

RPPR Final Report
as of 13-Jan-2023

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Proposal Number: 58369NCCF
INVESTIGATOR(S):

Agreement Number: W911NF-10-1-0470

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Report Date: 09-Dec-2012

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Final Report for Period Beginning 10-Sep-2010 and Ending 09-Sep-2012

Title: Moving Target Defense: Issues and Research Directions

Begin Performance Period: 10-Sep-2010

End Performance Period: 09-Sep-2012

Report Term: 0-Other

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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: 0

STEM Participants:

Major Goals: A multidisciplinary group of leading researchers from cyber security and cognitive system met to elaborate on the fundamental challenges facing the research community and identify promising solutions paths. The goals of the workshops were to establish the state of the art in the moving target defense area and to set the course for future research. A multidisciplinary group of leading researchers from cyber security and cognitive system met to elaborate on the fundamental challenges facing the research community and identify promising solutions paths.

Accomplishments: The results of the workshop were captured in the following edited books:

1. Sushil Jajodia, Anup K. Ghosh, V. S. Subrahmanian, Vipin Swarup, Cliff Wang, X. Sean Wang, eds., Moving Target Defense II: Application of Game Theory and Adversarial Modeling, ISBN 978-1-4614-5415-1, Springer Advances in Information Security, Vol. 100, Berlin, 2013, 203 pages.
2. Sushil Jajodia, Anup K. Ghosh, Vipin Swarup, Cliff Wang, X. Sean Wang, eds., Moving Target Defense: Creating Asymmetric Uncertainty for Cyber Threats, ISBN 978-1-4614-0976-2, Springer Advances in Information Security, Vol. 54, Berlin, 2011, 183 pages.

In the first volume of MTD, we presented papers on MTD foundations, MTD approaches based on software transformations and network and software stack configurations. In the follow-on second volume of MTD, a group of leading researchers described game-theoretic, cyber maneuver, and software transformation approaches for constructing and analyzing MTD systems.

Training Opportunities: Nothing to Report

Results Dissemination: Please see the attached report.

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Please see the attached report.

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PARTICIPANTS:

Participant Type: PD/PI

Participant: Sushil Jajodia

Person Months Worked: 1.00

Project Contribution:

National Academy Member: N

Funding Support:

Partners

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I certify that the information in the report is complete and accurate:

Signature: Sushil Jajodia

Signature Date: 1/10/23 12:44PM

Final Report
Moving Target Defense: Issues and Research Directions
Research Agreement No. W911NF-10-1-0470

Submitted by

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We organized two invitational workshops at George Mason University on Moving Target Defense. The goals of the workshops were to establish the state of the art in the moving target defense area and to set the course for future research. A multidisciplinary group of leading researchers from cyber security and cognitive system met to elaborate on the fundamental challenges facing the research community and identify promising solutions paths.

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Table of contents of both volumes are given below.

Moving Target Defense II: Application of Game Theory and Adversarial Modeling, Table of Content

1. Game Theoretic Approaches to Attack Surface Shifting
Pratyusa K. Manadhata
2. Security Games Applied to Real-World: Research Contributions and Challenges
Manish Jain, Bo An, and Milind Tambe
3. Adversarial Dynamics: The Conficker Case Study
Daniel Bilar, George Cybenko, and John Murphy
4. From Individual Decisions from Experience to Behavioral Game Theory: Lessons for Cybersecurity
Cleotilde Gonzalez
5. Cyber Maneuver Against External Adversaries and Compromised Nodes
Don Torrieri, Sencun Zhu, and Sushil Jajodia
6. Applying Self-Shielding Dynamics to the Network Architecture
Justin Yackoski, Harry Bullen, Xiang Yu, and Jason Li
7. Moving Target Defenses in the Helix Self-Regenerative Architecture
Claire Le Goues, Anh Nguyen-Tuong, Hao Chen, Jack W. Davidson, Stephanie Forrest, Jason D. Hiser, John C. Knight, and Matthew Van Gundy
8. Diversifying the Software Stack Using Randomized NOP Insertion
Todd Jackson, Andrei Homescu, Stephen Crane, Per Larsen, Stefan Brunthaler, and Michael Franz

Moving Target Defense: Creating Asymmetric Uncertainty for Cyber Threats Table of Content

1. A Formal Model for a System's Attack Surface
Pratyusa K. Manadhata and Jeannette M. Wing
2. Effectiveness of Moving Target Defenses
David Evans, Anh Nguyen-Tuong, John Knight

3. Global ISR: Toward a Comprehensive Defense Against Unauthorized Code Execution
Georgios Portokalidis and Angelos D. Keromytis
4. Compiler-Generated Software Diversity
Todd Jackson, Babak Salamat, Andrei Homescu, Karthikeyan Manivannan, Gregor Wagner, Andreas Gal, Stefan Brunthaler, Christian Wimmer, Michael Franz
5. Symbiotes and defensive Mutualism: Moving Target Defense
Ang Cui and Salvatore J. Stolfo
6. Manipulating Program Functionality to Eliminate Security Vulnerabilities
Martin Rinard
7. End-to-End Software Diversification of Internet Services
Mihai Christodorescu, Matthew Fredrikson, Somesh Jha, and Jonathon Giffin
8. Introducing Diversity and Uncertainty to Create Moving Attack Surfaces for Web Services
Yih Huang and Anup K. Ghosh
9. Toward Network Configuration Randomization for Moving Target Defense
Ehab Al-Shaer
10. Configuration Management Security in Data Center Environments
Krishna Kant