INTERNATIONAL STANDARD

ISO/IEC 10181-7

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Information technology — Open Systems Interconnection — Security frameworks for open systems: Security audit and alarms framework

Technologies de l'information — Interconnexion de systèmes ouverts (OSI) — Cadres pour la sécurité dans les systèmes ouverts: Cadre pour l'audit de sécurité et les alarmes

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 10181-7 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open systems interconnection, data management and open distributed processing*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.816.

ISO/IEC 10181 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Security frameworks for open systems*:

—Part 1: Overview

—Part 2: Authentication framework

—Part 3: Access control framework

—Part 4: Non-repudiation framework

—Part 5: Confidentiality framework

—Part 6: Integrity framework

—Part 7: Security audit and alarms framework

Annexes A to D of this part of ISO/IEC 10181 are for information only.

Introduction

This Recommendation | International Standard refines the concept of security audit described in ITU-T Rec. X.810 | ISO/IEC 10181-1. This includes event detection and actions resulting from these events. The framework, therefore, addresses both security audit and security alarms.

A security audit is an independent review and examination of system records and activities. The purposes of a security audit include:

- assisting in the identification and analysis of unauthorized actions or attacks;
- helping ensure that actions can be attributed to the entities responsible for those actions;
- contributing to the development of improved damage control procedures;
- confirming compliance with established security policy;
- reporting information that may indicate inadequacies in system controls; and
- identifying possible required changes in controls, policy and procedures.

In this framework, a security audit consists of the detection, collection and recording of various security-related events in a security audit trail and analysis of those events.

Both audit and accountability require that information be recorded. A security audit ensures that sufficient information is recorded about both routine and exceptional events so that later investigations can determine if security violations have occurred and, if so, what information or other resources have been compromised. Accountability ensures that relevant information is recorded about actions performed by users, or processes acting on their behalf, so that the consequences of those actions can later be linked to the user(s) in question, and the user(s) can be held accountable for his or her actions. Provision of a security audit service can contribute to the provision of accountability.

A security alarm is a warning issued to an individual or process to indicate that a situation has arisen that may require timely action. The purposes of a security alarm service include:

- to report real or apparent attempts to violate security;
- to report various security-related events, including "normal" events; and
- to report events triggered by threshold limits being reached.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – SECURITY FRAMEWORKS FOR OPEN SYSTEMS: SECURITY AUDIT AND ALARMS FRAMEWORK

1 Scope

This Recommendation | International Standard addresses the application of security services in an Open Systems environment, where the term "Open Systems" is taken to include areas such as Database, Distributed Applications, Open Distributed Processing and OSI. The Security Frameworks are concerned with defining the means of providing protection for systems and objects within systems, and with the interactions between systems. The Security Frameworks are not concerned with the methodology for constructing systems or mechanisms.

The Security Frameworks address both data elements and sequences of operations (but not protocol elements) which are used to obtain specific security services. These security services may apply to the communicating entities of systems as well as to data exchanged between systems, and to data managed by systems.

The purpose of security audit and alarms as described in this Recommendation | International Standard is to ensure that open system-security-related events are handled in accordance with the security policy of the applicable security authority.

In particular, this framework:

a) defines the basic concepts of security audit and alarms;

b) provides a general model for security audit and alarms; and

c) identifies the relationship of the Security Audit and Alarms service with other security services.

As with other security services, a security audit can only be provided within the context of a defined security policy.

The Security Audit and Alarms model provided in clause 6 supports a variety of goals not all of which may be necessary or desired in a particular environment. The security audit service provides an audit authority with the ability to specify the events which need to be recorded within a security audit trail.

A number of different types of standard can use this framework including:

1) standards that incorporate the concept of audit and alarms;

2) standards that specify abstract services that include audit and alarms;

3) standards that specify uses of audit and alarms;

4) standards that specify the means of providing audit and alarms within an open system architecture; and

5) standards that specify audit and alarms mechanisms.

Such standards can use this framework as follows:

- standard types 1), 2), 3), 4) and 5) can use the terminology of this framework;
- standard types 2), 3), 4) and 5) can use the facilities defined in clause 8; and
- standard types 5) can be based upon the characteristics of mechanisms defined in clause 9.

2 Normative references

The following Recommendations and International Standards contain provisions, which through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this

Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model.*
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems management: Event report management function.*
- CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems management: Log control function.*
- CCITT Recommendation X.736 (1992) | ISO/IEC 10164-7:1992, *Information technology – Open Systems Interconnection – Systems management: Security alarm reporting function.*
- CCITT Recommendation X.740 (1992) | ISO/IEC 10164-8:1993, *Information technology – Open Systems Interconnection – Systems management: Security audit trail function.*
- ITU-T Recommendation X.810 (1995) | ISO/IEC 10181-1:1996, *Information technology – Open Systems Interconnection – Security frameworks for open systems: Overview.*

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT applications.*

  ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework.*
- CCITT Recommendation X.800 (1991), *Security Architecture for Open Systems Interconnection for CCITT applications.*

  ISO 7498-2:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 2: Security Architecture.*

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1 Basic Reference Model definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.200 | ISO/IEC 7498-1.

a) entity;

b) facility;

c) function;

d) service.

3.2 Security architecture definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.800 | ISO/IEC 7498-2.

a) Accountability;

b) Availability;

c) Security Audit;

d) Security Audit Trail;

e) Security Policy.

3.3 Management framework definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.700 | ISO/IEC 7498-4:

- Managed Object.

3.4 Security framework overview definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.810 | ISO/IEC 10181-1.

- Security Domain.

3.5 Additional definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.5.1 alarm processor: A function which generates an appropriate action in response to a security alarm and generates a security audit message.

3.5.2 audit authority: The manager responsible for defining those aspects of a security policy applicable to conducting a security audit.

3.5.3 audit analyser: A function that checks a security audit trail in order to produce, if appropriate, security alarms and security audit messages.

3.5.4 audit archiver: A function that archives a part of the security audit trail.

3.5.5 audit dispatcher: A function which transfers parts, or the whole, of a distributed security audit trail to the audit trail collector function.

3.5.6 audit trail examiner: A function that builds security reports out of one or more security audit trails.

3.5.7 audit recorder: A function that generates security audit records and stores them in a security audit trail.

3.5.8 audit provider: A function that provides security audit trail records according to some criteria.

3.5.9 audit trail collector: A function that gathers records from a distributed audit trail into a security audit trail.

3.5.10 event discriminator: A function which provides initial analysis of a security-related event and, if appropriate, generates a security audit and/or an alarm.

3.5.11 security alarm: A message generated when a security-related event that is defined by security policy as being an alarm condition has been detected. A security alarm is intended to come to the attention of appropriate entities in a timely manner.

3.5.12 security alarm administrator: An individual or process that determines the disposition of security alarms.

3.5.13 security-related event: Any event that has been defined by security policy to be a potential breach of security, or to have possible security relevance. Reaching a pre-defined threshold value is an example of a security-related event.

3.5.14 security audit message: A message generated as a result of an auditable security-related event.

3.5.15 security audit record: A single record in a security audit trail.

3.5.16 security auditor: An individual or a process allowed to have access to the security audit trail and to build audit reports.

3.5.17 security report: A report that results from the analysis of the security audit trail and that can be used to determine whether a breach of security has occurred.

4 Abbreviations

OSI Open Systems Interconnection

5 Notation

The terms "service" and "mechanism", where not otherwise qualified, are used to refer to "security audit service" and "security audit mechanism" respectively. The term "audit", where not otherwise qualified, refers to a "security audit". The term "alarm", where not otherwise qualified, refers to a "security alarm".

6 General discussion of security audit and alarms

This clause describes a model for handling security alarms and for conducting a security audit for open systems.

A security audit allows the adequacy of the security policy to be evaluated, aids in the detection of security violations, facilitates making individuals accountable for their actions (or for actions by entities acting on their behalf), assists in the detection of misuse of resources, and acts as a deterrent to individuals who might attempt to damage the system. Security audit mechanisms are not involved directly in the prevention of security violations: they are concerned with the detection, recording and analysis of events. This allows changes to operational procedures to be implemented in response to abnormal events such as security violations.

A security alarm is generated following detection of any security-related event that has been defined by security policy to be an alarm condition. This could include the case of a pre-defined threshold being reached. Some of these events may require immediate recovery action while others may require further investigation to determine what, if any, action is required.

An implementation of the security audit and alarms model may need to use other security services to support the security audit and alarms service and to ensure its correct and assured operation. This subject is considered further in clause 10.

Although security audit trails and security audits have special characteristics, other (non-security) audit trails and audits may make use of the facilities and mechanisms described in this framework.

As with other aspects of security, maximum effectiveness is achieved by ensuring that specific security audit requirements are designed into the system. Systems developers should, therefore, take account of the need for auditability (i.e. ready examination and analysis) of both the design process and the system under development.

NOTE – The security audit and alarms model does not show how other system management and operational facilities relate to this model.

6.1 Model and functions

The model presented below illustrates the functions used in the provision of a security audit and alarms service.

6.1.1 Security audit and alarms functions

Various functions are necessary to support a security audit and alarm service. These are:

- the **event discriminator** which provides initial analysis of the event and determines whether to forward the event to the audit recorder or the alarm processor;
- the **audit recorder** which generates audit records from the messages received and stores the records in a security audit trail;
- the **alarm processor** which generates both an audit message and an appropriate action in response to a security alarm;
- the **audit analyser** which checks a security audit trail and, if appropriate, produces security alarms and security audit messages;
- the **audit trail examiner** which builds security reports out of one or more security audit trails;
- the **audit provider** which provides audit records according to some criteria; and
- the **audit archiver** which archives part of a security audit trail.

Additional functions may be necessary to support distributed security audit trails and alarms. These include:

- the **audit trail collector** that gathers records from a distributed audit trail into a security audit trail; and
- the **audit dispatcher** which transfers parts, or the whole, of a distributed security audit trail to the audit trail collector function.

6.1.2 Security audit and alarms model

The security audit and alarms model depicted below involves several phases. Following detection of an event, a determination must be made as to whether the event is security-relevant or not. The *event discriminator* assesses the event to determine whether a security audit message and/or a security alarms message should be generated. Security audit messages are forwarded to the *audit recorder*: security alarms are forwarded to the *alarm processor* for evaluation and further action. Security audit messages are then formatted and transformed into security audit records to be included in the security audit trail. The older parts of the security audit trail may be archived and both the security audit trail and the security audit trail archives may be used to construct audit reports by selecting particular security audit trail records according to specified criteria. That is, the security audit trail may be analysed and security audit reports and/or security alarms generated. The security audit and alarms model is shown in Figure 1.

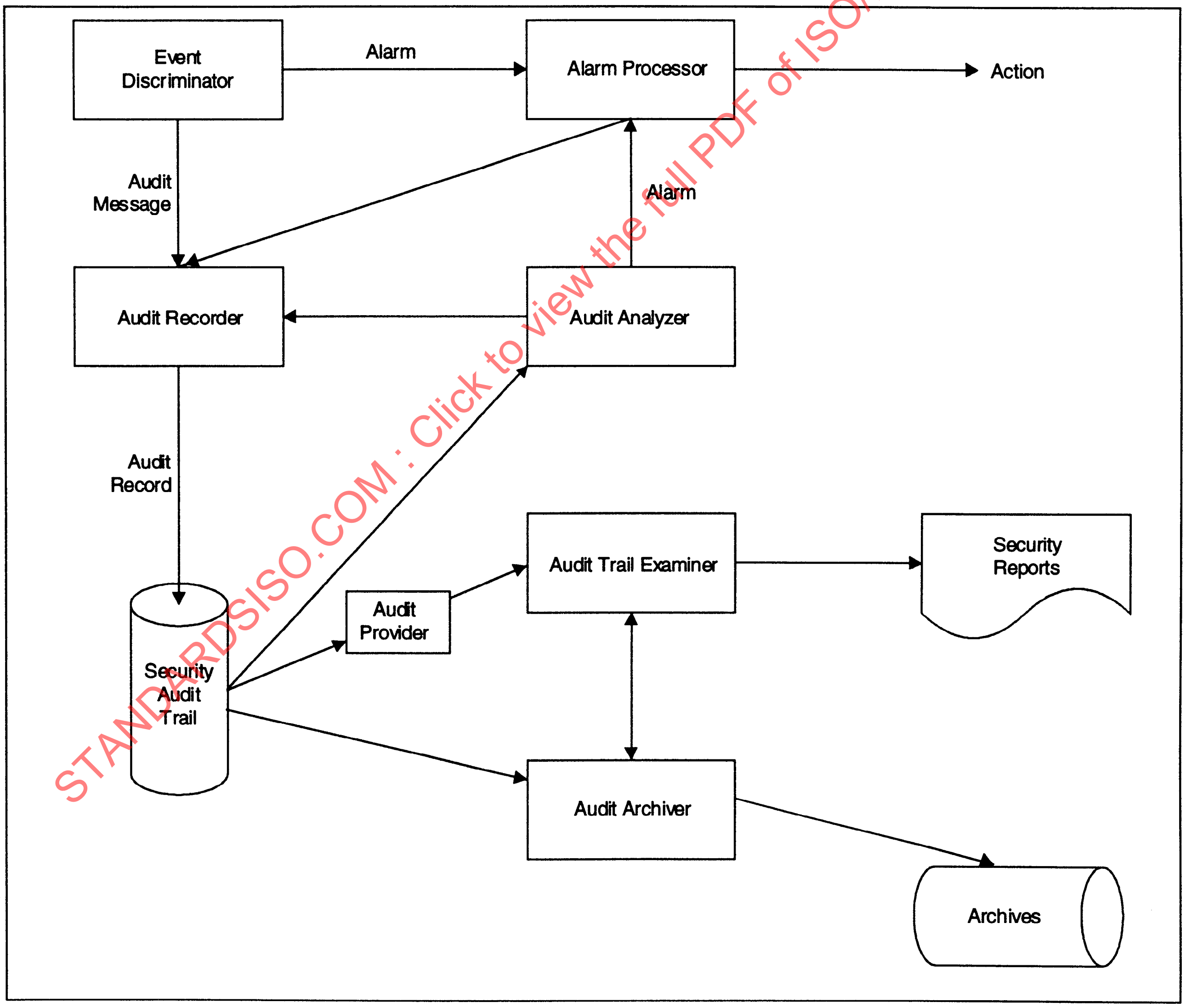

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Figure 1 – Security audit and alarms model

6.1.3 Grouping of security audit and alarm functions

The functions depicted in the model may be colocated in one component of a system or distributed among several components of the system. These functions may also be located in different end systems and they may be duplicated. In some cases, such as for performance considerations, it will be advantageous for the functions to be grouped. In particular, an *audit recorder*, an *audit dispatcher*, an *audit provider* and an *audit analyser* all working on the same security audit trail may form a part of an unattended end-system.

Another grouping could be an *audit trail examiner*, and an *audit analyser* which may be useful for a security auditor.

There may be a chain of functions arranged in a hierarchical manner, particularly in a distributed security audit trail (see Figure 2). Here an *audit trail collector* of one component collects audit messages from the *audit dispatcher* of another component. This chain ends when a component does not support an *audit dispatcher*: in this case the component must support an *audit archiver* to be able to archive its security audit trail.

The decision of what, if any, functions to group is an implementation issue. The above examples are given as illustrations only.

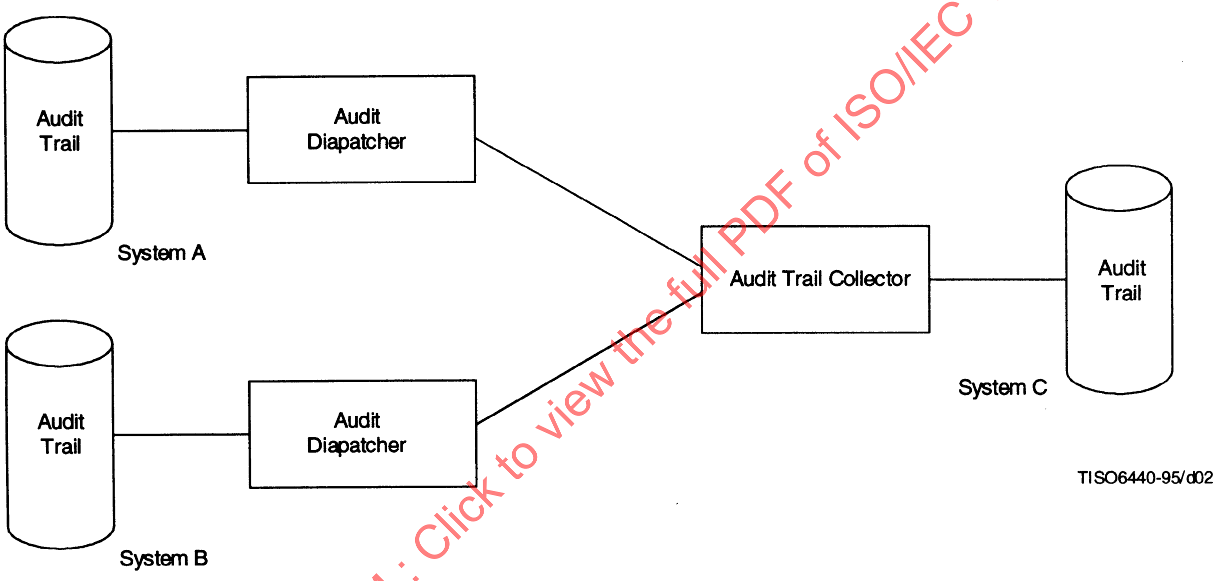

Figure 2 – Distributed audit trail model

6.2 Phases of security audit and alarms procedures

The security audit service provides an audit authority with the ability to specify and select the events which need to be detected and to be recorded within a security audit trail, and the events which need to trigger a security alarm and security audit messages.

The following phases may occur in audit procedures:

- detection phase, in which a security-related event is detected;
- discrimination phase, in which an initial determination is made as to whether it is necessary to record the event in the security audit trail or to raise an alarm;
- alarm processing phase, in which a security alarm or security audit message may be issued;
- analysis phase, in which a security-related event is evaluated together with, and in the context of, previously detected events as logged in the audit trail, and a course of action determined;

- aggregation phase, in which distributed security audit trail records are collected into a single security audit trail;
- report generation phase, in which audit reports are built from security audit trail records; and
- archiving phase, in which records from the security audit trail are transferred to the security audit trail archive.

The phases described here are not necessarily distinct in time, i.e. they may overlap.

6.2.1 Detection phase

The detection phase involves determining that an event that may be security-related has occurred. Actual determination of what, if any, action should be taken in response to this event is the task of the *event discriminator* (see 6.2.2) but, in some cases, as determined by security policy, an immediate alarm may be raised.

6.2.2 Discrimination phase

When a security-related event has been detected, the event discriminator will determine the appropriate initial course of action. The action will be one of:

a) take no action;

b) generate a security audit message; or

c) generate both a security alarm and a security audit message.

The decision as to which of these courses of action should be taken for each event is dependent on the security policy in effect.

6.2.3 Alarm processing phase

In the alarm processing phase, the alarm processor analyses the alarm to determine the correct course of action. The action will be one of:

a) take no action;

b) initiate recovery action; or

c) initiate recovery action and generate a security audit message.

The decision as to which of these courses of action should be taken for each event is dependent upon the security policy in operation.

NOTE – b) and c) might involve bringing the event to the attention of a person such as a security officer or audit administrator.

6.2.4 Analysis phase

In the analysis phase, a security-related event is processed to determine the appropriate course of action. This processing can also make use of information about earlier security-related events, as recorded in the security audit trail. The action will be one of the following:

a) take no action;

b) generate a security alarm;

c) generate a security audit record; or

d) generate both a security alarm and a security audit record.

The decision as to which of these four courses of action should be taken for each event is dependent upon the security policy in effect.

As part of the analysis process, reference may be made to previous events by examining records in the security audit trail and the security audit trail archive.

6.2.5 Aggregation phase

Individual security audit records from a distributed audit trail must periodically be collected into a single audit trail. This process, which includes use of an *audit trail collector* (at the collection point) and the use of an *audit dispatcher* function (at the remote systems), is called aggregation. (As noted in 6.1.3, this process could be hierarchical.)

6.2.6 Report generation phase

When required or mandated according to security policy, the security audit trail may be processed. This processing will involve an element of analysis and may also involve the manipulation of the security audit trail records into a suitable format. The output of the analysis of a security audit trail is a security report which may indicate that an attempt has been made to breach the security of a system, in which case, security recovery actions may need to be undertaken. Analysis of the security audit trail can be used to assess the extent of an attack and to determine appropriate damage control procedures.

A security report may be used by security recovery to identify the extent of damage resulting from a security problem. In particular, it may be used to identify the resources that have been used by an authorized user who has been using his or her rights in an abnormal manner. It may also be used to assess any damage so that necessary recovery action can be attempted.

6.2.7 Archiving phase

Security audit trails may need to be retained for long periods of time. In the archiving phase, part of a security audit trail is moved to a long-term storage medium. The storage used for archiving must maintain the integrity of the original record(s). Archiving of security audit trails may be either local to, or remote from, the original source of the audit trail. Provision may be made for remote archiving.

6.3 Correlation of audit information

Audit records within one or more security audit trails may be inter-related. For example, a connection request may be transmitted through a number of intermediate systems and may, as a result, generate several security audit records in different security audit trails. It may be important that these security audit records be accurately time-stamped or identified as being inter-related. Another example is the recording of two different events in two different security audit trails where it is important to be able to determine which event happened first. A discussion of the problems involved in correlating the times of events from different event generators can be found in Annex D.

7 Policy and other aspects of security audit and alarms

7.1 Policy

A security audit policy defines security-related events and identifies rules to be applied for the collection, recording (in an audit trail) and analysis of the various security-related events. There are several considerations that may be included in audit policies and in their expression as rules. One or more of these considerations may be applicable to a particular security policy.

A security audit policy should define the requirements for performing various levels and types of security audit and should also define the criteria for the generation of security alarms. Testing the adequacy of system controls, confirming compliance with security policy, and determining indicated changes in policy, controls and procedures will require the analysis of security audit trail records and many other aspects of systems design, configuration, and operation.

NOTE – The way to define security-related events in a security policy is outside the scope of this Recommendation | International Standard.

7.2 Legal aspects

In many countries there are laws designed to protect citizens' privacy. In some cases this will mean that an audit trail record containing information of a personal nature will fall within national laws such as those relating to privacy and access to information. Such records will need to be protected from unauthorized disclosure.

Where security audit records are used as legally admissible evidence, specific requirements may exist with respect to the use, storage and protection of security audit records.

7.3 Protection requirements

Two aspects of protection may be considered:

- protection of the security audit trail and the audit information; and
- protection of the security audit service.

7.3.1 Protection of the audit information

Information collected in a security audit trail may come directly from audit messages or from other security audit trails. Hence a security audit trail may be the aggregate of security audit trail records generated by one or more sources. In the simplest case, a security audit trail contains all the security audit records generated by a single system.

The security audit trail must be protected from unauthorized disclosure and/or unauthorized modification. Access control, confidentiality, integrity and authentication mechanisms may be used to protect it. One specific protection technique that is used is to store audit records on a medium that can be written only once so that overwriting cannot be used to erase the record of an event.

The security audit messages, the security alarms and the security reports must also be protected against unauthorized disclosure and/or unauthorized modification. In addition, it is important that the sender and receiver of the information have confidence that the source and destination of the data are as claimed and that the information is not been corrupted in any way.

Confidentiality of at least some of the information may also be required. This may be for several reasons:

- legal aspects with respect to personal privacy;
- to conceal which audit events are or are not recorded;
- to conceal the identities of recipients (or non-recipients) of actions resulting from alarms.

7.3.2 Protection of the audit and alarms service

A security audit and alarms service is dependent on there being a high level of availability. Denial of service is a threat to the audit and alarms service. Information intended for either a security alarm administrator or a security auditor could be delayed to the point where this information is no longer of value. It is of primary importance that the information reach the intended correspondent in a timely manner.

Further discussion of these aspects of protection may be found in clause 10.

8 Security audit and alarms information and facilities

The processing of security audit and alarms information may be considered to have two aspects:

- the processing of messages generated in response to an unexpected event (i.e. unsolicited security audit and alarms information); and
- the processing of requests for specific security audit and alarms information (i.e. solicited information).

Management services are required to control several aspects of the security audit and alarms process including the security audit trail mechanisms, the criteria that define the specific actions taken on detection of a security-related event, and the processes involved in handling the audit and alarms information.

8.1 Audit and alarms information

Security audit and alarms information includes security alarms, security audit messages, security audit records, and security reports.

8.1.1 Security audit messages

A *security audit message* is a message generated as a result of an auditable security-related event.

A security audit message may be generated, for example, from the initial analysis of a security-related event by the *event discriminator* or as a result of subsequent evaluation by the *alarm processor* or the *audit analyser*.

8.1.2 Security audit records

The term *security audit record* is used to describe a single record in a security audit trail. In many cases this will correspond to single security-related event but it is also conceivable that, in some implementations, a security audit record may be generated as a result of more than one security-related event.

A typical security audit trail record includes information about the origin and cause of the message, and may contain information about the entities involved in the detection and processing of the message.

8.1.3 Security alarms

A *security alarm* is a message generated following detection of a security-related event that is determined to be a potential breach of security and that constitutes an alarm condition. This could be a single event or it could be the result of a threshold being reached. In either case, the definition of what constitutes an alarm condition is specified in the security policy.

Security alarms may be initiated by the *event discriminator* (as a result of initial evaluation of a security event) or by the *audit analyser* if, at any time, it determines an alarm condition exists.

8.1.4 Security reports

Security reports are information produced as a result of analysis of security audit trail. The *audit trail examiner* is used to build the reports from one or more security audit trails.

8.1.5 Example of composition of audit and alarms information

Audit and alarms information typically contains the following:

- the information/message type (i.e. security alarm, security audit message, or security report);
- the distinguishing identifier of the elements (e.g. initiator/target for the security-related event; subject/object of the action);
- the cause of the message;
- the distinguishing identifiers of the *event discriminator*, *audit provider* and/or *audit recorder*.

8.2 Security audit and alarms facilities

In order to apply effective auditing and allow efficient event analysis, a method is required for determining which events are security-related and how they are to be processed. The analysis of messages is carried out by a filtering mechanism which determines the appropriate action to be taken on receipt of an audit message. The filter acts according to criteria (identified by the audit authority) which establish the action to be taken for each message type. Criteria which may be acted upon include:

- the time of day;
- a threshold counter;
- the event type; and
- the entity causing the event.

For the purposes of management, the filter may be defined as a managed object with specified behaviour and parameters.

The audit and alarms management-related facilities provide a means for establishing the selection criteria that allow a user to process information necessary for the provision of security audit and alarms service. In broad terms these facilities are:

a) create, modify and delete the criteria for processing security-relevant events;

b) enable and disable the generation of specified security audit messages;

c) enable and disable the generation of security audit trails;

d) enable and disable the generation and processing of alarms.

The audit and alarms operational-related facilities are:

a) generate audit and alarms information (e.g. generate alarm, generate audit message, generate security report);

b) record audit and alarms information;

c) collect/aggregate audit and alarms information;

d) analyse audit and alarms information; and

e) archive audit and alarms information.

8.2.1 Determination and analysis of security events – Criteria for audit and alarms functions

Both a security alarm and a security audit message identify the event type, the cause of the event, the time at which the event was detected, the identity of the event detector and the identities of the entities associated with the event (i.e. the subject and object of the action which causes the event to occur).

Criteria are established to specify the action to be taken when processing different types of information. The criteria defined are as follows:

Criteria 1 – Event discrimination

These criteria will determine the action to be taken upon detection of a security-related event.

Candidate input parameters:

- type of security-related event;
- time of day;
- entity causing event.

Candidate output parameters:

- action to be taken;
- security alarm to be generated;
- security audit message to be generated.

Criteria 2 – Audit trail examination

These criteria provide a basis for the selection of information contained in one or more security audit trails for the purpose of compiling security reports.

Candidate input parameters:

- type of audit record;
- type of security-related event;
- time of event under review;
- entity about which information is requested.

Candidate output parameter:

- list of selected records.

Criteria 3 – Audit trail analysis criteria

These criteria determine how the audit trail will be processed by the audit analyser. Audit trails will be analysed by assessing the occurrence and frequency of events prior to determining the action to be taken.

Candidate input parameters:

- event type;
- number of occurrences;
- period of time.

Candidate output parameter:

- action to be taken.

NOTE – Criteria are not required for security audit recording or security audit archiving.

9 Security audit and alarms mechanisms

The security audit and alarms service is different from the other security services described in this series of Recommendations | International Recommendations in that there is no single specific security mechanism that can be used to provide the service. Audit mechanisms may be characterized as procedures based on a number of management and operational approaches. For this reason, no detailed discussion is included on audit mechanisms. However, as an example of the type of approaches being used for audit, mechanisms for security related event analysis may involve:

- comparing the activity of an entity against a known profile, e.g. unusual access based on time or geography, unusual use of resources, etc;
- detecting the accumulation of one or several event types within some period of time; and
- observing the non-occurrence of one or several event types within some period of time.

The above list of examples is not exhaustive.

10 Interaction with other security services and mechanisms

10.1 Entity authentication

The transfer of a security audit trail between an *audit dispatcher* and an *audit collector* requires mutual authentication so that the *audit dispatcher* releases the security audit trail to the intended *audit collector* and the *audit collector* receives the security audit trail from the intended dispatcher.

10.2 Data origin authentication

Data origin authentication is used so that the origin of security audit messages and security alarms may be known. It is also used by the *audit analyser* to ensure that messages from unknown event generators or unknown audit analysers are rejected.

10.3 Access Control

Access Control services must be used in the storage and transfer of security audit trail records. Access control could also be used to prevent un-authorized access to a security audit trail.

10.4 Confidentiality

Confidentiality services may be used during the transfer of the security audit trails, selected security audit records, security audit messages and security alarms. The confidentiality service may also be used to protect stored audit records.

10.5 Integrity

It is of primary importance that any unauthorized modification of a security audit trail, a set of selected security audit records, a security audit message or a security alarm be detected. An integrity service may be used for this purpose.

10.6 Non-repudiation

As the transfer of audit trails will usually be done within the same security domain, a non-repudiation service will not normally be used.

Annex A

General security audit and alarms principles for OSI

(This annex does not form an integral part of this Recommendation | International Standard)

It is recommended that the following types of security-related event always be audited:

- operations relating to the management of security information;
- operations that change the set of events to be audited; and
- operations that change the identification of audited objects.

This annex specifies the OSI events which will potentially give rise to a security-related event. Both normal and abnormal conditions may need to be audited, for instance each Connection Request may be a subject for a security audit trail record, whether or not the request was abnormal and irrespective of whether the request was accepted or not.

The following events, amongst others, may be subject to auditing. The list is not exhaustive and is provided for guidance only.

Security related events related to a specific connection:

- Connection Requests;
- Connection Confirmed;
- Disconnection Requests;
- Disconnection Confirmed;
- Statistics appertaining to the connection.

Security related events related to the use of security services:

- Security Service Requests;
- Security Mechanisms Usage;
- Security alarms.

Security related events related to management:

- management operations;
- management notifications.

The list of auditable events should include at least:

- deny access;
- authenticate;
- change attribute;
- create object;
- delete object;
- modify object;
- use privilege.

In terms of the individual security services, the following security-related events are important:

–	authentication:	verify success;
–	authentication:	verify fail;
–	access control:	decide access success;
–	access control:	decide access fail;
–	non-repudiation:	non-repudiable origination of message;
–	non-repudiation:	non-repudiable receipt of message;

- non-repudiation: unsuccessful repudiation of event;
- non-repudiation: successful repudiation of event;
- integrity: use of shield;
- integrity: use of unshield;
- integrity: validate success;
- integrity: validate fail;
- confidentiality: use of hide;
- confidentiality: use of reveal;
- audit: select event for auditing;
- audit: deselect event for auditing;
- audit: change audit event selection criteria.

NOTE – When access control is used as the basis of integrity or confidentiality mechanisms, the audit records associated with "decide access fail" can be converted to an explicit indication of confidentiality or integrity attempted violation.

All audit trail records pertaining to a particular instance of communication should be unambiguously identified to ensure that the records can be traced.

The services of CCITT Rec. X.734 | ISO/IEC 10164-5 may be used to manage the event forwarding service and to configure the event forwarding discriminators that specify the selection criteria for security-related events that are of relevance to a security audit.

The security audit trail reporting service of CCITT Rec. X.740 | ISO/IEC 10164-8 may be used by entities to generate security audit messages.

The services of CCITT Rec. X.735 | ISO/IEC 10164-6 may be used to specify the selection of security audit messages that are stored in security audit trails.

The security alarm reporting service of CCITT Rec. X.736 | ISO/IEC 10164-7 may be used by a security audit trail application to generate security alarms.

Annex B

Realization of the security audit and alarm model

(This annex does not form an integral part of this Recommendation | International Standard)

The functions of the security audit and alarms model are shown in Figure 1. The entire procedure may be distributed among many separate open systems, with each system responsible for one or more aspects of the procedure. An example of this is shown in Figure B.1.

An example of a security event could be an attempt to log-on to a system by using an invalid password on an account. Analysis of the audit trail might reveal that this was one of a series of attempts to log-on to the account with a false password and an alarm might be raised when a threshold is reached.

S1 is capable of detecting security-related events and analysing them according to defined criteria (Criteria 1) but has no security audit trail capability, so its security alarms are sent to S2 and its security audit messages are sent to S3 for inclusion in the security audit trail.

S3 is responsible for the update of the security audit trail. S3 also provides to S6, access to the security audit trail and to the security audit trail archives so that security audit trail records may be selected according to defined criteria (Criteria 2) and gathered into a security report.

S4 is responsible for the archiving and retrieval of the audit trail records.

S5 contains an application which analyses the audit trail records (and archived records) according to defined criteria (Criteria 3) and sends alarms to S2 when threshold limits are exceeded or when other alarm conditions are detected.