CBTS & OWASP

SSRF ATTACK SCENARIOS & DEFENSIVE OPTIONS

ABOUT US

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- CBTS Principal Security Engineer
- Former Software Developer (ASP.net/C#, Perl, Python)
- Professional Security Practitioner for over 12 years

Nate Fair

- CBTS Information Security Engineer
- Adjunct Professor Penetration Testing @ UC
- Information Security & Penetration Tester for 5 years

ABOUT THIS TALK

ATTACK

- SSRF101
 - Things to look for
- TYPES OF SSRF
 - BASIC/BLIND/MIXED
- ABUSING SSRF
 - PORT SCANNING
 - BYPASS FIREWALLS
- LABS
 - Demo

Defend

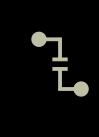
- DETECTING SSRF
 - North/south and East/West
 - LOGGING
- DEFENDING/PREVENTING SSRF
 - INPUT FILTERING
 - DOMAIN WHITELISTING
 - Additional Strategies

WHAT THIS TALK WON'T COVER

- (AT LEAST ON THE ATTACK SIDE)
- Advanced topics like
 - PROTOCOL SMUGGLING
 - SMTP OVER HTTPS (SNI)
 - CR-LF INJECTION
 - EXPLOITING URL PARSERS
 - CURL (LIBCURL), GO (NET/URL), PHP (PARSE_URL), RUBY (ADDRESSABLE), NODEJS (URL)

YOU CAN FIND ALL OF THAT AND MUCH MORE HERE

<u>HTTPS://WWW.BLACKHAT.COM/DOCS/US-</u> <u>17/THURSDAY/US-17-TSAI-A-NEW-ERA-OF-SSRF-EXPLOITING-</u> <u>URL-PARSER-IN-TRENDING-PROGRAMMING-LANGUAGES.PDF</u>



Vulnerability class that encompasses behavior in which a server request is initiated by an attacker



Applications will take a URL from a user perform some action

setting your avatar via URL, Image/Link preview in chat



To exploit an SSRF vulnerability, an attacker can: convince server to make requests on internal resources

bypass firewall restrictions to uncover new hosts

SSRF101

THINGS TO LOOK FOR AND WHAT YOU CAN DO

- User supplied URLs
 - REQUEST LOCAL/REMOTE FILES
 - INITIATE PROXIED CONNECTIONS
- PDF GENERATION
 - CREDIT CARD STATEMENTS, DOCUMENT EXPORT FUNCTIONS
- DOCUMENT PARSERS:
 - INJECT XML TAGS
- LINK EXPANSION
 - IMAGE/LINK PREVIEW IN CHATS
- File Uploads
 - AVATAR/PROFILE PHOTO FROM URL
 - ATTEMPT DIFFERENT URI RESOURCES

WHAT IT LOOKS LIKE IN CODE

//getimage.php

\$content = file_get_contents(\$_GET['url']);

file_put_contents('image.jpg', \$content);

GET /getimage.php?url=https://website.com/images/cat.jpg

GET /getimage.php?url=http://127.0.0.1/api/v1/getuser/id/1

GET /getimage.php?url=http://169.254.169.254/latest/meta-data/

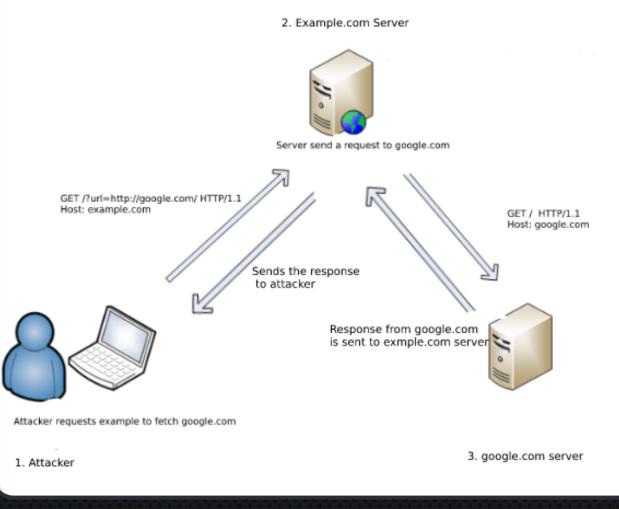
GET /getimage.php?url=file:///etc/passwd

OTHER LESS OBVIOUS THINGS TO LOOK FOR

- URL'S EMBEDDED IN FILE UPLOAD FUNCTIONALITY
 - SVG, JPG, XML, JSON
- HIDDEN API ENDPOINTS ACCEPTING
 URL INPUTS
- HTML TAG INJECTION (COMMONLY SEEN IN XSS ATTACKS)

TYPICAL SCENARIO

- NOT JUST HTTP!
- VALID PROTOCOL HANDLERS:
 - FILE:// -- FETCH LOCAL FILES
 - GOPHER:// -- FETCH REMOTE FILES
 - DICT:// -- LOOKUP ENTRIES ACROSS NETWORK
 - TFTP:// -- INSECURE FILE TRANSFER
 - SFTP:// -- SECURE FILE TRANSFER
 - LDAP:// -- INTERACT WITH DIRECTORY SERVICES



Source: https://medium.com/@madrobot/ssrf-server-side-request-forgery-types-and-waysto-exploit-it-part-1-29d034c27978

TYPES OF SSRF

Basic

- •Target application provides a response back to attacker
- •Often in the form of HTTP response codes, application errors, other salient behavior
- High degree of confidence vulnerability is present, exploitability likely possible

Blind

- •Target application does not provide response back to attacker
- Vulnerability presence is unknown/uncertain, exploitability more difficult
- •Often requires more analysis & testing to confirm/deny

Mixed

- •Largely application specific
- Time Based inverse mapping through time/responses variations
- Error Based "access denied" combined with inverse mapping

PORT SCANNING THE INTERNAL NETWORK

- INVERSE MAPPING/TIME BASED/ERROR BASED
 - PORT SCANNING INTRANET RESOURCES
 - INVERSE MAPPING (TIME & ERROR BASED), DISCOVER NEW HOSTS
 - BYPASS TYPICAL FIREWALL RESTRICTIONS/BOUNDARIES
 - UNCOVER HOSTS UNREACHABLE FROM THE WEB (IE, NON-ROUTEABLE DMZ HOSTS A LA RFC1918)

EXISTING LABS

- EXTREME VULNERABLE WEB APPLICATION (XVWA)
 - PHP/MySQL
 - <u>HTTPS://GITHUB.COM/S4N7H0/XVWA</u>
- OWASP NODEGOAT TOP 10
 - NODE JS/MONGODB, HEROKU APP AVAILABLE
 - <u>HTTPS://GITHUB.COM/OWASP/NODEGOAT</u>
- PORTSWIGGER
 - WEB SECURITY ACADEMY (AWESOME!)
 - <u>HTTPS://PORTSWIGGER.NET/WEB-SECURITY/SSRF</u>

• C1

- <u>HTTPS://APPLICATION.SECURITY/</u>
 - INTERACTIVE, RECONSTRUCT DATA BREACH

DEMO

- XVWA
- NODEGOAT
- PORTSWIGGER WEB SECURITY
- C1

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DETECTING SSRF

North/South and East/West

- WAF for North/South
- East/West firewalling is critical for this sort of attack detection
- Position to inspect traffic between web server and back end infrastructure/data sources

Logging!!!

- Centralized logging from WAF, additional firewalls, web server, other infrastructure systems
- Due to the nature of the exploit, there will be many failed requests, watch for scanning type activity
- Ensure that logging levels are correct to capture all the potential events. Debugging not necessary, but INFO level should be collected and reviewed.

Input Filtering

- Sanitize and filter user input, limiting to known good data inputs
- Potential for regex-style data matching for validation

Domain Whitelisting

- Restrict access to internal resources using a specific whitelist of organizational domains
- Log ALL requests, highlight improper requests and alert

DEFENDING/ PREVENTING SSRF

Additional Strategies

- User and group access review and validation, especially important in cloud environments (Capital One)
- Proper error and response handling!!!
 (Again, Capital One)

OTHER REAL WORLD EXAMPLES

• Twitter - Link Expansion



tip - Open Graph Protocol is a good case for Blind SSRF / Extract of Meta Data. My POC: SSRF in Twitter via a Tweet :) - \$5,040



7:09 PM · May 26, 2017 · Twitter Web Client

https://twitter.com/BugBountyHQ/status/868242771617792000

REAL WORLD EXAMPLES PT. 2

ACCESSING NIPRNET THROUGH JIRA

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OK

https://medium.com/bugbountywriteup/piercing-the-veil-serverside-request-forgery-to-niprnet-access-c358fd5e249a

SOURCES

- <u>HTTPS://PORTSWIGGER.NET/WEB-SECURITY/SSRF</u>
- <u>HTTPS://MEDIUM.COM/SWLH/SSRF-IN-THE-WILD-E2C598900434</u>
- <u>HTTPS://TACTIFAIL.WORDPRESS.COM/2019/07/26/THREE-VULNS-FOR-THE-PRICE-OF-ONE/</u>
- <u>HTTPS://MEDIUM.COM/@LOGICBOMB_1/THE-JOURNEY-OF-WEB-CACHE-FIREWALL-BYPASS-TO-SSRF-TO-AWS-CREDENTIALS-COMPROMISE-B250FB40AF82</u>
- <u>HTTPS://HACKERONE.COM/REPORTS/713</u>
- <u>HTTPS://WWW.HACKERONE.COM/BLOG-HOW-TO-SERVER-SIDE-REQUEST-FORGERY-SSRF</u>
- <u>HTTPS://DOCS.GOOGLE.COM/DOCUMENT/D/1v1TkWZTRHzRLyOBYXBcDLUEDXGB9NJTNIJXa3u9akHM/edit</u>
- HTTPS://WWW.ACUNETIX.COM/BLOG/ARTICLES/SERVER-SIDE-REQUEST-FORGERY-VULNERABILITY/
- <u>HTTPS://DZONE.COM/ARTICLES/THE-SERVER-SIDE-REQUEST-FORGERY-VULNERABILITY-AND</u>