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Securing the Cloudscape

Resilient Multi-Cloud Detection Engineering
SEC1225B

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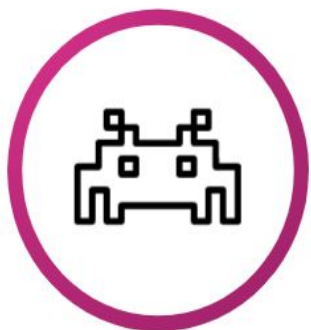


Bhavin Patel

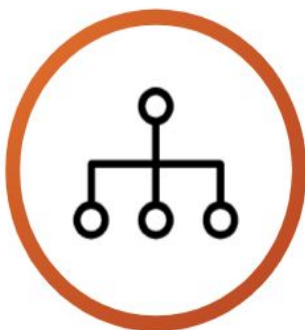
Senior Threat Researcher | Splunk

Splunk Threat Research Team (STRT)

**Study
Threats**



**Create
Datasets**



**Build
Detections**



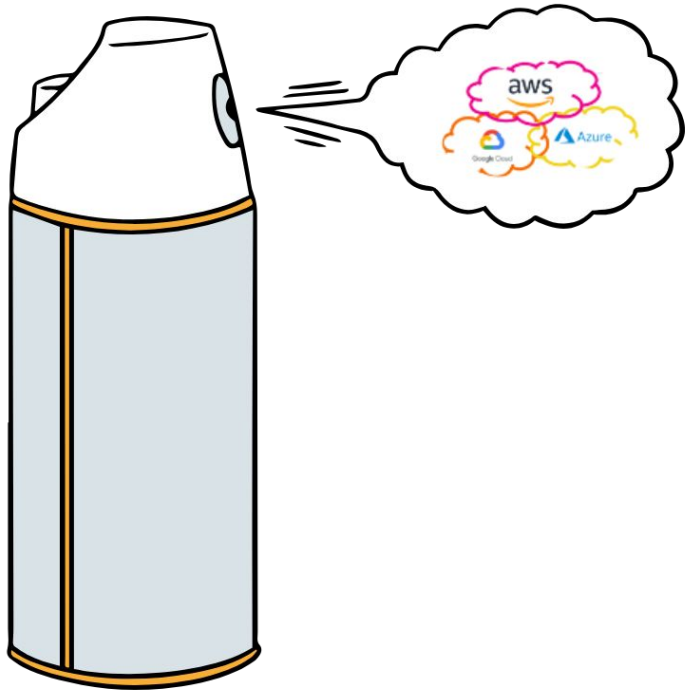
**Release
Tools**



**Share with
Community**



<https://research.splunk.com>



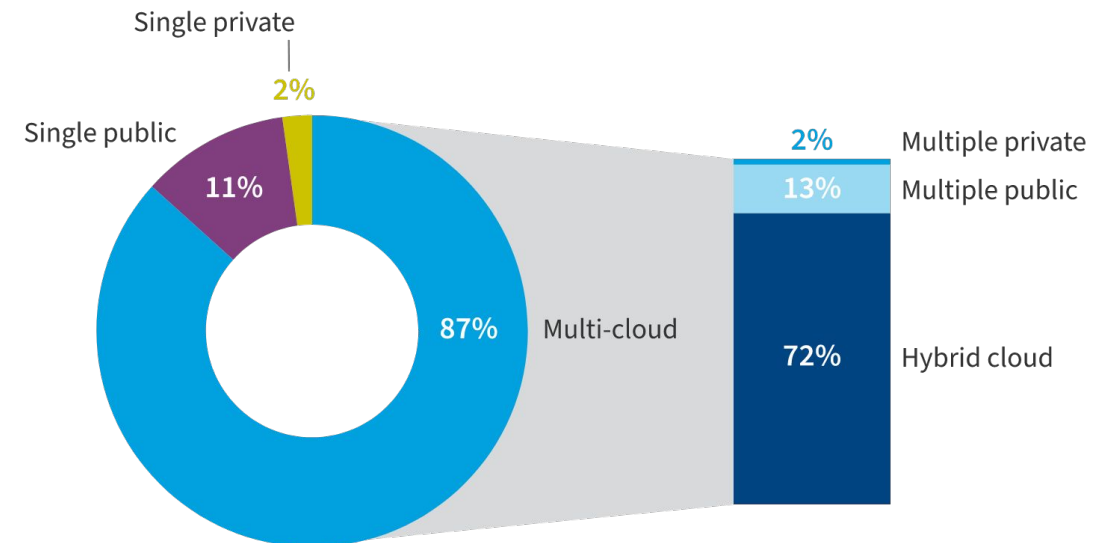
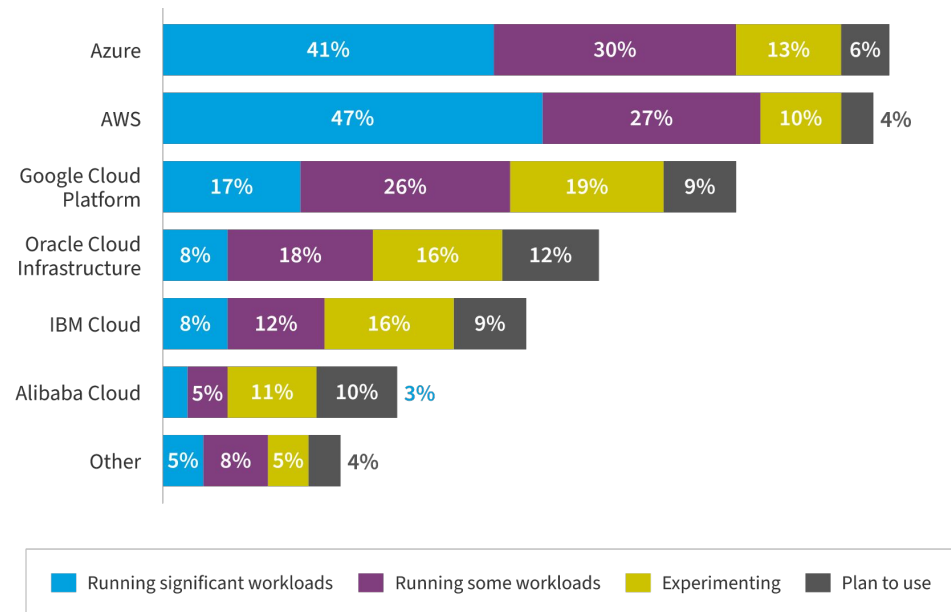
Agenda

- Introduction
- Cloud Telemetry
- Multi-Cloud Detection Engineering
- Demo
- Takeaways

Introduction



Cloudy with a Chance of Multi-Cloud



Source: Flexera 2023 State of the Cloud Report; N=750.

Why Organizations Use Multiple Clouds

Different stacks for different tasks

GCP for internal services

Google Workspace
Workday
Salesforce



AWS for development

Microservices
Containers
EC2, Storage

Azure for lift and shift

Reduce costs
Disaster recovery

Turbulence in the Clouds

SECURITY

JANUARY 17, 2023

Check Point Research
flags a 48% growth in
cloud-based networks
attacks in 2022,
compared to 2021



By Check Point Research Team

MeriTalk

CrowdStrike Reports Spike in Cloud Environment Attacks

Cybersecurity services provider CrowdStrike said today in its new 2023 Global Threat Report that the firm saw a sharp rise in cyberattacks...

Feb 28, 2023

CYBERSECURITY | SECURITY NEWSWIRE | LOGICAL SECURITY | CYBERSECURITY NEWS

Report shows nearly 600% annual growth in vulnerable cloud attack surface

By Security Staff

Dark Reading

Cloud Data Breaches Are Running Rampant. What Are the Common Characteristics?

Protecting against data breaches requires detailed analysis of recent attacks for remediation and prevention.

Oct 12, 2022



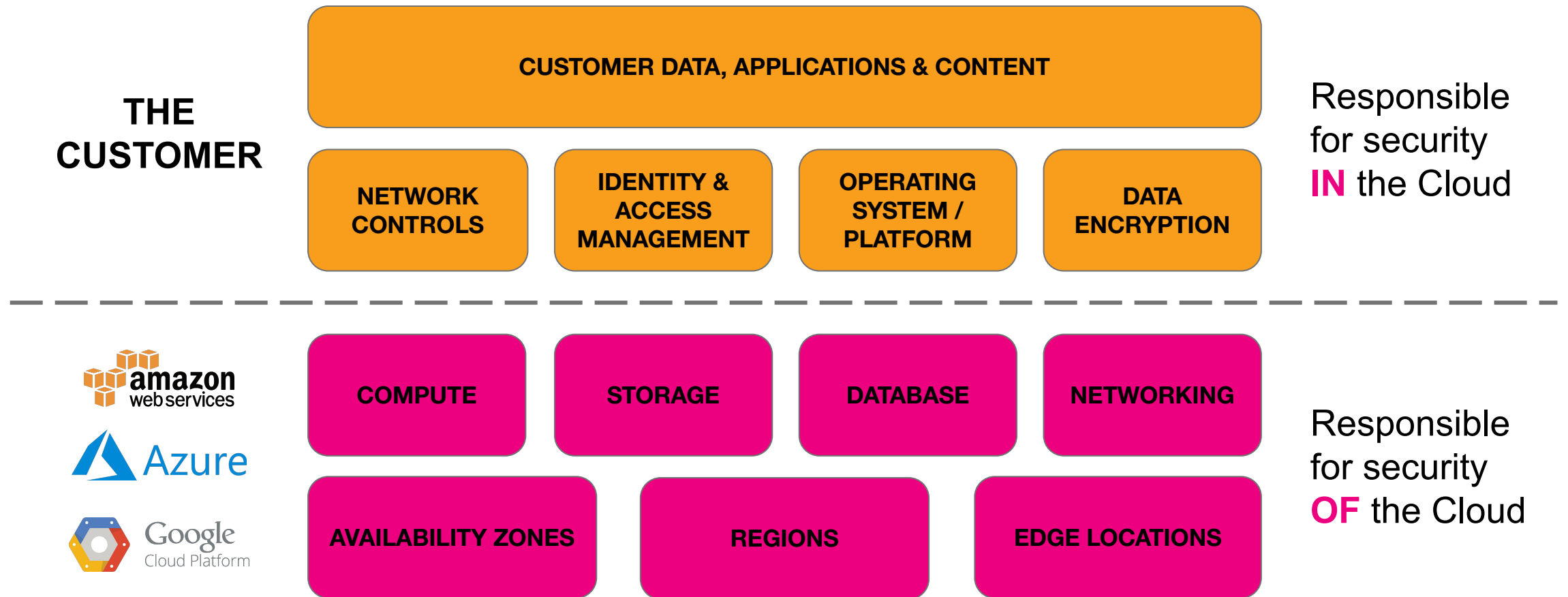
MITRE Cloud Matrix

Cloud-based techniques for Azure AD, Office 365, Google Workspace, SaaS, IaaS (v13)

Initial Access 5 techniques	Execution 4 techniques	Persistence 7 techniques	Privilege Escalation 3 techniques	Defense Evasion 9 techniques	Credential Access 9 techniques	Discovery 13 techniques	Lateral Movement 3 techniques	Collection 5 techniques	Exfiltration 2 techniques	Impact 8 techniques
Drive-by Compromise	Cloud Administration Command	Account Manipulation (5)	Domain Policy Modification (1)	Domain Policy Modification (1)	Brute Force (4)	Account Discovery (2)	Internal Spearphishing	Automated Collection	Exfiltration Over Alternative Protocol	Account Access Removal
Exploit Public-Facing Application	Command and Scripting Interpreter (1)	Create Account (1)	Event Triggered Execution	Hide Artifacts (1)	Forge Web Credentials (2)	Cloud Infrastructure Discovery	Taint Shared Content	Data from Cloud Storage		Data Destruction
Phishing (1)	Serverless Execution	Event Triggered Execution	Valid Accounts (2)	Impair Defenses (3)	Modify Authentication Process (2)	Cloud Service Dashboard	Use Alternate Authentication Material (2)	Data from Information Repositories (3)	Transfer Data to Cloud Account	Data Encrypted for Impact
Trusted Relationship	User Execution (1)	Implant Internal Image		Modify Authentication Process (2)	Multi-Factor Authentication Request Generation	Cloud Service Discovery		Data Staged (1)		Defacement (1)
Valid Accounts (2)		Modify Authentication Process (2)		Modify Cloud Compute Infrastructure (4)	Network Sniffing	Cloud Storage Object Discovery		Email Collection (2)		Endpoint Denial of Service (3)
		Office Application Startup (6)		Unused/Unsupported Cloud Regions	Steal Application Access Token	Network Service Discovery				Inhibit System Recovery
		Valid Accounts (2)		Use Alternate Authentication Material (2)	Steal or Forge Authentication Certificates	Network Sniffing				Network Denial of Service (2)
				Valid Accounts (2)	Steal Web Session Cookie	Password Policy Discovery				Resource Hijacking
					Unsecured Credentials (3)	Permission Groups Discovery (1)				

Source: <https://attack.mitre.org/matrices/enterprise/cloud/>

Bottom Line – Security is a Shared Responsibility in the Cloud



Challenges of Monitoring Multi-Cloud

- Holistic visibility
- Complexity and differences across platforms
- Query languages and log schemas (SQL,KQL,etc)
- (Near) real time alerting
- Threat intelligence integration
- Multiple vendors and tools to manage

Source: <https://www.shutterstock.com/search/cyber-security-cartoon>

Console?



CloudTrail > Event history

Event history (50+) [Info](#)

Event history shows you the last 90 days of management events.

Lookup attributes

Read-only ▼ 🔍 false ✕

<input type="checkbox"/>	Event name	Event time	User name	Event source	
<input type="checkbox"/>	UpdateInstanceInfor...	May 23, 2023, 10:01:59 (UTC-07...	i-0e47d66b269d4...	ssm.amazonaws.com	-
<input type="checkbox"/>	CreateLogStream	May 23, 2023, 10:00:28 (UTC-07...	SecurityHubToSpl...	logs.amazonaws.com	-
<input type="checkbox"/>	UpdateInstanceInfor...	May 23, 2023, 09:56:59 (UTC-07...	i-0e47d66b269d4...	ssm.amazonaws.com	-
<input type="checkbox"/>	CreateLogStream	May 23, 2023, 09:52:25 (UTC-07...	splunk-firehose-flo...	logs.amazonaws.com	-
<input type="checkbox"/>	CreateLogStream	May 23, 2023, 09:52:18 (UTC-07...	splunk-firehose-flo...	logs.amazonaws.com	-
<input type="checkbox"/>	UpdateInstanceInfor...	May 23, 2023, 09:51:59 (UTC-07...	i-0e47d66b269d4...	ssm.amazonaws.com	-
<input type="checkbox"/>	CreateLogStream	May 23, 2023, 09:48:09 (UTC-07...	security-content-a...	logs.amazonaws.com	-

Console? Another Console?

The image shows a screenshot of the Google Cloud Logs Explorer console interface. The interface is divided into several sections:

- Header:** Includes the Google Cloud logo, a search bar with the text "logs", and a "Search" button.
- Left Sidebar:** Contains navigation links for "Operations", "Logging", "Logs Explorer", "Logs Dashboard", "Log-based Metrics", "Log Router", "Logs Storage", "Log Analytics", and "Integrations".
- Main Content Area:**
 - Logs Explorer:** Features tabs for "Query", "Recent (10)", "Saved (0)", "Suggested (0)", and "Library". A "Last 7 days" filter is selected.
 - Log fields:** A section for filtering logs, with a search bar and a list of fields including "RESOURCE TYPE", "SEVERITY", and "Info".
 - Histogram:** A chart showing log activity over time, with a peak around May 16, 8:00AM.
 - Query results:** A table displaying 36 log entries. The table has columns for SEVERITY, TIMESTAMP, PDT, SUMMARY, and EDIT. The entries show various IAM and Pub/Sub operations performed by the "iam.googleapis.com" service account.

Console? Another Console? One More?

The image displays three overlapping console interfaces. At the top left is the Amazon CloudTrail logo. In the center is the Google Workspace logo. Below these are three overlapping screenshots of web consoles. The leftmost console is the AWS CloudTrail console, showing the 'Event history' section with a list of events. The middle console is the Google Cloud Admin console, showing the 'Reporting' section with a list of reports. The rightmost console is the Google Workspace Admin console, showing the 'Draft investigation' page with a search bar and a table of results. The search results table has columns for Date, Event, Description, Actor, and IP address. A notification banner at the bottom of the search results states: 'By default, only a subset of the available columns are displayed when generating a search for Admin log events. To display or hide columns, click the Manage columns icon in the top-right corner of the search-results table. Learn more'. The notification banner has a 'DISMISS' button on the right.

A Portal to What?

The image displays a collage of cloud service logos and screenshots, illustrating the integration of various cloud services into a single portal. The logos shown are Amazon CloudTrail, Google Workspace, and a red-bordered icon of a blue pyramid. Below the logos are three screenshots of cloud management interfaces:

- CloudTrail Console:** Shows the 'Event history' section with a list of events and a 'Lookup at' section with a 'Read-only' button.
- Google Cloud Admin Console:** Shows the 'Admin' section with a sidebar menu including 'Operations', 'Logging', 'Logs Explorer', 'Logs Dashboard', 'Log-based Metrics', 'Log Router', 'Logs Storage', 'Log Analytics', and 'Integrations'.
- Microsoft Azure Default Directory Sign-in logs:** Shows the 'Sign-in logs' page with a table of sign-in events. The table includes columns for Date, Request ID, User, Application, Status, and IP address.

Date	Request ID	User	Application	Status	IP address
5/23/2023, 11:00:24 AM	a4934792-a144-4021-8896-...	Bhavin Patel	Azure Portal	Success	23.93.193.6
5/23/2023, 11:00:17 AM	26594cd1-2782-4104-8f1f-8...	Bhavin Patel	Azure Portal	Interrupted	23.93.193.6
5/23/2023, 10:59:30 AM	ee837957-36f3-491d-b828-...	Bhavin Patel	Azure Portal	Interrupted	23.93.193.6
5/23/2023, 10:59:13 AM	9a84c25d-dcc6-4914-9791-...	Bhavin Patel	Azure Portal	Interrupted	23.93.193.6
5/23/2023, 10:55:45 AM	637e91b0-fb1f-4b8b-8c10-2...	Splunk Threat Research	Azure Portal	Success	72.43.121.35

uhhh, well....?

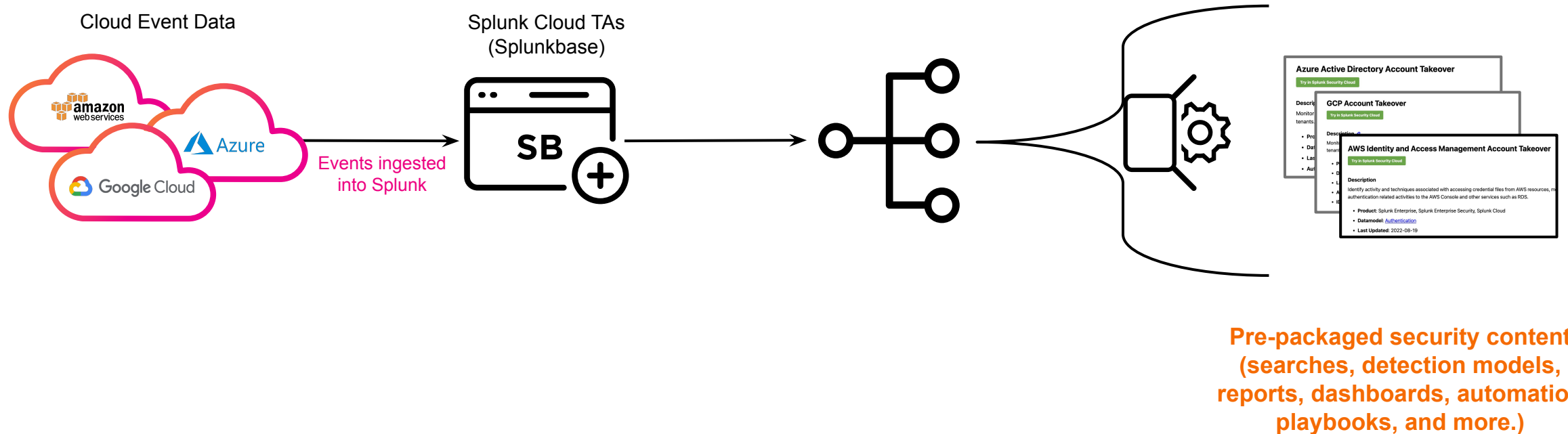


Don't Fear, Splunk is Here!

Collect Cloud Events

Analyze Telemetry

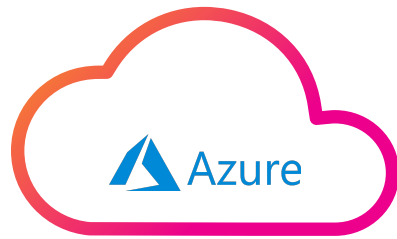
Write Detections!



Cloud Telemetry



Technologies and Features



Available Log Sources



AWS

- AWS Cloudtrail
- AWS IAM Access Analyzer
- Amazon CloudWatch Logs
- Amazon Security Lake
- Amazon Security Hub
- Amazon Guardduty



Azure

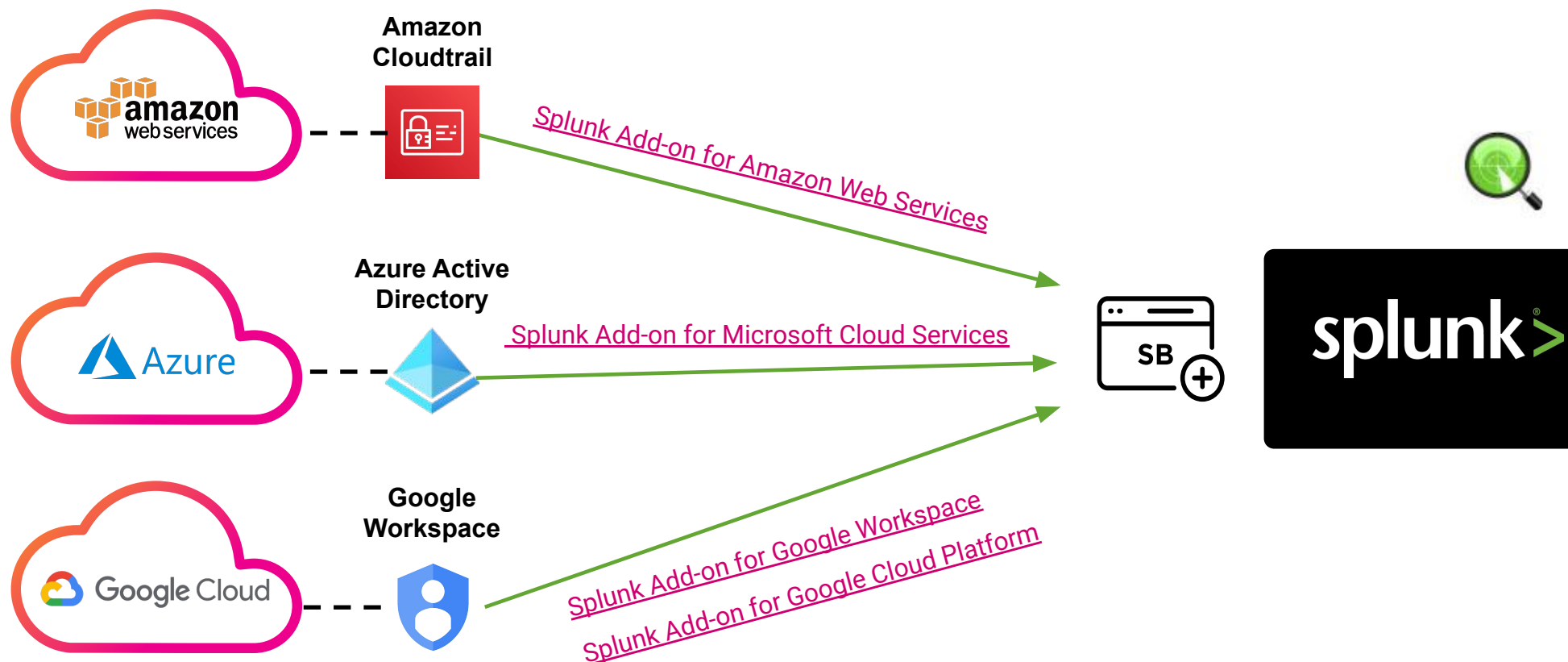
- Sign-ins
- Audit
- Provisioning
- Resource Logs
- Activity Logs



GCP/GWS

- Admin Log Events
- User Log Events
- Audit Logs Events
- Admin Activity audit logs
- Data Access audit logs
- System Event audit logs
- Policy Denied audit logs


Splunk Technology Add-Ons





Data Manager for Splunk Cloud

Choose Cloud Data Platform

Which of the following sources are you onboarding?


**Amazon Web Services**
Get your Amazon Web Services data into your Splunk Cloud deployment.


**Google Cloud Platform**
Get your Google Cloud Platform data into your Splunk Cloud deployment.


**Microsoft Azure**
Get your Microsoft Azure data into your Splunk Cloud deployment.


AWS Data Onboarding


☒ AWS Security and AWS Metadata
☐ Amazon CloudWatch Logs
☐ Select all Data Sources below


☐ **AWS CloudTrail**
AWS CloudTrail is a service that enables governance, compliance, operational auditing, and risk auditing of your AWS account.
[View sample event](#)

☐ **AWS Security Hub**
AWS Security Hub gives you a comprehensive view of your security alerts and security posture across your AWS accounts.
[View sample event](#)

☐ **Amazon GuardDuty**
Amazon GuardDuty is a threat detection service that monitors for malicious activity and behavior to protect AWS accounts, workloads, and data in S3.
[View sample event](#)

☐ **IAM Access Analyzer**
IAM Access Analyzer helps you identify the resources in your organization and accounts, such as Amazon S3 buckets or IAM roles, that are shared with an external entity.
[View sample event](#)

☐ **IAM Credential Report**
IAM Credential Report lists all users in your account and the status of their various credentials, including passwords, access keys, and MFA devices.
[View sample event](#)

☐ **Metadata**
Metadata is data about your Amazon EC2 instances, IAM users, Network ACLs and Amazon EC2 security groups.
[View sample event](#)

[Cancel](#) [Back](#) [Next](#)

splunk>enterprise

App: Data Manager

Administrator

2 Messages

Settings

Activity

Help

Find

Data Management

Previous page name = Data Management

All Status

All Type

Choose Filter

Choose Value

New Data Input

General Status	Data Input Name	Destination	Data Volume (GB)	Actions
Success	Azure AAD Log	AAD Index	80.116	Refresh Open in Search Edit Delete
Success	GCP - Audit Logs	Audit Logs index	9.772	Refresh Open in Search Edit Delete
Success	Cloudwatch log	Cloudwatch index	4.889	Refresh Open in Search Edit Delete
Success	Azure Activity Log	Audit, internal	30.123	Refresh Open in Search Edit Delete
Success	Non S3	aws_security	1.234	Refresh Open in Search Edit Delete



Source: bit.ly/3p9kT1d

Multi-Cloud Detection Engineering



Multi-Cloud Detection Engineering Workflow



Analyze Threats



Define a Detection Opportunity



Create a Detection Template

`//pseudo spl`



Create Analytics

Cloud Identity Attack



A **cloud identity attack** involves unauthorized actions or attempts to compromise the identities, credentials, or privileges associated with users, administrators, or service accounts within a cloud environment.

Identity Providers

"An identity provider is a system entity that creates, maintains, and manages identity information for principals"

What are the different Identity Providers?

- **AWS Identity and Access Management (IAM)**
- **Azure[®] Active Directory**
- **Google Workspace[™]**
- **Cloud Identity[™]**



Password Spraying



Technique by which adversaries leverage a single password against a large group of user accounts with the goal of acquiring valid account credentials.

Source: bit.ly/466yWoS



Detection Template

Password Spraying

Password Spraying

Identify one IP Address failing to authenticate with more than 30 users in a 10 minute time span

< Data Source >

< Failed Authentication Events >

```
| bucket span=10m _time
| stats dc(< user >) AS unique_accounts values(< user >)
as tried_accounts by _time, src_ip

| where unique_accounts > 30
```



AWS Cloudtrail

sourcetype= aws:cloudtrail

```
{ [-]
  additionalEventData: { [-]
    MFAUsed: No
    MobileVersion: No
  }
  awsRegion: us-west-2
  eventCategory: Management
  eventID: 654802e0-a93d-4479-bfa8-52c15656e9b9
  eventName: ConsoleLogin
  eventSource: signin.amazonaws.com
  eventTime: 2023-05-23T17:05:06Z
  eventType: AwsConsoleSignIn
  eventVersion: 1.08
  managementEvent: true
  readOnly: false
  recipientAccountId: 591511147606
  requestParameters: null
  responseElements: { [-]
    ConsoleLogin: Success
  }
  sourceIPAddress: 23.93.193.6
  tlsDetails: { [-]
    cipherSuite: TLS_AES_128_GCM_SHA256
```

```
1 | `cloudtrail` eventName=ConsoleLogin action=failure
2 | | bucket span=10m _time
3 | | stats dc(user_name) AS unique_accounts values(user_name) as tried_accounts by _time, src_ip, eventName, action, user_agent
4 | | where unique_accounts > 30
5 | |`aws_unusual_number_of_failed_authentications_from_ip_filter`
```

```
  type: AssumedRole
}
```



Azure Active Directory

sourcetype = mscs:azure:eventhub

```
{ [-]
  Level: 4
  callerIpAddress: 35.83.149.153
  category: SignInLogs
  correlationId: 1634ad3a-1f98-4964-add5-92fc5862194
  durationMs: 0
  identity: User30
  location: US
  operationName: Sign-in activity
  operationVersion: 1.0
  properties: { [+]
  }
  resourceId: /tenants/fc69e276-e9e8-4af9-9002-1e410d77244e
  resultDescription: Invalid username or password or
  resultSignature: None
  resultType: 50126
  tenantId: fc69e276-e9e8-4af9-9002-1e410d77244e
  time: 2023-01-23T21:29:14.1490728Z
}
```

```
properties: { [-]
  alternateSignInName: user30@splunkresearch.com
  appDisplayName: Azure Active Directory PowerShell
  appId: 1b730954-1685-4b74-9bfd-dac224a7b894
  appServicePrincipalId: null
  appliedConditionalAccessPolicies: [ [+]
  ]
  authenticationContextClassReferences: [ [+]
  ]
  authenticationDetails: [ [+]
  ]
  authenticationProcessingDetails: [ [+]
  ]
  authenticationProtocol: none
  authenticationRequirement: singleFactorAuthentication
  authenticationRequirementPolicies: [ [+]
  ]
  authenticationStrengths: [ [+]
  ]
  autonomousSystemNumber: 16509
  clientAppUsed: Mobile Apps and Desktop clients
  clientCredentialType: none
  conditionalAccessStatus: notApplied
  correlationId: 1634ad3a-1f98-4964-add5-92fc58621944
  createdDateTime: 2023-01-23T21:29:14.1490728+00:00
  crossTenantAccessType: none
  deviceDetail: { [+]
  }
  flaggedForReview: false
  homeTenantId: fc69e276-e9e8-4af9-9002-1e410d77244e
  id: 13148568-d61e-45eb-b38b-1fa63c106d00
  incomingTokenType: none
  ipAddress: 35.83.149.153
  isInteractive: true
  isTenantRestricted: false
  location: { [+]
  }
}
```

```
1 | `azuread` body.category= SignInLogs body.properties.status.errorCode=50126 body.properties.authenticationDetails{}.succeeded=
2 | rename body.properties.* as *
3 | bucket span=5m _time
4 | stats dc(userPrincipalName) AS unique_accounts values(userPrincipalName) as tried_accounts by _time, ipAddress
5 | where unique_accounts > 30
```



Google Login Reports

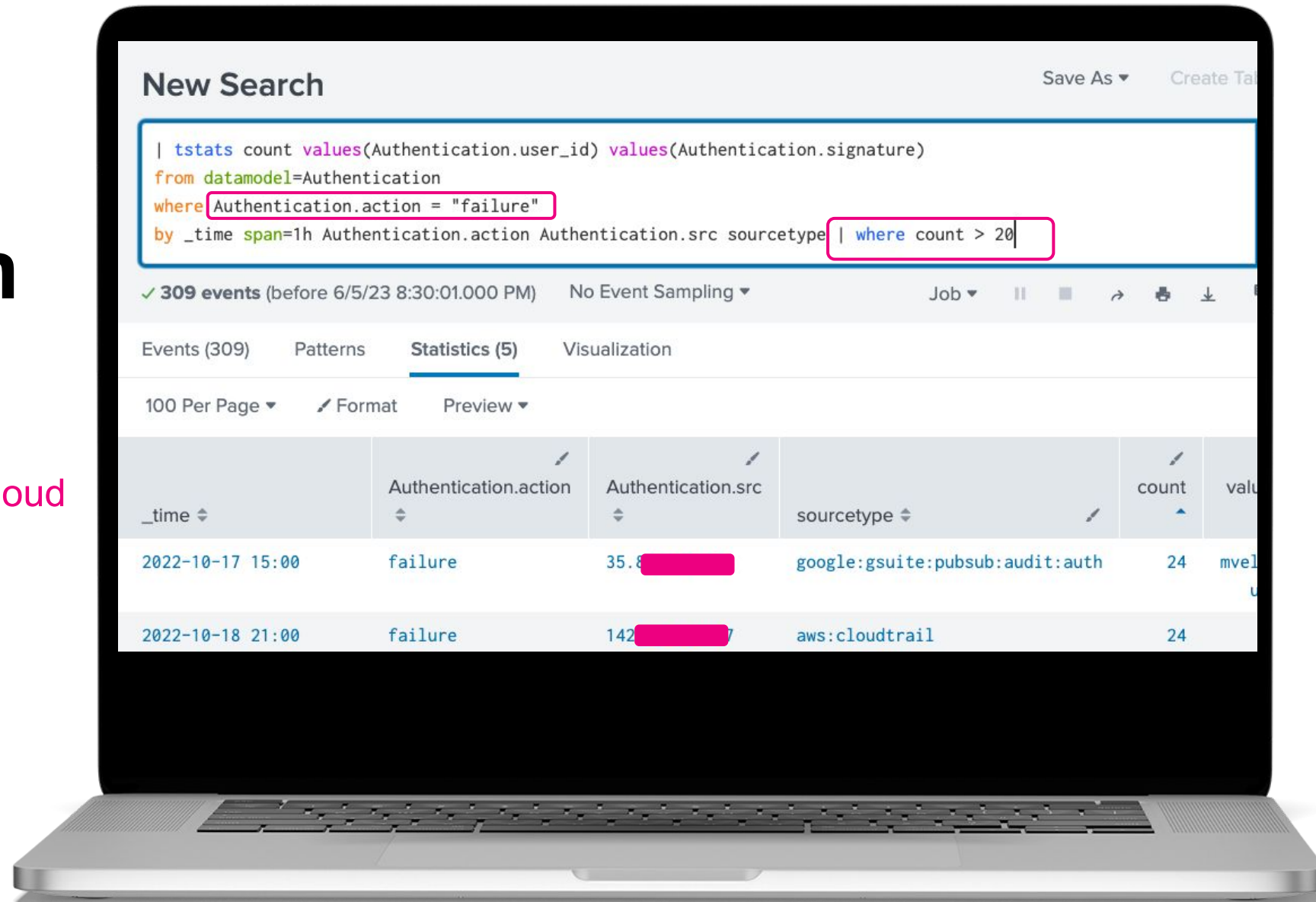
sourcetype = gws:reports:login

```
{ [-]
  actor: { [-]
    email: strt_admin@splunkresearch.com
    profileId: 100059258581444193973
  }
  etag: "0fyudVe0cfsbWn1nPJtswmy-HiIKZlUyqkedxOKwC5M/xBRGkG037upGV56NkumK36
  event: { [-]
    name: login_failure
    parameters: [ [-]
      { [-]
        name: login_type
        value: google_password
      }
      { [-]
        multiValue: [ [+]
        ]
        name: login_challenge_method
      }
    ]
  }
  type: login
}
id: { [-]
  applicationName: login
```

```
1 `gws_reports_login` event.type = login event.name = login_failure
2 | bucket span=5m _time
3 | stats count dc(user) AS unique_accounts values(user) as tried_accounts values(authentication_method)
4 | `security_content_ctime(firstTime)`
5 | `security_content_ctime(lastTime)`
6 | where unique_accounts > 20
```

Authentication Data Model

High number of login failures in Cloud



The screenshot shows the Splunk Search interface with a search query for authentication failures. The query is:

```
| tstats count values(Authentication.user_id) values(Authentication.signature)
from datamodel=Authentication
where Authentication.action = "failure"
by _time span=1h Authentication.action Authentication.src sourcetype | where count > 20
```

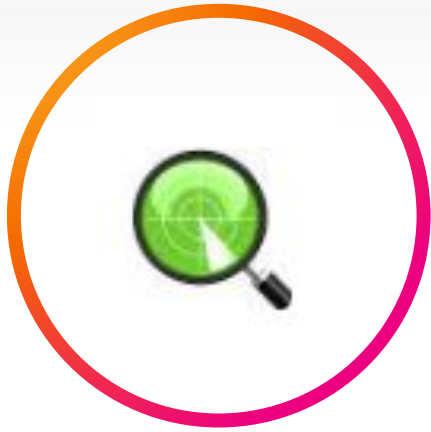
The search results show 309 events. The interface is displaying the Statistics tab with 5 statistics. The table shows the following data:

_time	Authentication.action	Authentication.src	sourcetype	count	values
2022-10-17 15:00	failure	35.8 [REDACTED]	google:gsuite:pubsub:audit:auth	24	mvel
2022-10-18 21:00	failure	142 [REDACTED] 7	aws:cloudtrail	24	

MFA Fatigue



An MFA Fatigue attack is when a threat actor attempts to log in with stolen credentials over and over, causing what feels like an endless stream of MFA push requests to be sent to the account's owner's mobile device.



Detection Opportunity

MFA Fatigue

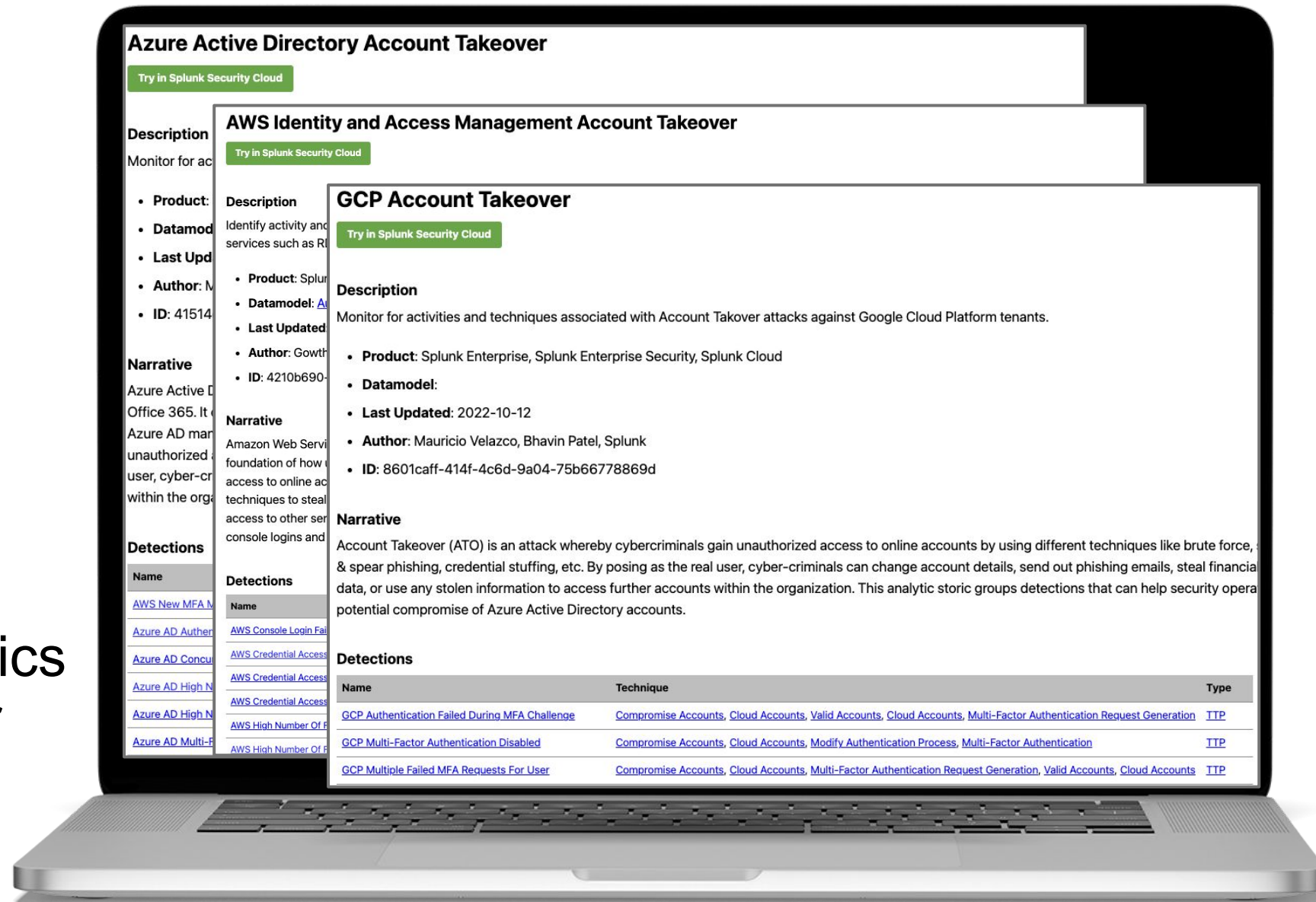
MFA Fatigue

“Identify one user failing on the second factor authentication more than 10 times in a 5 minute time span”

Account Takeover Analytic Stories

<https://research.splunk.com>

30+ detection analytics covering the 3 major cloud providers



Demos



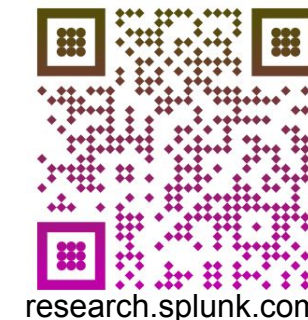
Demo



Takeaways



Takeaways



- The Splunk ecosystem enables security teams obtain a holistic cloud visibility
- Centralizing cloud telemetry provides many benefits for cloud detection engineering
- Prioritize comprehension of the threat and identifying detection opportunities
- The workflow can also be applied to threat hunting and incident response
- You don't have to start from scratch. STRT has your back!
- Related .conf 2023 sessions:
 - **SEC1228B - Gloves Off/Hands On: Threat Simulation and Detection Engineering With Splunk**
 - **PLA1962A - Accelerate the Value of Your Data Using Splunk® Cloud Platform's New Data Processing Features**

Thank You

