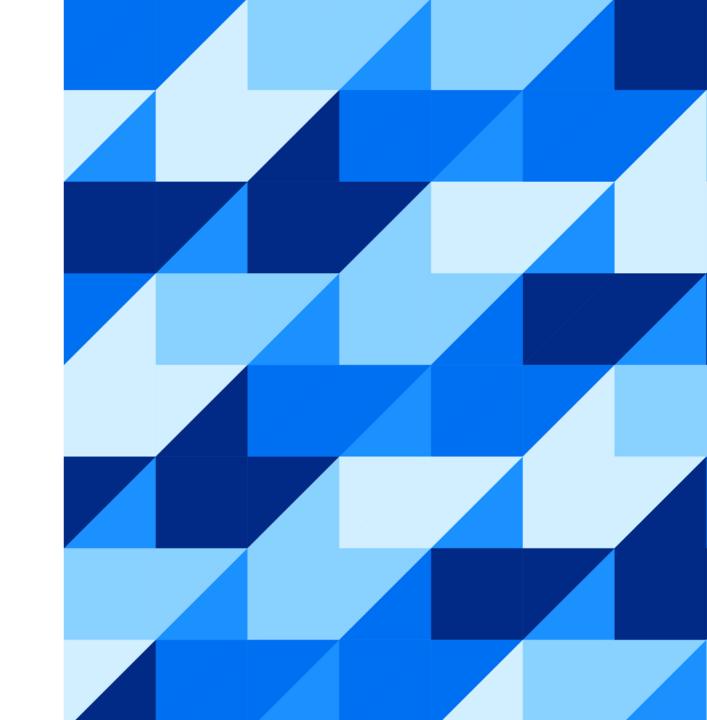


Security Audit Log Past, Present and Future

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What is the Security Audit Log (SAL)?

"The Security Audit Log is a tool designed for auditors who need to take a detailed look at what occurs in the SAP System. By activating the audit log, you keep a record of those activities you consider relevant for auditing. You can then access this information for evaluation in the form of an audit analysis report." – source: SAP Help Pages



- Introduced in SAP R/3 4.0B
- Originally designed for audit purposes
- Now a valuable tool for security analysis and forensics

Event and Log Categories for Audit Logs

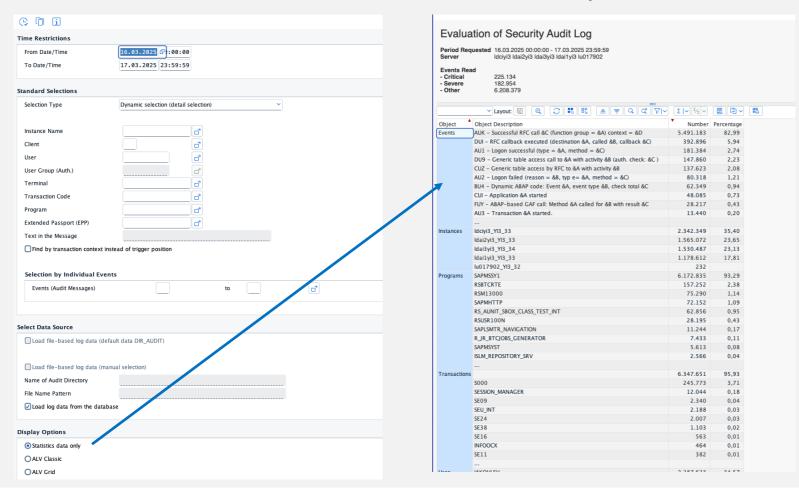
Log Categories	Security	DPP related	Configuration Changes	Application compliance				
Scope	Evidence of compliance & threat identification Auditors, Compliance and Security Experts							
Used By								
Tamper Proof	Yes							
UI performance	No							
Frequent Data Access	No							
Long Data retention	Yes	No	Yes	Yes				

Events for the Security Audit Log

damlan Caan	Dynamic List Display		
	rity Audit Log Event IDs (214 Entries) IDs Message text	Audit Class S	Severit
AU AU0	Audit - Test. Text: &A	Other Events I	Low
AU AU1	Logon successful (type = &A, method = &C)	Dialog Logon	Medium
AU AU2	Logon failed (reason = &B, typ e= &A, method = &C)	Dialog Logon F	High
AU AU3	Transaction &A started.	Transaction Start I	Low
AU AU4	Start of transaction &A failed (reason = &B)	Transaction Start F	High
AU AU5	RFC/CPIC logon successful (type = &A, method = &C, context = &D)	RFC/CPIC Logon I	Low
AU AU6	RFC/CPIC logon failed (reason = &B, type = &A, method = &C, context = &D)	RFC/CPIC Logon F	High
AU AU7	User &A created.	User Master Changes	High
AU AU8	User &A deleted.	User Master Changes	High
AU AU9	User &A locked.	User Master Changes	Medium
AUA AUA	User &A unlocked.	User Master Changes	Medium
AU AUB	Authorizations for user &A changed.	User Master Changes	Medium
AU AUC	User Logoff	Dialog Logon I	Low
AU AUD	User master record &A was changed.	User Master Changes	Medium
AU AUE	Audit configuration changed	System Events F	High
AU AUF	Audit: Slot &A: Class &B, severity &C, user &D, client &E, &F	System Events F	High
AU AUG	Application server started	System Events F	High
AU AUH	Application server stopped	System Events F	High
AU AUI	Audit: Slot &A: Inactive	System Events F	High
AU AUJ	Audit: Active status set to &1	System Events F	High
AU AUK	Successful RFC call &C (function group = &A) context = &D	RFC Function Call I	Low
AU AUL	Failed RFC call &C (function group = &A) context = &D	RFC Function Call	High
AUM AUM	User &B locked in client &A after errors in password checks	Dialog Logon F	High
AU AUN	User &B unlocked in client &A after entering wrong password	Dialog Logon F	High
AU AUO	Logon failed (reason = &B, type = &A)	Dialog Logon	Medium
AU AUP	Transaction &A locked	Transaction Start N	Medium
AU AUQ	Transaction &A unlocked	Transaction Start N	Medium
AU AUR	&A &B created	User Master Changes	Medium
AU AUS	&A &B deleted	User Master Changes	Medium
AU AUT	&A &B changed	User Master Changes	Medium

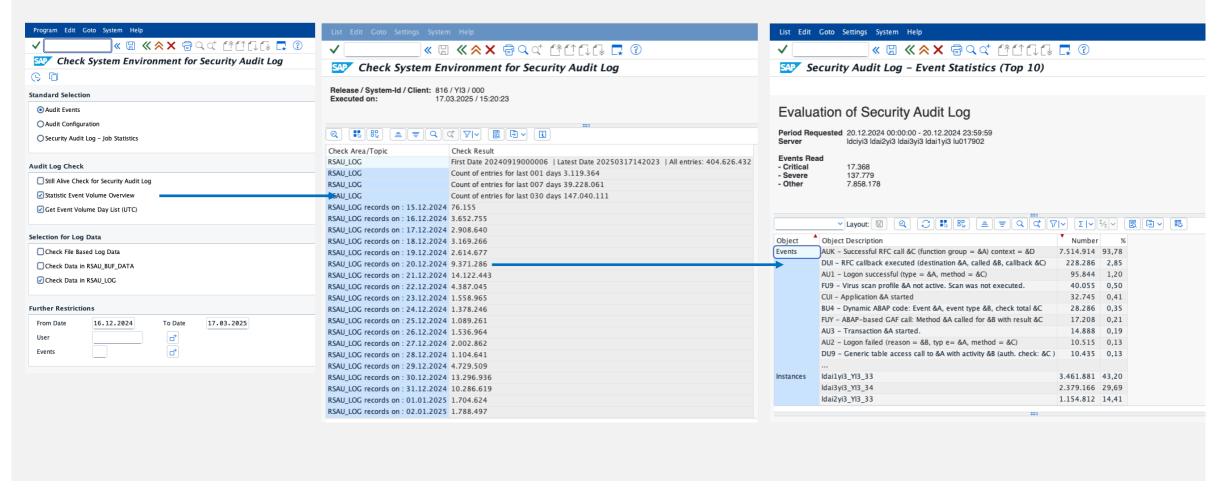
Optimization especially for database-based audit log

Event statistics as an overview introduction to the audit (in RSAU_READ_LOG/SM20)

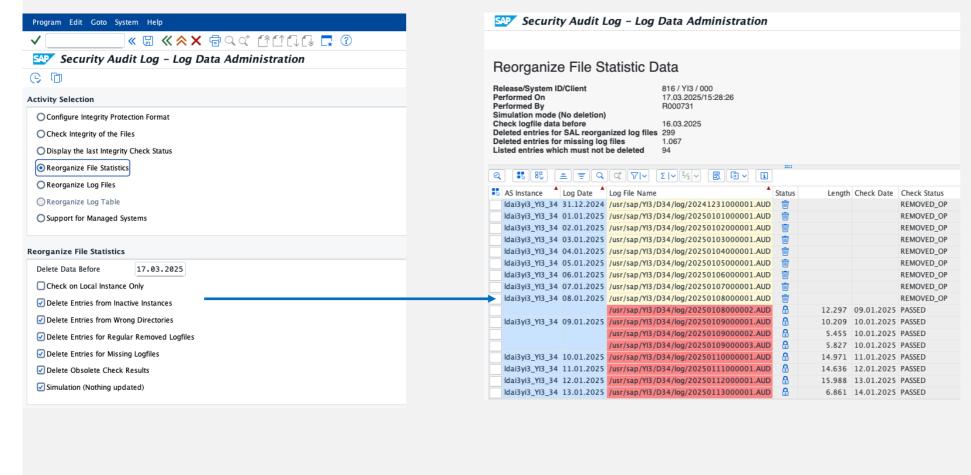


Optimization especially for database-based audit log

Volume Statistics in RSAU_SELF_CHECK_DIA or SM19 context menu



Integrity protection format and file management(RSAU_ADMIN)



	Generischer ändernder Datenzugriff auf &A mittels &B gestartet	Transaktionsstart	Kritisch	i	%
FUF					
UJ	Funktionsbaustein &A wurde in der Testumgebung gestartet (Destination &B)	Sonstiges	Kritisch	i	%
FUK	Methode &B der Klasse &A wurde in der Testumgebung gestartet	Sonstiges	Kritisch	i	%
UM	SQL-Statement &B an System &A (&C) gesendet	Sonstiges	Schwerwiegend	i	%
UN	Ergebnis zum Ereignis FUM für &A (&B) – SQL Code &C – &D	Sonstiges	Unkritisch	i	7:
:UO	Fehlercode zum Ereignis FUM für &A (&B) – SQL Code &C – &D	Sonstiges	Unkritisch	i	%
UP	Fehlercode zum Ereignis FUM für &A (&B) – SQL Code &C – &D	Sonstiges	Kritisch	i	%
EU1 EU2 EU3	Systemänderbarkeit geändert (&A to &B) Mandanteneinstellung fuer &A geändert (&B) &A Änderungsbelege wurden ohne Archivierung gelöscht (&B)	System System Sonstiges	Kritisch Kritisch Kritisch	i	7: 7:
EUE	Erfolgreicher Aufruf des RFC-Funktionsbausteines &A	RFC-Start	Unkritisch	i	7:
EUF	Aufruf des RFC-Funktionsbausteines &A fehlgeschlagen	RFC-Start	Unkritisch	i	%
EUG	Benutzer hat keine Berechtigung um RFC-Funktionsbaustein &A auszuführen	RFC-Start	Unkritisch	i	7:
EUQ	Analyseprogramm &A &B wurde im Simulationsmodus gestartet	Reportstart	Schwerwiegend	i	%
EUR	Analyseprogramm &A &B wurde als Echtlauf gestartet	Reportstart	Kritisch	i	7:
EUS	Lesezugriff auf DCT-Änderungsprotokoll (&A)	Sonstiges	Schwerwiegend	i	7:
EUT	DCT-Änderungsprotokoll (&A) wurde reorganisiert	Sonstiges	Schwerwiegend	i	7:
EUU	Verdächtige WHERE-Clause bei generischem Tabellenzugriff auf &A (Clause &B)	Sonstiges	Kritisch	i	1:



Logging & Security

Why is the **Security** Audit Log important?

- Logging can give detailed information about suspicious activities or configuration changes within the system.
- You can learn to improve your current security setup based on the events you discover in the logs.
- The security detection process becomes more agile. If logging is taken seriously you could provide quicker response time to security events and better security program effectiveness.



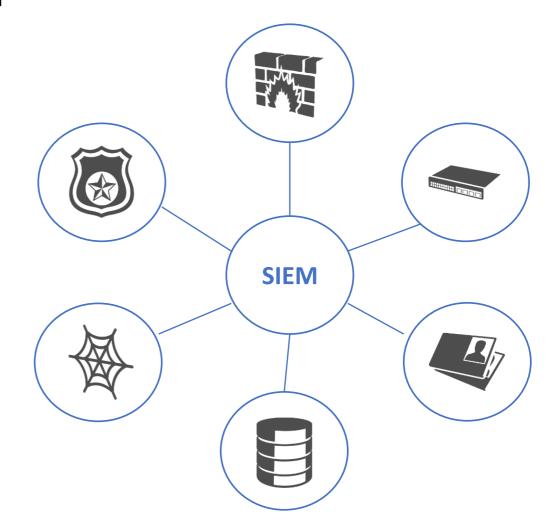


BUT, Security Logging is often not in focus until the first security incident happens!

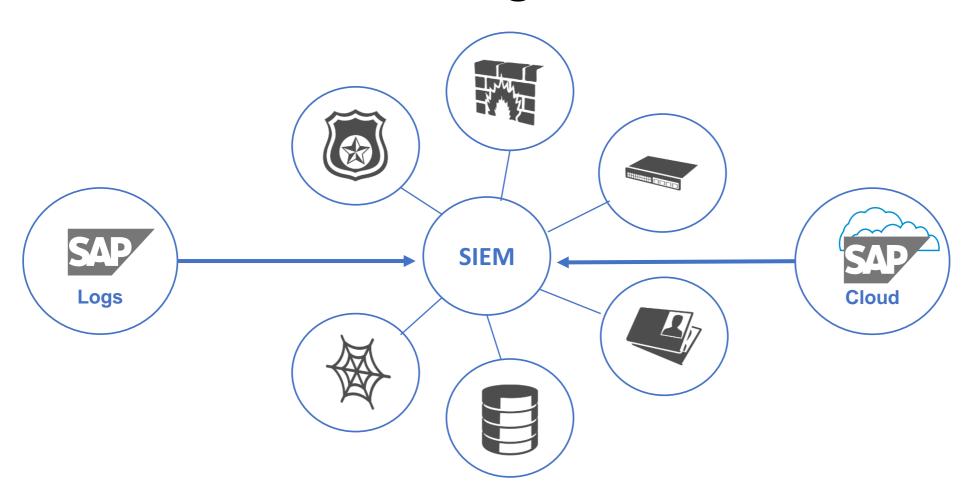
SAP Systems and SIEM

SIEM solutions cover many devices / information:

- Network data
- Identity Management
- Security devices
- Firewall
- Routers
- Databases

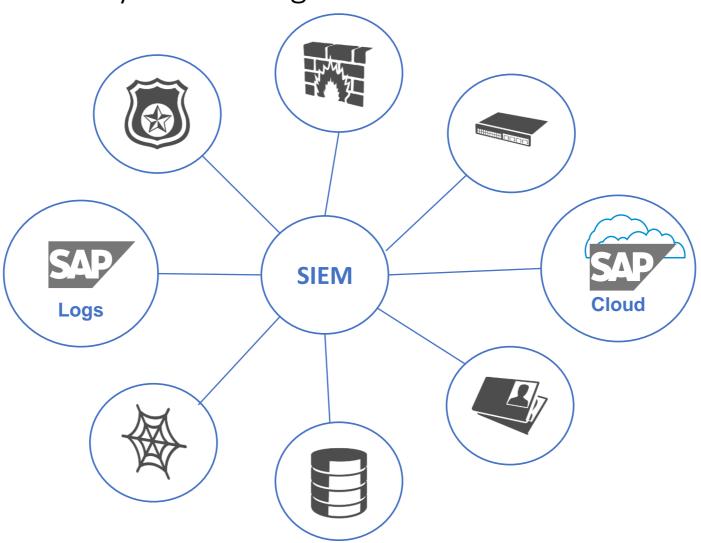


SIEM: What's missing



SIEM and SAP:

Comprehensive security monitoring

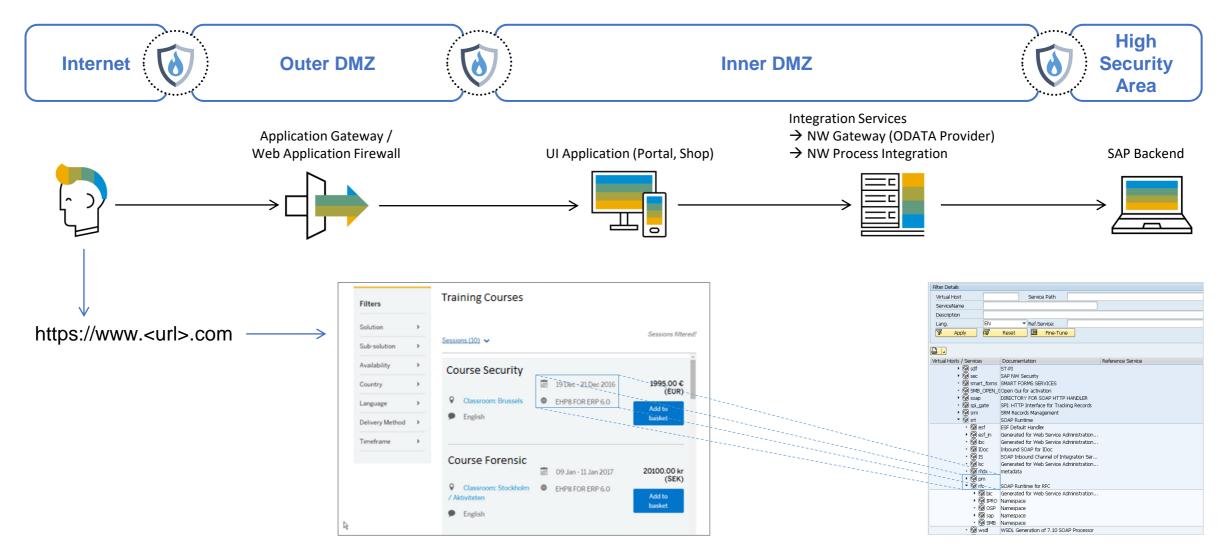




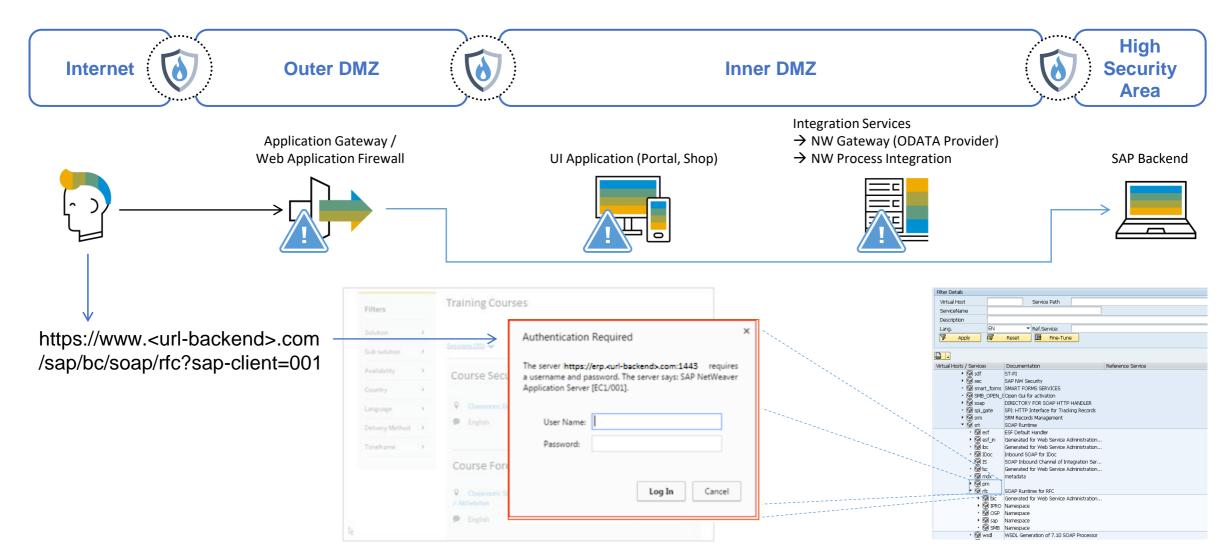
- Customer identified that hackers have compromised the customer internal network to a large extent
- Customer identified that an SAP system was used by attackers as one entry point
- SAP was contacted to support a forensic investigation
 - Gather details how SAP system has been compromised
 - Gather details about attack timeline
 - Derive Indicators of Compromise (IoC)
 - Analyze if other parts of the SAP customer landscapes have been compromised, too



Landscape Architecture



What went wrong?



What went wrong?

In most companies,

- frontend application designers / portal operations
- backend (SAP) operators
- and network security

are in entirely different teams.



Communication failures happen frequently such as:

- portal operations assumes that direct URLs will be rewritten / blocked by WAF (network security)
- network security does not know which access type to block (e.g. watch for "sap-client=000")
- SAP operations are not aware that their system is exposed at all.



If SAP operations then (assuming they are not exposed) think it is not really dangerous to have

- critical ICF services active
- SAP standard users still up and running, even with default passwords,



Results of the forensic investigation that can be shared

Details on the attacked SAP system

- Attacks on Internet-facing SAP NetWeaver system were running at least for 1 year
- Information / fixes for exploited SAP vulnerabilities were published years ago. Details how to exploit vulnerabilities are available publicly for several years.
- Tools for remote code execution were installed and hidden as SAP components.
- Attackers had full access to the vulnerable SAP NetWeaver system
- Attackers had substantial knowledge on SAP NetWeaver technology

Lateral Movement to other SAP systems

 It was not possible to proof that other SAP systems of the customer landscapes were attacked due to

weak SAP security configuration of the whole SAP landscape

inactive SAP logs

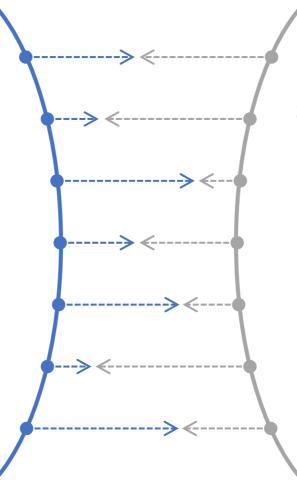


Business impact vs forensic analysis



Business Impact of the attacked SAP system

- SAP system was removed from the Internet immediately after attacks were identified
- Backups were not available to restore
 SAP system before first successful attacks
- SAP system was not available for several weeks



Re-attach SAP system to Internet



- SAP recommended to re-build system from scratch as hints were found that attackers were able to modify additional parts of the system
- Customer business decision:
 - SAP system was re-attached to the Internet with manual removal of infected parts
 - Unknown if attacker manipulated other parts of the SAP system

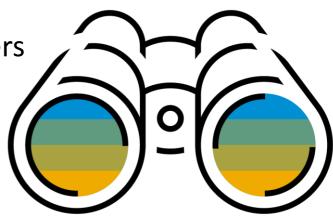
Security Audit Log

What to look for?

- Successful and failed logons from SAP Standard users
- Successful and failed logons from "interesting" dialog users
- Generic table access
- Downloaded files
- RFC Callback Traffic
- Changes to the SAL configuration itself

If an attack happened and the timeline is identified

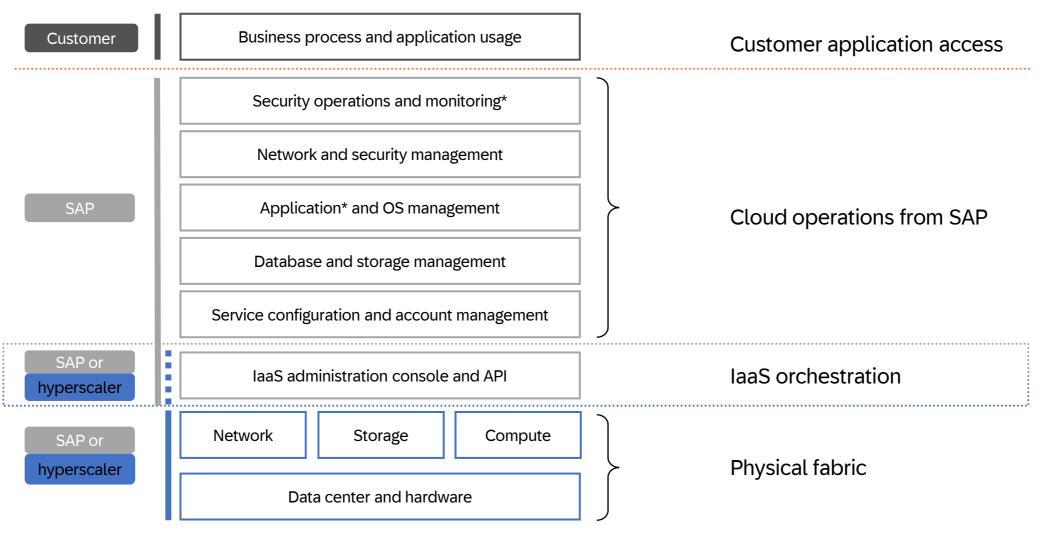
Analyze what kind of events can be found during the attack timeline



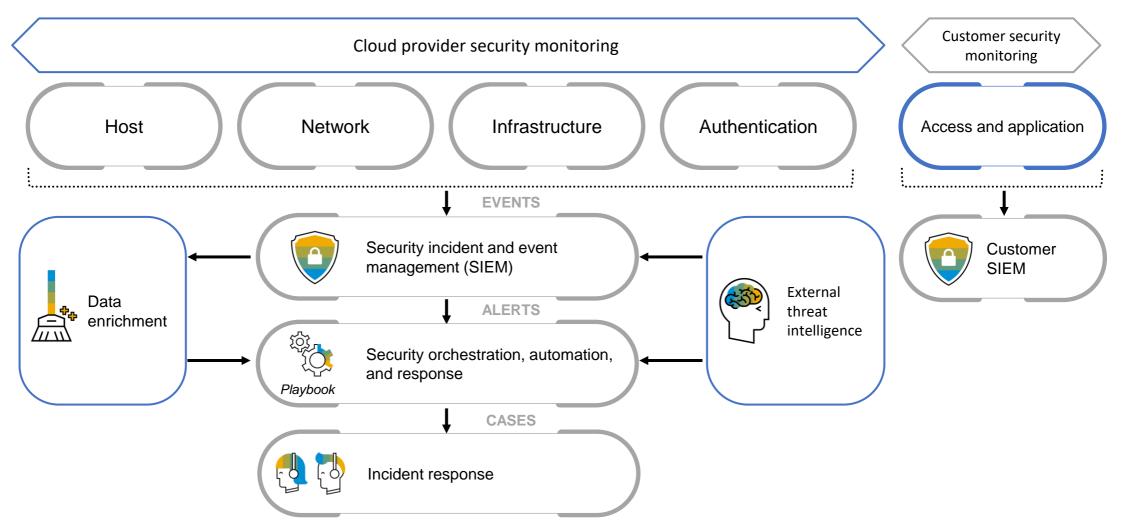


The Security Audit Log in the Cloud

Background: SAP S/4HANA Cloud shared responsibility



Security monitoring: Detection, protection, and response

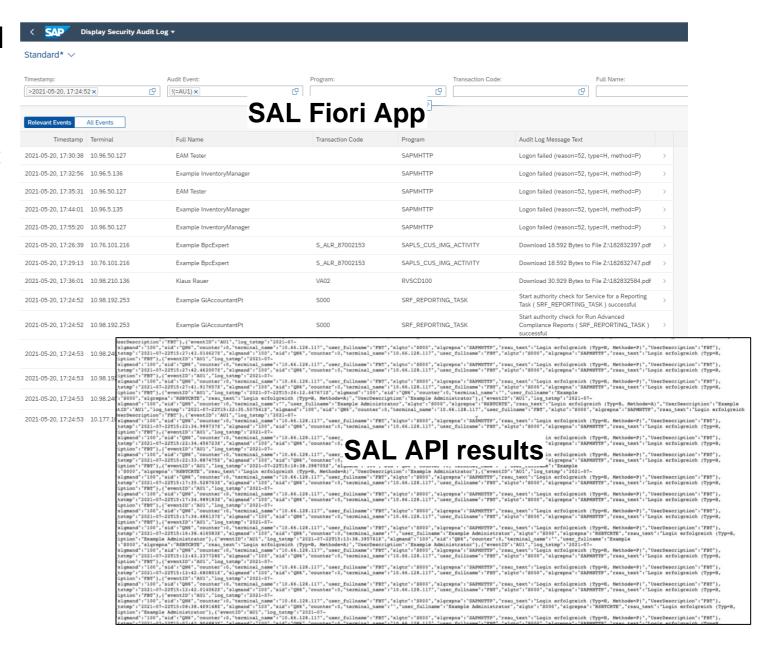


Events Definition in SAP S/4HANA Cloud Public Edition

Event	vent Short Text		Severity			
AU1	Logon successful (type = &A, method = &C)	Logon	19.05.20	025	Dynamic List Display	1
			Display	Security Au	dit Log Event IDs (214 Entries)	
			Area E	Event IDs Mes	ssage text	Audit Class
AU2	Logon failed (reason = &B, typ e= &A, method = &C)	Logon	AU A	AUO Aud	dit - Test. Text: &A	Other Events
			AU A	AU1 Log	gon successful (type = &A, method = &C)	Dialog Logon
			AU A	LOG	gon failed (reason = &B, typ e= &A, method = &C)	Dialog Logon
AU3 Transaction &A starte	Transaction &A started.	Transactio	AU A	MU3 Tra	ansaction &A started.	Transaction Star
7.00	Transaction of Stateor.	Turisaction	AU A	MU4 Sta	art of transaction &A failed (reason = &B)	Transaction Star
AU4 Start	rt of transaction &A failed (reason = &B)	Transactic	AU A	U5 RFC	C/CPIC logon successful (type = &A, method = &C, context = &D)	RFC/CPIC Logon
			AU A	MU6 RF0	C/CPIC logon failed (reason = &B, type = &A, method = &C, context = &D)	RFC/CPIC Logon
			AU A	US US	er &A created.	User Master Chan
			AU A	US US	er &A deleted.	User Master Chan
	RFC/CPIC logon failed (reason = &B, type = &A, method = &C, context = &D)	RFC Logii	AU A	Use	er &A locked.	User Master Chan
	(D)		AU A	AUA Use	er &A unlocked.	User Master Chan
			AU A	AUB Aut	thorizations for user &A changed.	User Master Chan
AU7 User &A cre	User &A created.	User Mas	AU A	UC Use	er Logoff	Dialog Logon
	out of order	Change	AU A	AUD Use	er master record &A was changed.	User Master Chan
	ser &A deleted.	User Mas	AU A	AUE Aud	dit configuration changed	System Events
	Oser an deteted.	Change	AU A	AUF Aud	dit: Slot &A: Class &B, severity &C, user &D, client &E, &F	System Events
	Lleav Q A leadrad	Lleav Maa	AU A	AUG App	plication server started	System Events
	Jser &A locked.	User Mas Change	AU A	App	plication server stopped	System Events
			AU A	AUI Aud	dit: Slot &A: Inactive	System Events
AUA User &A unlocked.	User &A unlocked.	User Mas Change	AU A	AUJ Aud	dit: Active status set to &1	System Events
		Change	AU A	AUK Sud	ccessful RFC call &C (function group = &A) context = &D	RFC Function Cal
AUO Logon failed (reason = &B, ty	Logon failed (reason = &B, type = &A)	Logon	AU A	AUL Fai	lled RFC call &C (function group = &A) context = &D	RFC Function Cal
			AU A	US UM	er &B locked in client &A after errors in password checks	Dialog Logon
			AU A	UN Use	er &B unlocked in client &A after entering wrong password	Dialog Logon
AUY	Download &A bytes to file &C	Other	AU A		gon failed (reason = &B, type = &A)	Dialog Logon
	Downtoad &A bytes to file &C	Otrier			ansaction &A locked	Transaction Star
				AUQ Tra	ansaction &A unlocked	Transaction Star
				AUR &A	&B created	User Master Chang
DI 11	Dassword chack failed for user S.R in client S.A	Other	AU A	AUS &A	&B deleted	User Master Chang
					&B changed	User Master Chang
					&B activated	

Security Audit Log Fiori App & API

- Customer can review security relevant activities of customer users and SAP staff in the Security Audit Log with
 - Timestamp
 - Terminal ID
 - Audit Log Event



Security Audit Log: Outlook for SAP S/4HANA Cloud & BTP

Business Technology Platform:

- All Applications are required to use the Audit Log Service
- Standardization in progress

SAP S/4HANA Cloud Public Edition:

- Additional Events
- More logs

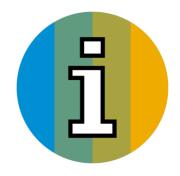
4.1 Audit Log

Applications should log their security relevant events. Audit Logging is a necessity to retrace potential malicious activities of end users and monitor administrative configuration changes or similar. In the case of a breach or other system failures, audit logs serve as forensic evidence for legal procedure. Therefore, logging audit relevant events helps SAP and its customers proving their compliance in litigations.

All cloud services and applications must write their audit logs into the <u>Audit Log Service</u>. Audit relevant events as for example read access to sensitive personal data, change of configurations in the Audit Log

Items (34) | Last Update: 04/15/2025, 14:37:21 **Audit Class Event Short Text** Severity Logon successful (type = &A, method = &C) Severe Logon Logon failed (reason = &B, typ e= &A, method = &C) Logon Critical Transaction &A started. Transaction Start Non-Critical Start of transaction &A failed (reason = &B) **Transaction Start** Critical RFC/CPIC logon failed (reason = &B, type = &A, method = &C, context = Critical RFC Login Critical User &A created User Master Record Change User &A deleted User Master Record Critical Change User &A locked User Master Record Severe Change User &A unlocked User Master Record Severe

Further Information



SAP Help Portal

SAP S/4HANA Cloud – Documentation including security audit log

https://help.sap.com/viewer/product/SAP_S4HANA_CLOUD/ -> Product Assistance -> Protect Your SAP S/4HANA Cloud

Relevant SAP Notes on the Security Audit Log

https://me.sap.com/notes/539404

https://me.sap.com/notes/2191612

Analysis and Recommended Settings SAL

 $\frac{https://community.sap.com/t5/application-development-and-automation-blog-posts/analysis-and-recommended-settings-of-the-security-audit-log-sm19-rsau/ba-p/13297094$

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