduce HPC from the standpoints of hardware, software, and architecture, and how all three topics intimately interact to form a definition of HPC consistent with NSA values. He will discuss how our hardest mission problems inform how we design, build, test, and interact with at-scale systems, and present an argument that HPC is a constant flow of planning for, and enabling, new technologies.

Speaker Bio:

Dr. Marcel Fallet is a STEM Technical Leader at the National Security Agency (NSA), specializing in high performance computing (HPC). A chemist by training, Dr. Fallet's career has granted him varied experience as a computational simulation researcher, as well as a technical leader for large scale system design, production, delivery, and support. Dr. Fallet received his Master's Degree in chemistry from Northwestern University in 2007, and his Ph. D in computational chemistry from Clemson University in 2013. Prior to joining the NSA, Dr. Fallet was a Research Assistant Professor at the United States Naval Academy, working to advance the state of the art in tribological simulations using molecular dynamics.

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