How to break SAML if I have paws?

How to break SAML if I have paws? - Aleksei "GreenDog" Tiurin, Speaker Deck.

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Content

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How to break SAML if I have paws? - Speaker Deck

How to break SAML if I have paws?

Overview of "how to hack SAML" from a security conference - KazHackStan https://kazhackstan.com/en/

In this talk, we will figure out how to break Single Sign On(SSO) based on SAML. Let's look at the components of SAML and the associated attack vectors, current vulnerabilities and methods of their exploitation. Everything a pentester needs to pohakat SAML without soiling the fur.

[image: Avatar for GreenDog]

GreenDog

September 21, 2023

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Ruby on Rails

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[RailsConf 2023] Rails as a piece of cake

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Transcript

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Суповой набор №5a. Как ломать SAML, если у меня лапки?

How to hack SAML if I have paws? Aleksei “GreenDog” Tiurin

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WHOAMI? - Security researcher - Invicti Security (Acunetix) - Зеленые

лапки расслабленности t.me/greenrelaxpaws agrrrdog.blogspot.com github.com/GrrrDog/ Aleksei Tiurin GreenDog

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SAML - Security Assertion Markup Language • SSO • Authentication

and authorization • Everywhere

-

SAML - Security Assertion Markup Language • Very old standards

(~2002-2005) SAML 1.0 / 2.0 • Based on HTTP XML XML Schema XML Digital Signature (XML DSig) XML Encryption • Complicated standards Protocols/Bindings/Profiles Full specs - hundreds of pages

-

“10 Years later” • Old technologies -> old libs

xmlsec (java / c) • Complex configurations • Many Implementations https://en.wikipedia.org/wiki/SAML-based_products_and_services • ZeroNights 2012 • (almost) All the same attacks ^_^

-

Identity Provider (IdP) - where user creds are stored -

Okta, OneLogin, PingIdentity, MS AAD, etc - OpenAM, Keycloak, Oracle OAM, Shibboleth, etc Service Provider (SP) - an application that a user wants to access - ... Jira, WordPress, AWS ...

-

- One IdP - many SPs - Corporate SSO -

One SP - many IdPs - SaaS that needs to support multiple organizations

-

Flows - SP initiated - IdP initiated (from 4) SAML

Request SAML Response

-

SAMLRequest - From SP toIdP - Redirect Binding (GET) /

POST Binding (HTML Form) - Base64

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SAMLResponse - From IdP to SP - POST Binding HTML

form - Base64 + Deflate

-

SAMLResponse - Signed Response - Signed Assertion - Both

-

How does the signature work?

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Situations: - Anonymous attacks - A user in IdP -

Malicious SP - Malicious IdP Core tool - SAML Raider extension in Burp

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Anonymous attacks 1. SAMLRequest - Detect that SAML is used

1. From SAMLRequest - Issuer (IdP) - AssertionConsumerServiceURL (ACS) - where SP expects SAMLResponse - SP's SAML lib name - id generator - format, name, etc - Destination (IdP)

-

SAML Metadata - Configuration exchange for SP and IdP -

Names, endpoints, certificates... - Signature, encryption, additional attributes... SP doesn't expose it (usually) IdP: - know endpoints - oamfed/idp/metadata - from Destination - okta.com/app/appname/RND/sso/saml-> - okta.com/app/RND/sso/saml/metadata Now, we have almost everything to create a good SAMLResponse from nothing

-

Creating SAML Response - POST to ACS url - Known

SAML schemas - Info from SAMLRequest - Destination - ACS url - InResponseTo - ID - Issue Timestamp - Issuer - From metadata - Both Response and Assertion - Subject / NameID - email? - Conditions - NotBefore + NotOnOrAfter - AudienceRestriction - ? - AuthnStatement - ? http://www.datypic.com/sc/saml2/e-samlp_Response.html http://www.datypic.com/sc/saml2/e-saml_Assertion.html

-

1. XML -> XXE (+XSD/NS injection?) - https://nvd.nist.gov/vuln/detail/CVE-2022-35741 2. XSS

- Often show errors for debug - Before Sign check - Issuer, Destination, StatusCode, etc - using the created SAML Response - XSS payload -> every “field” - encode/CDATA Destination="> <img/src/onerror=alert(1)>" SAML Response

-

Authentication bypass - Disabled sign check - common misconfig -

No <Signature/> tag - no Sign check https://hackerone.com/reports/136169 - Complicated specifications - - nobody uses advanced features - Documentation (SP/IdP)? - NameID - email - Find a registered email? - Auto provisioning - Create SAML Response(s) - Try them - Error messages https://mishresec.wordpress.com/2017/10/13/uber-bug-bounty-gaining-access-to-an-inter nal-chat-system/

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KeyInfo - Info about the key - ds:Signature - Self-Signed

certificate SAML Response

-

Certificate faking for Authentication bypass - Take Certificate from Metadata

- Import in SAML Raider - Sign the created SAML Response(s) - Incorrect certificate match - Trust KeyInfo certificate https://epi052.gitlab.io/notes-to-self/blog/2019-03-13-how-to-test-saml-a-methodology-part-two/#certificate-faking SAML Response

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Dupe Key Confusion (.NET) - Alvaro Muñoz, Oleksandr Mirosh at

BlackHat 2019 https://i.blackhat.com/USA-19/Wednesday/us-19-Munoz-SSO-Wars-The-Token-Menace.pdf - Better with a valid SAML Response SAML Response

-

Certificate validation to SSRF - Trust KeyInfo certificate - Certificate

validation - SSRF in X509 cert - Michael Stepankin at BlackHat 2023 https://github.com/onhexgroup/Conferences/blob/main/Black%20Hat%20USA%202023%20slides/Michael %20Stepankin_mTLS%20When%20Certificate%20Authentication%20is%20Done%20Wrong.pdf - Java - AIA, SIA, CRL DP - Created SAML Response - Add KeyInfo with SSRF cert - Windows? .NET?

-

Reference dereferencing - Data location - URI - remote files

(http, https, etc) - local files - (Blind) SSRF - Everywhere! - XML DSig - XML Enc - Metadata - ... SAML Response

-

Reference dereferencing (XML DSig) - Reference https://github.com/IdentityPython/pysaml2/issues/510 - KeyInfo -

Java xmlsec. SecureValidation bypass (CVE-2021-40690) https://blog.tint0.com/2021/09/pinging-xmlsec.html SAML Response

-

Reference dereferencing (XML Enc) - CipherReference - DataReference - +

EncryptedKey -> KeyInfo

-

Transformations - XML “normalization” - Additional “preparations” - Base64 -

XPath - XPath-Filter - XSLT (optional) - ...

-

Base64 http://www.w3.org/2000/09/xmldsig#base64 - .NET XXE CVE-2022-34716 - Decode Reference +

Parse XML - XXE inside https://bugs.chromium.org/p/project-zero/issues/detail?id=2313

-

XPath http://www.w3.org/TR/1999/REC-xpath-19991116 - Blind SSRF - Mix with Reference (xml

files) - Error - Modified version of a payload for PingIdentity from https://blog.tint0.com/2021/09/pinging-xmlsec.html

-

XSLT http://www.w3.org/TR/1999/REC-xslt-19991116 - Java / Santuario (xmlsec) <= 1.4.1 (~

1. - via Xalan - RCE ManageEngine ServiceDesk CVE-2022-47966

-

xmlsec >= 1.4.2 - Secure-processing - true - Xalan CVE-2014-0107

< 2.7.2 - Arbitrary class instantiation https://blog.viettelcybersecurity.com/saml-show-stopper/

-

XSLT https://blog.viettelcybersecurity.com/saml-show-stopper/

-

How can we test dereference/transformations? - Acunetix - No manual

tools - SAML Raider - no Algorithm - unparsed-text - XSLT 2.0 - it won't detect CVE-2022-47966 (java xmlsec)

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Attacks on IdP - Signed SAMLRequest (AuthnRequest) - SP->IdP -

Redirect-POST -> POST-POST bindings - SAML protocol: LogoutRequest, etc - Metadata import (Malicious SP/IdP) - Same attack vectors

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With creds / Malicious SP/IdP - Transformation after Sign check

- Post-auth - "Malicious" SP/IdP - Generate a valid signature for arbitrary transformations - How? SAML Response

-

More attacks on IdP (w/ creds) ACSSpoofing Attack - Change

SAMLRequest ACS url to an attacker' server - Old https://web-in-security.blogspot.com/2015/04/on-security-of-saml-based-identity.html - is it string or url comparison? XML injection - SAMLRequest is not signed - Values from SAMLRequest reflected in SAMLResponse - copy as string - add new tags/attributes - correctly signed https://research.nccgroup.com/2021/03/29/saml-xml-injection/

-

Attacks on SP (w/ creds) - Sign check, Cert-related, etc

- XSW (w/ SAML Raider) - XML parsing - Comment injection https://duo.com/blog/duo-finds-saml-vulnerabilities-affecting-multiple-implementations - ~ 2017 - [] (https://speakerdeck.com/cdn-cgi/l/email-protection)<!---->.attacker.pw - [] (https://speakerdeck.com/cdn-cgi/l/email-protection) vs [] (https://speakerdeck.com/cdn-cgi/l/email-protection) - <? anything ?> - processing instructions inside XML - Much more - Logic vulnerabilities - "how to put things together" - very common

-

Session handling RelayState - State Preservation - URL - "Open

Redirect" https://hackerone.com/reports/1923672 https://www.anitian.com/owning-saml/

-

Multitenant (1 SP - many IdPs) Don't trust IdP -

Auth based on SAML Response - Manipulate NameId, Issuer, ACS - Email from another tenant -> access IdP confusion https://hackerone.com/reports/976603 - IdP victim - "IdP1" - IdP attacker -

“IdP1 ” (with a space at the end) - Sign check w/ victim’s IdP, log in to the attacker’s account

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Recommendations - Don’t implement SAML “lib” yourself - Use 3rd

party libs - Update libs systematically - Show a generic error - Disable unnecessary features - KeyInfo? XML Enc? - Be careful w/ metadata - Always pentest your SAML implementation in SP - Pentest your IdP if it’s not SaaS - Write me if you have any questions

-

Big thanks to the researchers of mentioned articles/white papers/tools

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New cheat sheet about SAML? https://github.com/GrrrDog/ Зеленые лапки р асслабленности https://t.me/greenrelaxpaws

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None