# Alexandros Kapravelos

akaprav@ncsu.edu
www.kapravelos.com


## Research Interests

My research interests span the areas of **systems and web security**. I am in particular interested in protecting the browser at all levels, from designing a secure browser architecture to measuring and understanding large-scale Internet attacks. Understanding how the web works and evolves over time and how we can make it more secure for the users is my current research focus.

## Employment

Aug 2022-now **Associate Professor**
Department of Computer Science
North Carolina State University

Jan 2016-2022 **Assistant Professor**
Department of Computer Science
North Carolina State University

## Education

2010-2015 **Ph.D. in Computer Security Lab**,
*Computer Science Department*,
University of California, Santa Barbara, USA

thesis *Analyzing and Defending Against Evolving Web Threats*

supervisors Professor Christopher Kruegel, Professor Giovanni Vigna

2010 **M.Sc. Candidate in Distributed Computing Systems Lab**,
*Computer Science Department*,
University of Crete, Greece
GPA: 8.7 out of 10.0

thesis *Robust Prevention of Dial Attacks*

supervisor Professor Evangelos Markatos

description An extensive evaluation of the security properties that arise from making accessible telephone devices from the Internet through the use of VoIP. The term Dial stands for *Digitally Initiated Abuse of teLephones*

2007 **B.Sc. in Computer Science**,
*Computer Science Department*, University of Crete, Greece
GPA: 7.43 out of 10.0

thesis *Packetloss: A Passive end-to-end Packet Loss estimation*

supervisor Professor Evangelos Markatos

description A novel idea for estimating accurately the packet loss ratio between different measuring points.

## Grants and Contracts [Total = $9,499,776]

NSF SaTC: Frontiers: Enabling a Secure and Trustworthy Software Supply Chain
Total Award: $9,150,000; NCSU amount: **$6,344,481**
Duration: 5 years (October 1, 2022 - September 30, 2027)
PI: Laurie Williams (NCSU); Co-PI: William Enck (NCSU), Michel Cukier (UMD), Christian Kaestner (CMU), Alexandros Kapravelos (NCSU), Yasemine Acar (GWU)

NSF SaTC: CORE: Medium: Collaborative Research: SaTC: CORE: Medium: Defending against Emerging Stateless Web Tracking
Total Award: $1,199,030; NCSU amount: **$399,515**
Duration: 4 years (June 15, 2022 - May 31, 2026)
PI: Alexandros Kapravelos; Co-PIs: Zubair Shafiq (UC Davis), Anupam Das (NCSU)

ONR Tools and Techniques to Improve the Granularity and Usability of Web Application Debloating
Total Award: $1,223,568; NCSU amount: **$389,312**
Duration: 2 years (February 2021 - February 2023)
NCSU PI: Alexandros Kapravelos; PI: Adam Doupé; Co-PIs: Manuel Egele, Nick Nikiforakis

NSF CAREER: Web Evolution and Emerging Threats
Total Award: **$561,188**
Duration: 5 years (July 2021 - June 2026)
NCSU PI: Alexandros Kapravelos;

CARTA Real-time Cyber Knowledge Platform for Web Threats
Sponsor: Center for Accelerated Real Time Analytics - NCSU Research Site
Total Award: **$60,000**
Duration: 1 year (January 2021 - December 31, 2021)
NCSU PI: Alexandros Kapravelos

LAS Machine Learning Assisted Fuzzing of JavaScript Engines
Sponsor: Laboratory for Analytic Sciences
Total Award: **$93,854**
Duration: 1 year (January 2021 - December 31, 2021)
NCSU PI: Alexandros Kapravelos

CARTA Real-time Cyber Knowledge Platform for Web Threats
Sponsor: Center for Accelerated Real Time Analytics - NCSU Research Site
Total Award: **$60,000**
Duration: 1 year (July 2018 - June 30, 2019)
NCSU PI: Alexandros Kapravelos

DARPA CHECRS: Cognitive Human Enhancements for Cyber Reasoning Systems
Total award: $11,070,493; NCSU Amount: **$884,817**
Duration: 3,5 years
Award #: FA8750-19-C-0003
PI: Ruoyu (Fish) Wang (ASU)
CoPIs (ASU): Yan Shoshitaishvili, Tiffany Bao, Adam Doupé, Chitta Baral, Stephanie Forrest
CoPIs (NCSU): Alexandros Kapravelos
CoPIs (EURECOM): Davide Balzarotti, Yanick Fratantonio
CoPIs (UCSB): Giovanni Vigna, Christopher Kruegel
CoPIs (UIowa): Antonio Bianchi
Starting date: January 2019

NSF SaTC: CORE: Medium: Collaborative: Taming Web Content Through Automated Reduction in Browser Functionality
Total Award: $1,199,787; NCSU amount: **$406,609**
Duration: 4 years (September 1, 2017 - August 31, 2021)
NCSU PI: Alexandros Kapravelos; PI: Adam Doupé; Co-PI: Engin Kirda

ONR XS-Shredder: A Cross-Layer Framework for Removing Code Bloat in Web Applications
Total Award: $1,230,547; NCSU amount: **$300,000**
Duration: 2 years (July 2017 - June 30, 2019)
NCSU PI: Alexandros Kapravelos; PI: Adam Doupé; Co-PIs: Manuel Egele, Nick Nikiforakis

## Publications


[1] Igibek Koishybayev, Aleksandr Nahapetyan, Raima Zachariah, Siddharth Muralee, Brad Reaves, **A. Kapravelos**, and Aravind Machiry. Characterizing the Security of Github CI Workflows. In *Proceedings of the USENIX Security Symposium*, August 2022.

[2] Dashmeet Kaur Ajmani, Igibek Koishybayev, and **A. Kapravelos**. yoU aRe a Liar://A Unified Framework for Cross-Testing URL Parsers. In *Proceedings of the IEEE SecWeb Workshop*, June 2022.

[3] Karthika Subramani, Jordan Jueckstock, **A. Kapravelos**, and Roberto Perdisci. SoK: Workerounds - Categorizing Service Worker Attacks and Mitigations. In *Proceedings of the IEEE European Symposium on Security and Privacy (EuroS&P)*, June 2022.

[4] Jordan Jueckstock, Peter Snyder, Shaown Sarker, **A. Kapravelos**, and Ben Livshits. Measuring the Privacy vs. Compatibility Trade-off in Preventing Third-Party Stateful Tracking. In *Proceedings of The Web Conference (WWW)*, April 2022.

[5] Seyed Ali Akhavani, Jordan Jueckstock, Junhua Su, **A. Kapravelos**, Engin Kirda, and Long Lu. Browserprint: An Analysis of the Impact of Browser Features on Fingerprintability and Web Privacy. In *Proceedings of the Information Security Conference (ISC)*, November 2021.

[6] Quan Chen, Panagiotis Ilia, Michalis Polychronakis, and **A. Kapravelos**. Cookie Swap Party: Abusing First-Party Cookies for Web Tracking. In *Proceedings of The Web Conference (WWW)*, April 2021.

[7] Jordan Jueckstock, Shaown Sarker, Peter Snyder, Aidan Beggs, Panagiotis Papadopoulos, Matteo Varvello, Ben Livshits, and **A. Kapravelos**. Towards Realistic and Reproducible Web Crawl Measurements. In *Proceedings of The Web Conference (WWW)*, April 2021.

[8] Pierre Laperdrix, Oleksii Starov, Quan Chen, **A. Kapravelos**, and Nick Nikiforakis. Fingerprinting in Style: Detecting Browser Extensions via Injected Style Sheets. In *Proceedings of the USENIX Security Symposium*, August 2021.

[9] Quan Chen, Peter Snyder, Ben Livshits, and **A. Kapravelos**. Detecting Filter List Evasion With Event-Loop-Turn Granularity JavaScript Signatures. In *Proceedings of the IEEE Symposium on Security and Privacy*, May 2021.

[10] Penghui Zhang, Adam Oest, Haehyun Cho, Zhibo Sun, RC Johnson, Brad Wardman, Shaown Sarker, **A. Kapravelos**, Tiffany Bao, Ruoyu Wang, Yan Shoshitaishvili, Adam Doupe, and Gail-Joon Ahn. CrawlPhish: Large-scale Analysis of Client-side Cloaking Techniques in Phishing. In *Proceedings of the IEEE Symposium on Security and Privacy*, May 2021. Best Student Paper Award.

[11] Sung Ta Dinh, Haehyun Cho, Kyle Martin, Adam Oest, Yihui Zeng, **A. Kapravelos**, Tiffany Bao, Ruoyu "Fish" Wang, Yan Shoshitaishvili, Adam Doupe, and Gail-Joon Ahn. Favocado: Fuzzing Binding Code of JavaScript Engines Using Semantically Correct Test Cases. In *Proceedings of the Network and Distributed System Security Symposium (NDSS)*, February 2021.

[12] Nikolaos Pantelaios, Nick Nikiforakis, and **A. Kapravelos**. You've Changed: Detecting Malicious Browser Extensions through their Update Deltas. In *Proceedings of the ACM Conference on Computer and Communications Security (CCS)*, November 2020.

[13] Shaown Sarker, Jordan Jueckstock, and **A. Kapravelos**. Hiding in Plain Site: Detecting JavaScript Obfuscation through Concealed Browser API Usage. In *Proceedings of the ACM Internet Measurement Conference (IMC)*, October 2020.

[14] Igibek Koishybayev and **A. Kapravelos**. Mininode: Reducing the Attack Surface of Node.js Applications. In *Proceedings of the International Symposium on Research in Attacks, Intrusions and Defenses (RAID)*, October 2020.

[15] Jordan Jueckstock and **A. Kapravelos**. VisibleV8: In-browser Monitoring of JavaScript in the Wild. In *Proceedings of the ACM Internet Measurement Conference (IMC)*, October 2019.

[16] Erik Trickel, Oleksii Starov, **A. Kapravelos**, Nick Nikiforakis, and Adam Doupe. Everyone is Different: Client-side Diversification for Defending Against Extension Fingerprinting. In *Proceedings of the USENIX Security Symposium*, August 2019.

[17] Aidan Beggs and **A. Kapravelos**. Wild Extensions: Discovering and Analyzing Unlisted Chrome Extensions. In *Proceedings of the Conference on Detection of Intrusions and Malware & Vulnerability Assessment (DIMVA)*, June 2019.

[18] Oleksii Starov, Pierre Laperdrix, **A. Kapravelos**, and Nick Nikiforakis. Unnecessarily Identifiable: Quantifying the fingerprintability of browser extensions due to bloat. In *Proceedings of the World Wide Web Conference (WWW)*, May 2019.

[19] Quan Chen and **A. Kapravelos**. Mystique: Uncovering information leakage from browser extensions. In *Proceedings of the ACM Conference on Computer and Communications Security (CCS)*, 2018.

[20] Luca Invernizzi, Kurt Thomas, **A. Kapravelos**, Oxana Comanescu, Jean-Michel Picod, and Elie Bursztein. Cloak of Visibility: Detecting When Machines Browse A Different Web. In *Proceedings of the IEEE Symposium on Security and Privacy*, 2016.

[21] Kurt Thomas, Elie Bursztein, Chris Grier, Grant Go, Nav Jagpal, **A. Kapravelos**, Damon Mccoy, Antonio Nappa, Vern Paxson, Paul Pearce, Niels Provos, and Moheeb Abu Rajab. Ad Injection at Scale: Assessing Deceptive Advertisement Modifications. In *Proceedings of the IEEE Symposium on Security and Privacy*, 2015. Distinguished Practical Paper Award.

[22] Apostolis Zarras, **A. Kapravelos**, Gianluca Stringhini, Thorsten Holz, Chris Kruegel, and Giovanni Vigna. The Dark Alleys of Madison Avenue: Understanding Malicious Advertisements. In *Proceedings of the Internet Measurement Conference (IMC)*, 2014.

[23] **A. Kapravelos**, Chris Grier, Neha Chachra, Chris Kruegel, Giovanni Vigna, and Vern Paxson. Hulk: Eliciting Malicious Behavior in Browser Extensions. In *Proceedings of the USENIX Security Symposium*. USENIX, 2014.

[24] Giancarlo De Maio, **A. Kapravelos**, Yan Shoshitaishvili, Chris Kruegel, and Giovanni Vigna. PExy: The other side of Exploit Kits. In *Proceedings of the Conference on Detection of Intrusions and Malware & Vulnerability Assessment (DIMVA)*, 2014.

[25] **A. Kapravelos**, Yan Shoshitaishvili, Marco Cova, Chris Kruegel, and Giovanni Vigna. Revolver: An Automated Approach to the Detection of Evasive Web-based Malware. In *Proceedings of the USENIX Security Symposium*, 2013.

[26] Nick Nikiforakis, **A. Kapravelos**, Wouter Joosen, Chris Kruegel, Frank Piessens, and Giovanni Vigna. Cookieless Monster: Exploring the Ecosystem of Web-based Device Fingerprinting. In *Proceedings of the IEEE Symposium on Security and Privacy*, 2013.

[27] Nick Nikiforakis, Luca Invernizzi, **A. Kapravelos**, Steven Van Acker, Wouter Joosen, Chris Kruegel, Frank Piessens, and Giovanni Vigna. You are what you include: Large-scale evaluation of remote javascript inclusions. In *Proceedings of the ACM Conference on Computer and Communications Security (CCS)*, 2012.

[28] **A. Kapravelos**, Marco Cova, Chris Kruegel, and Giovanni Vigna. Escape from Monkey Island: Evading High-Interaction Honeyclients. In *Proceedings of the Conference on Detection of Intrusions and Malware & Vulnerability Assessment (DIMVA)*, 2011.

[29] **A. Kapravelos**, Jason Polakis, Elias Athanasopoulos, Sotiris Ioannidis, and Evangelos P. Markatos. D(e|i)aling with VoIP: Robust Prevention of Dial Attacks. In *Proceedings of the European Symposium on Research in Computer Security (ESORICS)*, 2010.

[30] Ales Friedl, Sven Ubik, **A. Kapravelos**, Michalis Polychronakis, and Evangelos P. Markatos. Realistic Passive Packet Loss Measurement for High-Speed Networks. In

*Proceedings of the International Workshop on Traffic Monitoring and Analysis (TMA)*, 2009.

[31] Nikos Armenatzoglou, Yannis Marketakis, Lito Kriara, Elias Apostolopoulos, Vicky Papavasiliou, Dimitris Kampas, **A. Kapravelos**, Eythimis Kartsonakis, Giorgos Linardakis, Sofia Nikitaki, Antonis Bikakis, and Grigoris Antoniou. Flexconf: A flexible conference assistant using context-aware notification services. In *Proceedings of the IEEE Workshop on Context Aware Mobile Systems (CAMS)*, 2009.

[32] Antonis Papadogiannakis, **A. Kapravelos**, Michalis Polychronakis, Evangelos P. Markatos, and Augusto Ciuffoletti. Passive end-to-end packet loss estimation for grid traffic monitoring. In *Proceedings of the CoreGRID Integration Workshop*, 2006.

## Journal Publications

[1] Penghui Zhang, Adam Oest, Haehyun Cho, Zhibo Sun, RC Johnson, Brad Wardman, Shaown Sarker*, **Alexandros Kapravelos**, Tiffany Bao, Ruoyu Wang, Yan Shoshitaishvili, Adam Doupé, Gail-Joon Ahn. CrawlPhish: Large-scale Analysis of Client-side Cloaking Techniques in Phishing. *IEEE Security Privacy*, 2022

[2] Nick Nikiforakis, **Alexandros Kapravelos**, Wouter Joosen, Chris Kruegel, Frank Piessens, and Giovanni Vigna. On the Workings and Current Practices of Web-Based Device Fingerprinting. *IEEE Security Privacy*, 2014

## Teaching Experience

| | |
|---|---|
| Spring 2021 | CSC-405 Computer Security |
| Spring 2021 | CSC-705 Operating Systems Security |
| Fall 2020 | CSC-295 HackPack |
| Spring 2020 | CSC-405 Computer Security |
| Spring 2020 | CSC-591 Systems Attacks and Defenses |
| Spring 2019 | CSC-405 Computer Security |
| Spring 2019 | CSC-705 Operating Systems Security |
| Spring 2018 | CSC-405 Computer Security |
| Fall 2017 | CSC-591 Systems Attacks and Defenses |
| Spring 2017 | CSC-405 Introduction to Computer Security |
| Fall 2016 | CSC-574 Computer and Network Security |
| Spring 2016 | CSC-705 Operating Systems Security |
| November 2012 | Guest Lecture titled "Web Application Security" at UCSB's CS177 class "Computer Security and Privacy" |
| April 2012 | "Into the Mind of the Hacker" - Three hour hands-on workshop at UC Santa Barbara by request of Web Standard Group |
| Spring 2009 | Teaching Assistant, CS459 - Internet Measurements, University of Crete |
| Spring 2008 | Teaching Assistant, CS118 - Discrete Mathematics, University of Crete |
| Fall 2007, Fall 2008 | Teaching Assistant, CS345 - Operating Systems, University of Crete |

## Work Experience

| | |
|---|---|
| 2016 – now | I am an Assistant Professor in the Department of Computer Science at North Carolina State since January 2016. |
| 2010 – 2015 | As a Research Assistant in the Computer Security Lab at the University of California, Santa Barbara I was the lead developer of Wepawet, a public platform for the analysis of web-based threats. I also deployed a new public platform to track the evolution of malicious JavaScript attacks based on the work that I did for the Revolver paper. I was also part of the core team organizing the UCSB International Capture the Flag (iCTF) hacking competition, the largest live security exercise with more than 900 participating students and a proud member of the Shellphish hacking group. |
| Sept – Dec 2014 | I did an internship at Google at the anti-abuse research group under the supervision of Elie Bursztein and worked on a project with the goal to understand in depth ad injection from malicious browser extensions. |
| June – Sept 2014 | I visited the Security Group at UC San Diego for 3 months and worked with Stefan Savage and Geoff Voelker on a machine learning project regarding malicious browser extensions. |
| Oct – Dec 2013 | I consulted at Lastline Inc. for 3 months regarding advanced web security problems based on my experience from Wepawet. |
| June – Sept 2013 | For the summer of 2013 I visited the International Computer Science Institute at Berkeley to work as an intern with Chris Grier and Vern Paxson. My project there was to understand and develop methods to detect malicious extensions for the Chrome browser. |
| 2005 – 2010 | I worked as a Research Assistant at Distributed Computing Systems Lab of FORTH-ICS in Heraklion. I participated in two EU-funded programs: LOBSTER (Large-scale Monitoring of Broadband Internet Infrastructures) and MOMENT (Monitoring and Measurement in the Next Generation Technologies). |
| Sep - Nov 2009 | I visited Prof. Christopher Kruegel and Giovanni Vigna for 3 months at the University of California, Santa Barbara and worked in the Computer Security Lab as Junior Research Assistant. |

## Awards

| | |
|---|---|
| 2021 | IEEE Symposium on Security and Privacy - Best Student Paper Award |
| 2015 | IEEE Symposium on Security and Privacy - Distinguished Practical Paper Award |
| 2015 | UC Santa Barbara - Outstanding Dissertation Award |

## Service

| | |
|---|---|
| co-Chair | Workshop on Measurements, Attacks, and Defenses for the Web (MADWeb): 2019, 2020 |
| Security Session co-Chair | International Conference on Parallel and Distributed Systems (ICPADS): 2016 |
| co-Editor | ACM Digital Threats: Research and Practice (DTRAP) Co-Editor: 2020, 2021 |
| TPC member | USENIX Security Symposium: 2017, 2018, 2021, 2022 |
| TPC member | IEEE Symposium on Security and Privacy: 2019, 2020 |

| | |
|---|---|
| TPC member | ACM Conference on Computer and Communications Security (CCS): 2018, 2019, 2020, 2021 |
| TPC member | World Wide Web Conference (WWW) - Security Track: 2018, 2020, 2021, 2022 |
| TPC member | ACM Conference on Data and Application Security and Privacy (CODASPY): 2017, 2018, 2019 |
| TPC member | Annual Computer Security Applications Conference (ACSAC): 2016, 2017, 2018, 2019, 2020 |
| TPC member | European Workshop on Systems Security (EuroSec): 2018, 2019, 2020 |
| TPC member | Workshop on Offensive Technologies (WOOT): 2016, 2017, 2018 |
| TPC member | ACM ASIA Conference on Computer and Communications Security (ACM ASIACCS): 2019, 2020 |
| TPC member | Conference on Detection of Intrusions and Malware & Vulnerability Assessment (DIMVA): 2017, 2018, 2020, 2021 |
| TPC member | Symposium on Electronic Crime Research (eCrime): 2016, 2017, 2018, 2019 |
| TPC member | ACM ASIA Conference on Computer and Communications Security (ACM ASIACCS): 2019, 2020 |
| TPC member | ACM Symposium on Applied Computing (SAC) - Security Track: 2018 |
| TPC member | International Conference on Internet Monitoring and Protection (ICIMP): 2019 |
| TPC member | NSF SaTC panel: 2016, 2018 |
| Artifact Evaluation Committee Member | Annual Computer Security Applications Conference (ACSAC): 2019, 2020 |
| Organizer | DEF CON CTF - I am part of the 'Order of the Overflow' team that organizes the largest, oldest and most prestigious hacking competition colocated with the DEF CON Hacking Conference. |
| Organizer | HackPack CTF - I have been organizing yearly since 2016 a Capture The Flag (CTF) competition at NCSU together with the security student club named HackPack that I mentor. |
| Organizer | International Capture the Flag (iCTF) - I was one of the organizing members for the worlds' largest educational hacking competition for 4 years (2010-2014) |

## Invited Talks

| | |
|---|---|
| March 2019 | Browser Extensions and Privacy Implications - Centre for Research & Technology, Hellas, Greece - Yiannis Kompatsiaris |
| November 2018 | Brave Faculty Summit - Title: Browser Extensions and Privacy Implications |
| July 2016 | Analyzing and understanding in depth malicious browser extensions - University of Athens, Greece - Mema Roussopoulos |
| June 2016 | Analyzing and understanding in depth malicious browser extensions - Athens University of Economics and Business, Greece - Diomidis Spinellis |
| June 2016 | Analyzing and understanding in depth malicious browser extensions - Foundation for Research and Technology - Hellas (FORTH), Greece - Sotiris Ioannidis |

May 2016 Analyzing and understanding in depth malicious browser extensions - Aristotle University, Greece - Nikos P. Pitsianis

## Press

2019 VisibleV8 was featured in NSF Research news
https://bit.ly/2H2zEwz

2019 Coverage of our Mystique work in USA Today and Washington Post
http://bit.ly/2SBZ6e8 and https://wapo.st/2Rs659z

2019 Interview with Washington Post regarding privacy leaks from browser extensions and our Mystique work
https://wapo.st/2SvqA52

2015 Interview with BBC regarding malicious browser extensions
http://goo.gl/FiHzLU

2015 Official blogpost by Google with part of the work we did during my internship there
http://goo.gl/3FKIuU

2014 News article at InfoWorld for our malicious advertisement measurement study presented at IMC'14
http://goo.gl/Fs0aVU

2014 News article at PCWorld regarding Hulk and malicious browser extensions
http://goo.gl/RyNjNm

2014 News article at IEEE Spectrum maganzine about browser fingerprinting
http://goo.gl/trS3th

2013 News article at DARKReading for *Revolver*
http://goo.gl/I91J5S

## Mentoring

Over the years I had the fantastic opportunity to work with undergraduate and graduate students on some of the research projects that I envisioned at the time.

2020-now Junhua Su
2020-now Alex Nahapetyan
2018-now Nikolaos Pantelaios - Extension takeover [12]
2017-now Shaown Sarker - JavaScript Obfuscation [13, 10]
2017-now Igibek Koishybayev - Web application attack-surface reduction [14]
2016-now HackPack student club at NCSU - Mentoring students to play and organize CTFs
2017-2021 Kyle Martin - Browser Exploitation framework [11]
2017-2021 Jordan Jueckstock - Browser monitoring [15, 7, 13]
2016-2021 Quan Chen - Browser tainting for privacy leaks [19, 9, 8, 6]
2018-2021 Aidan Beggs - Extensions in the wild [17]
2018-2019 Shantanu Chandorkar - Threat-intelligence framework
2018-2020 Will Rabb - Form-leaking on the web
2018-2019 Tyler Nielsen - Browser extensions code dependencies
2017-2018 Robert Reichel - Browser extensions

2014 Giacomo Vecere - In-browser website analysis

2014 Suqi Liu - Identifying malicious browser extensions with machine learning

2014 Vasilios Mavroudis - Non-determinism in JavaScript

2014 Abhinav Gupta - Improving detection of Java-based drive-by download attacks in Wepawet

2014 Apostolis Zarras - Malicious Advertisements [22]

2013 Giancarlo De Maio - Analysis of Exploit kits [24]

2013 Luca Montecchi and Aldo Vaccari - Profiling JavaScript in the browser

2012 Sahin Koc - DNS reputation in conjunction with dynamic analysis systems

## Updated

November, 2022