TECHNICAL REPORT

ISO/IEC TR 15443-1

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Information technology — Security techniques — A framework for IT security assurance —

Part 1: Overview and framework

Technologies de l'information — Techniques de sécurité — Un canevas pour l'assurance de la sécurité dans les technologies de l'information —

Partie 1: Vue d'ensemble et canevas

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. 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.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/IEC TR 15443-1, which is a Technical Report of type 3, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 27, *IT Security techniques*.

ISO/IEC TR 15443 consists of the following parts, under the general title *Information technology — Security techniques — A framework for IT security assurance*:

— *Part 1: Overview and framework*

— *Part 2: Assurance methods*

Analysis of assurance methods will form the subject of a future Part 3.

Introduction

At the plenary meeting of ISO/IEC JTC 1/SC 27 in November 1994, a study group was set up to consider the question of testing and assessment methods which contribute to assurance that IT products and systems conform to security standards from SC 27 and elsewhere (e.g. SC 21 and ETSI; and some Internet standards contain security aspects). In parallel, the Common Criteria project created a working group on assurances approaches in early 1996. ISO/IEC TR 15443 resulted from these two activities.

The objective of ISO/IEC TR 15443 is to present a variety of assurance methods, and to guide the IT Security Professional in the selection of an appropriate assurance method (or combination of methods) to achieve confidence that a given deliverable satisfies its stated IT security assurance requirements. This report examines assurance methods and approaches proposed by various types of organisations whether they are approved or de-facto standards.

In pursuit of this objective, ISO/IEC TR 15443 comprises the following:

a) a framework model to position existing assurance methods and to show their relationships;

b) a collection of assurance methods, their description and reference;

c) a presentation of common and unique properties specific to assurance methods;

d) qualitative, and where possible, quantitative comparison of existing assurance methods;

e) identification of assurance schemes currently associated with assurance methods;

f) a description of relationships between the different assurance methods; and

g) guidance to the application, composition and recognition of assurance methods.

ISO/IEC TR 15443 is organised in three parts to address the assurance approach, analysis, and relationships as follows:

Part 1 Overview and Framework provides an overview of the fundamental concepts and a general description of assurance methods. This material is aimed at understanding Part 2 and the future Part 3 of ISO/IEC TR 15443. Part 1 targets IT security managers and others responsible for developing a security assurance program, determining the security assurance of their deliverable, entering an assurance assessment audit (e.g. ISO 9000, SSE-CMM (ISO/IEC 21827), ISO/IEC 15408-3), or other assurance activities.

Part 2 Assurance Methods describes a variety of assurance methods and approaches and relates them to the security assurance framework model of Part 1. The emphasis is to identify qualitative properties of the assurance methods that contribute to assurance. This material is catering to an IT security professional for the understanding of how to obtain assurance in a given life cycle stage of deliverable.

The future *Part 3 Analysis of Assurance Methods* will analyse the various assurance methods with respect to their assurance properties. The analysis will aid the Assurance Authority in deciding the relative value of each Assurance Approach and determining the assurance approach(s) that will provide the assurance results most appropriate to their needs within the specific context of their operating environment. Furthermore, the analysis will also aid the Assurance Authority to use the assurance results to achieve the desired confidence of the deliverable. The material in this part targets the IT security professional who must select assurance methods and approaches.

ISO/IEC TR 15443 analyses assurance methods that may not be unique to IT security; however, guidance given in ISO/IEC TR 15443 will be limited to IT security requirements. Similarly, additional terms and concepts defined in other International standardisation initiatives (i.e. CASCO) and International guides (e.g., ISO/IEC Guide 2) will be incorporated; however, guidance will be provided specific to the field of IT security and is not intended for general quality management and assessment, or IT conformity.

Information technology — Security techniques — A framework for IT security assurance —

Part 1: Overview and framework

1 Scope

1.1 Purpose

The purpose of this part of ISO/IEC TR 15443 is to introduce, relate and categorise security assurance methods to a generic life cycle model in a manner enabling an increased level of confidence to be obtained in the security functionality of a deliverable.

1.2 Approach

The approach adopted throughout this part of ISO/IEC TR 15443 presents an overview of the basic assurance concepts and terms required for understanding and applying assurance methods through a framework of identifying various assurance approaches and assurance stages.

1.3 Application

Using the categorisation obtained through this part of ISO/IEC TR 15443, Part 2 and the future Part 3 will guide the reader in the selection, and possible combination, of the assurance method(s) suitable for application to a given deliverable.

1.4 Field of Application

This part of ISO/IEC TR 15443 provides guidance for the categorisation of assurance methods including those not unique to IT security. It may be used in areas outside of IT security where criticality warrants assurance.

1.5 Limitations

This part of ISO/IEC TR 15443 applies to deliverables (refer to Clause 4.3) and their related organisational security issues only.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE The terms and definitions have been developed to be as generic as possible to support the assurance model developed in this part of ISO/IEC TR 15443. The assurance model, being applicable to a broad spectrum of assurance approaches, requires non-specific terminology to be applicable to a broad spectrum of assurance approaches.

Defining terms for a generic assurance model is a difficult task owing to the myriad of assurance terms that exist to satisfy the available assurance approaches. Furthermore, similar terms have different definitions and many are unique to a particular assurance approach making it difficult to construct a generic language for the assurance model. Owing to these

difficulties, terms and definitions have been crafted to ensure the neutrality of the assurance framework and applicability to a wide range of assurance methods. Relevant ISO standards are used wherever possible, in particular to maintain compatibility to ISO/IEC TR 15408 Parts 1 - 3 and ISO 9000 series.

The next difficulty was how to address the multiple definitions that existed for the same term and definitions that were not used, as they were not generic enough for the model. Should these terms be ignored or maintained for reference purposes? Ignoring definitions posed the problem of confusing readers when discussing the assurance approach from which they came. Maintaining definitions specific to a unique assurance approach added a level of formatting complexity to ISO/IEC TR 15443; however, the appropriate definition could then be used within the correct context. It was decided to maintain the previous definitions and to present them in a clear manner. Where multiple definitions exist for the same term, the principal definition for the purpose of ISO/IEC TR 15443 is listed first. Alternate definitions, bulleted and denoted in italics, are only applicable when cited in the context of their source.

2.1
accreditation

Procedure by which an authoritative body gives formal recognition, approval, and acceptance of the associated residual risk:

- *a) for the operation of an automated system in a particular security mode using a particular set of safeguards [adapted from AGCA];*
- *b) that a security body or person is competent to carry out specific tasks [adapted from ISO/IEC Guide 2]; and*
- *c) that a security service is suitable for the target environment.*

2.2
approach
The method used or steps taken in setting about a task or problem.

2.3
assessment
Verification of a deliverable against a standard using the corresponding method to establish compliance and determine the assurance.

2.4
assurance
Performance of appropriate activities or processes to instil confidence that a deliverable meets its security objectives.

- *a) Grounds for confidence that an entity meets its security objectives [ISO/IEC 15408–1].*

2.5
assurance approach
A grouping of assurance methods according to the aspect examined.

2.6
assurance argument
A set of structured assurance claims, supported by evidence and reasoning, that demonstrate clearly how assurance needs have been satisfied.

2.7
assurance assessment
Verification and recording of the overall types and amounts of assurance associated with the deliverable (entered into the assurance argument).

2.8
assurance authority
A person or organisation delegated the authority for decisions (i.e. selection, specification, acceptance, enforcement) related to a deliverable's assurance that ultimately leads to the establishment of confidence in the deliverable.

NOTE In specific schemes or organisations, the term for assurance authority may be different such as evaluation authority.

2.9
assurance evidence
Work products resulting from the assurance analysis of the deliverable (including summary reports or other justification) that supports the assurance claim.

2.10
assurance level
The amount of assurance obtained according to the specific scale used by the assurance method.

NOTE 1 The assurance level may not be measurable in quantitative terms.

NOTE 2 The amount of assurance obtained is generally related to the effort expended on the activities performed.

2.11
assurance method
A recognised specification for obtaining reproducible assurance results.

2.12
assurance property
A characteristic of an assurance method that contributes to the assurance result.

2.13
assurance result
Documented numerical or qualitative assurance statement pertaining to a deliverable.

2.14
assurance scheme
The administrative and regulatory framework under which an assurance method is applied by an assurance authority within a specific community or organisation.

a) *The administrative and regulatory framework under which the Common Criteria is applied by an evaluation authority within a specific community [ISO/IEC 15408–1].*

2.15
assurance stage
The deliverable life cycle stage on which a given assurance method is focused. The overall deliverable assurance takes into account the results of the assurance methods applied throughout the deliverable life cycle.

2.16
assurance evidence
Workproducts or any items generated from the assurance analysis of the deliverable including reports (justification) to support the assurance claim.

2.17
certification
Procedure by which a formal assurance statement is given that a deliverable conforms to specified requirements. Certification may be performed by a third party or self-certified [adapted from ISO/IEC Guide 2:1996].

a) *The issue of a formal statement confirming the results of an evaluation, and that the evaluation criteria used where correctly applied [ITSEC].*

b) *The certification process is the independent inspection of the results of the evaluation leading to the production of the final certificate or approval [ISO/IEC 15408–1].*

c) *The comprehensive assessment of the technical and non-technical security features of an information technology system, made in support of accreditation that establishes the extent to which a system satisfies a specified security policy [AGCA].*

2.18
confidence
A belief that a deliverable will perform in the way expected or claimed (i.e. properly, trustworthy, enforce security policy, reliably, effectively).

2.19
deliverable
An IT security product, system, service, process, or environmental factor (i.e. personnel, organisation) or the object of an assurance assessment. An object may be a Protection Profile (PP) or Security Target (ST) as defined by ISO/IEC 15408-1.

Note: ISO 9000:2000 holds that a service is a type of product and “product and/or service" when used in the ISO 9000 family of standards.

2.20
evaluation
Assessment of a deliverable against defined criteria (adapted from ISO/IEC 15408–1).

a) *Systematic examination (quality evaluation) of the extent to which an entity is capable of fulfilling specified requirements [ISO/IEC 14598-1].*

2.21
guarantee
Refer to the definition for *Warranty* in clause 2.36.

2.22
IT security product
A package of IT software, firmware and/or hardware, providing functionality designed for use or incorporation within a multiplicity of systems [ISO/IEC 15408–1].

2.23
life cycle stage
An instance within the deliverable life cycle that relates to the state of the deliverable.

a) *A period within the system life cycle that relates to the state of the system description and/or the system itself [ISO/IEC 15288].*

2.24
pedigree
Informal recognition of the vendor’s consistent repeatability to provide deliverables that satisfy its security policy or to perform as claimed (pedigree is an environmental factor associated with the vendor or deliverable).

2.25
process
An organised set of activities which uses resources to transform inputs to outputs [ISO 9000: 2000]

2.26
process assurance
Assurance derived from an assessment of activities of a process.

2.27
product
Refer to the definition of deliverable.

2.28
scheme
Set of rules defining the environment, including criteria and methodology required to conduct an assessment [adapted from ISO/IEC 18045 (Common Evaluation Methodology)].

2.29
security
All aspects related to defining, achieving, and maintaining confidentiality, integrity, availability, accountability, authenticity, and reliability [ISO/IEC 13335-1].

NOTE A product, system, or service is considered to be secure to the extent that its users can rely that it functions (or will function) in the intended way. This is usually considered in the context of an assessment of actual or perceived threats.

a) *The capability of the software product to protect information and data so that unauthorised persons or systems cannot read or modify them and authorised persons or systems are not denied access to them [ISO/IEC 9126-1].*

2.30
security assessment
Verification of a security deliverable against a security standard using the corresponding security method to establish compliance and determine the security assurance.

a) *The last stage of the product evaluation process [ISO/IEC 14598-1].*

2.31
security element
An indivisible security requirement.

2.32
service
A security process or task performed by a deliverable, organisation, or person.

2.33
stakeholder
A party having a right, share, or an asset at risk in a deliverable or in its possession of characteristics that meet the party's needs and expectations.

a) *A party having a right, share, or claim asset in a system or in its possession of characteristics that meet the party's needs and expectations [ISO/IEC 15288].*

2.34
system
A specific IT installation, with a particular purpose and operational environment [ISO/IEC 15408–1].

a) *A combination of interacting elements organized to achieve one or more stated purposes [ISO/IEC 15288].*

NOTE 1 A system may be considered as a product and/or as the services it provides [ISO/IEC 15288].

NOTE 2 In practice, the interpretation of its meaning is frequently clarified by the use of an associative noun, e.g. aircraft system. Alternatively the word system may be substituted simply by a context dependent synonym, e.g. aircraft, though this may then obscure a system principles perspective [ISO/IEC 15288].

2.35
system life cycle
The evolution with time of the system from conception through to disposal [ISO/IEC 15288].

2.36
warranty
A security service to correct or mitigate the deliverable's operation (deployment, performance, or delivery) if it does not satisfy its security policy.

2.37
work product
All items (i.e. documents, reports, files, data, etc.) generated in the course of performing any process for developing and supplying the deliverable [SSE-CMM (ISO/IEC 21827)].

a) Result of a system of activities, which use resources to transform inputs into outputs [ISO 9001].

3 Abbreviated terms

AST
Abstract Security Target

BSI
Bundesamt für Sicherheit in der Informationstechnik (German Information Security Agency)

CASCO
ISO Committee on conformity assessment

CEM
Common Evaluation Methodology (precursor of, and equivalent to NP N2729r1 Methodology for IT security evaluation)

CMM
Capability Maturity Model

CSE
Communications Security Establishment (Canadian IT Security Agency)

CTCPEC
Canadian Trusted Computer Product Evaluation Criteria (edited by CSE)

HCD
Human Centered Design

IEC
International Electrotechnical Commission

ISO
International Organization for Standardization

IT
Information Technology

ITSEC
Information Technology Security Evaluation Criteria (Office for Official Publications of the European Communities)

ITSEM
Information Technology Security Evaluation Methodology (Office for Official Publications of the European Communities)

NSA
National Security Agency (Government Agency of the USA)

PP
Protection Profile (defined in ISO/IEC 15408-1)

RAMP
Ratings And Maintenance Phase (NSA process following TCSEC evaluations)

RM
Ratings and Maintenance phase (CSE process following CTCPEC evaluations)

SCT
Strict (Security) Conformance Testing

SE-CMM
System Engineering Capability Maturity Model (Capability Maturity Model is a Trade Mark™ of Carnegie-Mellon University)

ST
Security Target (defined in ISO/IEC 15408-1)

SSAM®
SSE-CMM Appraisal Methodology (promoted by Support Organization), an entity within the International Systems Security Engineering Association (ISSEA)

SSE-CMM®
System Security Engineering - Capability Maturity Model ISO/IEC 21827 (submitted to ISO as a publicly available standard by the Support Organization of the International Systems Security Engineering Association (ISSEA)

TCSEC
Trusted Computer System Evaluation Criteria (edited by NSA)

TOE
Target of Evaluation (Term specific to ISO/IEC 15408 and defined in ISO/IEC 15408-1)

TPEP
Trusted Product Evaluation Program (TCSEC and CTCPEC)

TRA
Threat and Risk Assessment

4 Concepts

This clause introduces the concepts of assurance and aims to differentiate the applicability of assurance concepts between general IT assurance and IT security assurance. The concepts are broad and should not be applied specifically to IT security or conformity assessments.

4.1 Why do we need assurance?

IT systems are prone to failure and security violations due to errors and vulnerabilities. These errors and vulnerabilities can be caused by rapidly changing technology, human error, poor requirement specifications, poor development processes or as a result of underestimating the threat. In addition, system modifications, new flaws, and new attacks are frequently introduced contributing to increased vulnerabilities, failures, and security violations throughout the IT system life cycle.

Due to human error or oversight, component or equipment failure, and due to imperfection of the opposing security mechanisms, error-free, failure-free and risk-free operation is not usually achievable within acceptable cost and time constraints over the deliverable of the IT system life cycle. This situation makes it almost impossible to guarantee an error-free, risk-free, and secure IT system.

From the above paragraphs, it can be seen that errors, vulnerabilities and risks will probably always exist and may change over the deliverable's life cycle. Therefore, the errors, vulnerabilities and risks will have to be managed over the deliverable's life cycle within acceptable parameters otherwise the deliverable assurance will change. The task of IT security engineering and management is to manage the security risk by mitigating the vulnerabilities and threats with technological and organisational security measures to achieve a deliverable with acceptable assurance. IT security management has an additional task of establishing acceptable assurance and risk objectives. In this way, the stakeholders of an IT system will achieve reasonable confidence that the deliverable performs in the way intended or claimed with acceptable risk and within budget. From a security standpoint, this translates into confidence that the deliverable enforces the applicable security policy.

4.2 Assurance is distinguishable from confidence

It is important to point out that assurance and confidence are not identical and cannot be used in place of one another. Too often, these terms are used incorrectly as they are closely related. It is important for the reader to understand the distinction between these two terms. Confidence, from the perspective of an individual, is related to the belief that one has in the assurance of the deliverable whereas assurance is related to the demonstrated ability of the deliverable to perform its security objectives. Therefore, confidence is not a certainty but an expression of trust and belief created through assurance.

Assurance is determined from the evidence produced by the assessment process of the deliverable. The evidence, usually composed of an assurance argument, documentation, and other related work products, substantiates the claimed assurance based on the security engineering and assessment activities.

Confidence is subject to the individual's perception of their specific security requirements and to the knowledge gained in assessment processes that the deliverable will perform in the way expected or claimed. This includes the knowledge of the assurance criteria, method, scheme, and assessment process used. Furthermore, the reputation of the assessors and operators is a significant factor in establishing confidence of the deliverable as their qualifications and experience may or may not be acceptable. As a consequence, by their individual perception, stakeholders may have different degrees of confidence after the performance of a given assurance method by a given person or organisation.

4.3 What is a deliverable?

Traditionally, assurance has only been associated with IT products and systems composed of hardware or software and referred to as product or system assurance. It is now recognized that to address a wider range of risks, there is a need for assurance of other security objectives such as a security service, process, personnel, organisation, or other environmental factors. To address this new requirement, the term "deliverable" is used to refer to the objective of the security assessment.

The broad definition of "deliverable" encompasses the security items listed on a contract to be delivered or performed (i.e. service) for the client as the case may be. Contract items may include IT security products, services, and any other tangible or intangible security item sold (whether one-of-a-kind or mass produced), leased, trained, or contracted out. Furthermore, this includes any deliverable whether provided as a service, shareware, freeware, sample, or by other means and whether supplied directly or indirectly (warranty, guaranty, pedigree, etc.) or assumed by the consumer (pedigree, warranty, etc). Deliverables have

measurable security attributes that can be verified to meet their security policy. For example, the deliverable may refer to a Threat and Risk Assessment (TRA) service performed by an organisation or it may refer to the certification of personnel qualified to perform evaluations using the ISO/IEC15408 criteria. Personnel performing a security service or task are also considered to be deliverables. For example, those being trained to become evaluators, have a contract with the training organisation and are measured or graded on their abilities to acquire the knowledge and perform specific activities. Similarly, security consultants performing a service or task are also under contract.

Some assurance deliverables do not always appear as line items although they provide varying levels of confidence to Assurance Authorities and therefore must be factored into the security assessment. For instance, warranties and guarantees are specific services provided by the vendor either as stand-alone or as an additional feature bundled with the deliverable supplied. Warranty services serve to correct or mitigate the deliverable's operation (deployment, performance, or delivery) if it does not satisfy its security policy. A pedigree is an environmental factor associated with the vendor or deliverable, which although somewhat vague, cannot be discounted due to a recognized history of special performance such as consistent and repeated performance to meet its security policy or to meet the vendor claims.

Note: This definition of deliverable is similar to the term TOE defined in ISO/IEC 15408-1 except that deliverable has a broader application.

4.4 Stakeholders

Assurance may be sought by the stakeholders of a deliverable who are the ones having assets at risk through the deliverable. Therefore, the determination of an acceptable assurance method and level of assurance may be required/and or influenced by the stakeholders some of whom are listed below:

a) standard bodies;
b) national and international laws and regulations;
c) specific communities (such as government or the banking industry);
d) authorised units within an organisation;
e) policy (security, personnel, procurement, marketing, certificate policy, etc.) owners;
f) system owners;
g) system accreditors;
h) end users; and
i) the general public.

4.5 Assurance requirements

In terms of IT security, adequate assurance signifies that specific predefined security assurance requirements have been satisfied by performing appropriate assurance processes and activities, i.e. as prescribed by a chosen assurance method. Assurance requirements are determined from the security requirements and other driving factors.

Security assurance requirements are determined by analysing the security requirements for the deliverable, influencers, security requirements (policies), business drivers and the target environment for the deliverable. Influencers are any considerations that need to be addressed as they might affect the deliverable assurance requirements. The influence can have any origin and may not even be tangible such as politics, culture, local laws, and mandated requirements. A Risk Assessment is performed to provide an in-depth look at the asset sensitivity, vulnerabilities, and threats to determine the residual risk and recommendations for existing and proposed safeguards. The recommendations implemented are factored into the original security requirements to revise the security assurance requirements.

General guidance on security management and for performing a risk analysis can be found in ISO/IEC 13335 and ISO/IEC 17799. ISO/IEC 15408 contains information on security functional and assurance requirements for IT products and systems specific to traditional IT security evaluations.

Assurance requirements are unique to each environment due to the myriad of business and security requirements of each environment. Therefore, the same deliverable may not be suitable to other environments without modifications as different assurance requirements will usually need to be satisfied.

4.6 Assurance methods applicability to IT security

This clause expands on the assurance definition in Clause 2.4. It discusses different aspects of assurance in order to demonstrate how the different aspects of assurance might be applied to IT security.

From the assurance definition in Clause 2.4, it is seen that the application of appropriate assurance activities is what establishes confidence that the deliverable satisfies its security objectives. The confidence is realised by reviewing the assurance evidence gained through assessment processes and activities during development, deployment and operation, and through experience in actual usage of the deliverable. Any activities that can reduce the uncertainty by producing evidence attesting to the correctness, effectiveness, and quality of the deliverable's attributes is useful in determining security assurance. Recognising that some types of evidence more clearly establish the claims they support than other types, the key is creating a comprehensive assurance argument that firmly establishes the type and amount of assurance gained from the applied assurance methods. There are many existing assurance methods with only a small number specific to IT security. However, non-IT security assurance methods may also contain certain assurance properties relevant to IT security assurance. Due to the small number of security specific assurance methods available, it is important to recognise the value of all assurance methods since many non-security assurance methods are used throughout the IT industry. Assurance evidence is frequently in the form of documentation developed during the normal course of IT engineering activities. Anything that can be used to construct an assurance argument and thereby reduce the uncertainty (risk) associated with a particular deliverable is of considerable importance.

The intent here is to communicate the value of non-IT security assurance methods and not downplay the value of IT security specific assurance methods. The latter is clearly preferable; however, some assurance can be obtained from many sources and should not be discounted simply because it does not come from a recognised security assurance method. Having said this, it is very important to recognise the source of the evidence and take that into account when developing the assurance argument. Furthermore, one must be familiar with their security and assurance requirements and understand the value of the evidence and its source to ensure that it satisfies their needs.

For example, while ISO 9000 is a quality assurance standard originally made for manufacturing organisations, it also contains process assurance properties applicable to software, and as such to IT security software products and systems. By contrast, the SSE-CMM (ISO/IEC 21827) is a security assurance method although not a traditional assurance method. This method produces assurance evidence by assessing the organisation's security engineering processes and not the deliverable directly.

Certain assurance methods specifically focus on defining consistent and complete sets of security features, which often reflect a standardised threat scenario or good practices. Different assurance methods may have some components or aspects of assurance in common.

All these factors will have an impact on the assurance framework, and in particular on the definition of metrics. The relationship between assurance methods will take account of these factors.

4.7 Assurance schemes

A specific assurance method that may be implemented in a way that emphasises the context within which the method is executed is called an assurance scheme. Recognised facilities and assessors might ensure a higher degree of assurance gained by using the respective assurance method. Such an assurance scheme may also provide a basis for acceptance of results or verdicts achieved by the assurance method in a broader audience.

4.8 Quantifying assurance risk and mechanism strength

Assurance does not “add” any safeguards or services to the deliverable. Thus it is sometimes difficult for non-security personnel to understand what benefit they are receiving from the investment of resources in assurance. For example, with respect to an IT security product, it has been argued that assurance contributes to the “strength” of a security mechanism; however, the assurance actually contributes to the confidence that one has in the mechanism strength by reducing the uncertainty (or probability) of a threat occurrence causing a security breach. For example, Two-Factor authentication is often mistaken as having more assurance than a simple password mechanism, where in reality it is only a stronger authentication mechanism. Two-Factor authentication is a stronger mechanism since it verifies two user attributes versus one attribute in a password mechanism. This in itself does not offer assurance since it is the assurance activities in the development of the mechanism that contributes to the assurance of the mechanism.

It is important to understand that assurance does not automatically imply good security: only that it meets its security objectives (security policy). In other words, the assurance provides confidence that the deliverable enforces its security objectives without examining if the security objectives appropriately address the risks and threats. For example, while a high assurance IT product can be trusted to meet its security objectives, it depends on the nature of these objectives whether or not the product behaves in a secure manner. In contrast, a low assurance product with more appropriate objectives may actually be more secure.

4.9 Assurance reduces security risk

Assurance contributes to a reduction of risk, in-so-much-as assurance reduces the uncertainty associated with vulnerabilities of the deliverable, and thus the potential vulnerability is reduced leading to a reduction in the overall risk associated with the deliverable. As discussed in the previous clause, assurance does not add any additional controls to counter risks related to security, rather the assurance activities attempt to substantiate that the deliverable satisfies its security objectives. This involves the production of assurance relevant evidence and rationale to provide the confidence that the controls implemented will reduce the anticipated risk.

4.10 Quantifying assurance

Direct qualification or valuation of the contribution of assurance or increased assurance to the organization is not easy to achieve. However, increased assurance of a security control does reduce the uncertainty associated with the risk, specifically the vulnerability components of the risk, that the control is implemented to address. Thus the value of the assurance in this case can be inferred from a reduction in the uncertainty associated with the risk. Relating assurance to the uncertainty of a risk, or its constituent parts, facilitates assurance measurements; as the uncertainty of a risk occurrence is easier to quantify than assurance itself. Assurance measurements could be made indirectly by measuring the likelihood of the risk occurrence and then adjusted, as it is inversely proportional to assurance.

4.11 Assurance authority

The Assurance Authority is a person (or body) responsible for decisions pertaining to the deliverable at a specific stage of its lifecycle. Given that there are several stages within a deliverable’s lifecycle and several stakeholders, there will be several Assurance Authorities, each with their vested interest and specific responsibilities. For example, during the development phase, the Assurance Authority may be a security engineer in the vendor organisation responsible for ensuring the appropriate assurance is built in to the deliverable. Simultaneously, the client organisation may have their own Assurance Authority responsible for ensuring their assurance requirements are addressed by the vendor organisation. Still, another Assurance Authority may exist in the evaluation organisation responsible for ensuring the deliverable satisfies the assurance scheme. Here we see three Assurance Authorities each responsible for a particular stage of the deliverable and from different perspectives. Furthermore, an Assurance Authority may be responsible for multiple stages. Such would be the case if the client Assurance Authority in the example above, would also be responsible for accepting the certification report submitted by the Certifier.

Assurance Authorities are applicable to all types of security deliverables regardless if it is a product, system, service, process, personnel, etc. The Assurance Authority is responsible for the assurance decisions surrounding the deliverable with respect to the organisation’s objectives.

Depending on the organisation and their responsibilities, the Assurance Authority will have any number of responsibilities. Some of their tasks may include selecting the appropriate assurance method and identifying the required amount and type of assurance required to satisfy their specific requirements. The assurance authority also has the responsibility of liaising with other assurance organisations such as the assurance assessment organisation with concerns regarding the IT security evaluation scheme if for example ISO/IEC 15408 and its corresponding scheme were being used.

Within certain organisations, in particular within government and military organisations, assurance may be regulated, limiting the choices and at the same time, the risk to the Assurance Authority. Organisations may designate different roles as the Assurance Authority and the duties may differ according to their unique operating models; however, the assurance authority will still be responsible for the required duties. In small organisations, an employee would typically have other duties in addition to being the Assurance Authority where larger organizations may have a dedicated employee assume the role of the Assurance Authority. Larger organisations would usually designate a senior employee as the Assurance Authority to be accountable for the implementation of an assurance method and acceptance of the assurance results.

Depending on the organisation, the person responsible for final acceptance of the assurance results may also be accountable for the operation of the deliverable (i.e. putting the system into operation or accepting the service delivered). Therefore, the Assurance Authority will often have to determine an appropriate balance between the extent and depth to which assurance is performed, and thereby the cost and time frame of the related assessment activities.

5 Selecting security assurance

Selecting a security assurance method and the appropriate amount of assurance is a decision that should be based on the organisational security assurance policy, business requirements, and type of deliverable (i.e. product, process, environment, system, service or personnel). For example, some assurance methods are only applicable to processes (i.e. SSE-CMM (ISO/IEC 21827)) while others are applicable to products (i.e. ISO/IEC 15408).

The selected assurance method should be compatible with the organisation's environment and be capable of examining the desired attributes and life cycle stages of the deliverable. The assurance method selection must take into account the available resources (time, personnel, budget, etc.) to ensure that the resources expended are reasonable for the type and amount of assurance obtained. For example, adding a fifty thousand dollar safeguard to a low assurance deliverable would be unreasonable. Similarly, there is no need to select an evaluation assurance method (i.e. TCSEC, ITSEC, CTCPEC, ISO/IEC 15408) when a shorter assurance method would be acceptable (assuming that an evaluation assurance method is not mandated) and save months off the schedule[1]. For organisations (i.e. government departments) that are required to choose vendors who have developed evaluated IT security products, and use IT security evaluated products to gain assurance, there may be little requirement for decision thus eliminating most or all of the expense of resources for consideration of options.

For example, a private organisation could use the SSE-CMM (ISO/IEC 21827) assurance method to establish assurance of their corporate website to prevent unauthorised persons from accessing the private part. This would require an assessment of the processes surrounding the development, deployment, and operation of the website including the processes to implement the security and operational policies. Based on the findings, an assurance argument would be produced along with a SSE-CMM (ISO/IEC 21827) maturity level of the organisation. This assurance method should suffice, as the Assurance Authority only needed to address their internal security assurance policy. A second example is of a government department that used the ISO/IEC 15408 assurance method to establish high assurance because it was required to use this particular assurance method and approach to meet specific government security requirements. This example demonstrates the latitude that the Assurance Authority has depending on the organisation and their security assurance policies. No statement is made regarding which assurance method is better or provides more assurance. Where existing policy or regulation does not prescribe a particular assurance method and

[1] These are simplistic examples to demonstrate a point and not to imply actual dollar amounts or time frames with respect to a particular assurance method.

assurance level, the selection of an assurance method and assurance level has to be selected in fulfilment of the assurance requirements which correspond to the security requirements as a function of the security objectives. However, it is possible that security risk management may indicate situations where greater assurance is required, in-so-much-as if security risk management is having to address high levels of uncertainty, then increased assurance can contribute to a reduction in overall uncertainty, and thus a net reduction in security risk. In these situations increased assurance is indicated.

Note that even when an assurance method is mandated, there may be some options available, such as:

a) what to assure;

b) how much assurance;

c) which evaluation lab to use; and

d) which certification and accreditation services to use.

There are many different assurance approaches and methods available with few assurance methods being widely accepted or regulated. Guidance is therefore required to assist stakeholder(s) in selecting and applying an assurance method.

5.1 Assurance requirements specification

Prior to choosing and/or performing assurance methods, the assurance requirements have to be specified. Various methods are available to arrive at these specifications. Generally a TRA and organisational security assurance requirements will aid in the selection of the assurance method. Requirements may also include regional and business aspects such as when a customer requires a specific assurance approach such as ISO/IEC 15408 to satisfy internal or procurement requirements.

To address organisation or market requirements, the assurance requirements specification may include recognition and acceptance of the assurance method or assurance scheme, mutual recognition, and minimal assurance level.

Examples of assurance requirements include constraints on the rigour of the development process and/or requirements to search for and analyse the impact of potential security vulnerabilities.

When the deliverable contains security mechanisms such as a password or hash function, the assurance requirements may specify a minimum strength level consistent with the security objectives be claimed.

Assurance requirements specifications should address all organisational requirements and contain all mutually supportive assurance components such as correctness assurance and effectiveness assurance. Furthermore, acceptable assurance approaches and methods need to be detailed as well as specifying the Assurance Authorities, their responsibilities, and communication channels.

5.2 Economical aspects

Assurance generally is resource intensive causing cost and delays. Furthermore, assurance is geared to prevent losses rather than providing revenue or profit. Therefore its return on investment is not measurable but hypothetical similar to insured losses. Even when a supplier amortises assurance over a number of IT security products, it may take several years to recoup the investment depending on the assurance method and desired assurance level. The benefit an organisation receives from the investment of resources in assurance will not be obvious to people not familiar with security issues and therefore it may require extensive justification and must be well presented to gain management approval.

Different forms of assurance target different audiences. For example, the assurance provided by a warranty is of little value to the user when the system is down, but it is of value to the manager in defraying the cost of a delay. In a similar manner, the assurance provided by a guarantee of technical support if the system fails is of little value while the system is functioning, but will be of value to operations if the system malfunctions.

All forms of assurance provide different benefits to different parts of the organisation; not assessing these different benefits devalues the assurance being obtained.

What assurance actually does is reduce uncertainty, at least with respect to vulnerabilities associated with the IT security product or service. Uncertainty is associated with all factors used in the assessment of security risk. Thus reduction of uncertainty facilitates focusing on the aspects that are truly of greatest risk to the organisation. This represents a measurable benefit to the organisation and a beneficial investment of resources.

5.3 Organisational aspects

It is important to recognise the security environment, and in particular to understand that the assurance requirements reflect the organisation's culture and business requirements. An understanding of the organisational requirements is necessary to decide whether a particular assurance method is acceptable and/or how much assurance is sufficient. The organisation policy should specify the following:

a) how assurance requirements are to be determined;

b) the circumstances under which a deliverable should be certified against a particular standard;

c) standards against which deliverables are to be certified;

d) the degree of assurance required in certification processes in nominated circumstances;

e) responsibilities for an assurance authority; and

f) the circumstances where accreditation of deliverables is necessary.

For example, a government organisation may decide to specify and control the assurance process to for their specific environments. They may develop all aspects of the process such as the assurance methods, criteria (a standard), guidance on using the standard, performing assessment, and even the level of assurance required. However, the assurance authority for the accreditation will still have to make the final decision of acceptable assurance and be held accountable for resources and schedule. By contrast, a private organisation may choose to select a de-facto assurance method for their in-house development if their Assurance Authority is not required to satisfy external influences. The organisational policies are essential to specify what is required and also referenced when verifying if the security safeguards and assurance are appropriate to the organisation.

5.4 Type of assurance

To address the composition of multiple assurance methods for a specific deliverable, it is best to construct a security assurance model to show how the different types of assurance are intended to work together to contribute to the total assurance associated with the deliverable. The security assurance model for a deliverable can then be composed of different constituent assurance models each corresponding to a specific assurance approach (i.e. evaluation assurance, process assurance, development assurance). In this way, the deliverable assurance model by being a compound of several distinct assurance models, will address how these assurance models are combined regardless of the assurance phase to which they have been applied. Further, it may be that some security assurance associated with the deliverable is not directly intended for the next recipient of the deliverable, but is in fact intended for the final recipient. The model can show this clearly, and help to ensure that the final recipient receives a clear picture of the associated security assurance.

Each assurance model can then specify the type and quantity of assurance for a specific life cycle stage of the deliverable to facilitate comparison. The deliverable assurance model would glue the distinct models together by describing the trade-offs and providing the rationalisation to describe the resultant assurance for the deliverable.

5.5 Technical aspects

Many assurance methods are available to choose from and offer potential for optimisation in terms of resources and time frame. The assurance method should be selected from the following list as is appropriate for the deliverable or its attribute(s) to be assessed:

a) assurance methods applicable exclusively to specific IT deliverables such as IT security hardware or software products, systems, networks, personnel, services, etc;

b) assurance methods specific to a life cycle process; or

c) assurance methods based on experience and actual usage.

Applying an assurance method to assess the assurance of a deliverable may yield different types or quantities (levels) of assurance due to:

a) deficiencies or characteristics of the deliverable;

b) the size and complexity of the deliverable;

c) differences in the applied assurance methods;

d) applying an assurance method with a limited rigour or effort;

e) the nature of the security objectives being met;

f) the specific environment;

g) the specific IT life cycle stage; or

h) the combination with other methods.

Incremental assurance of a deliverable may be gained from:

a) increased knowledge of its pre-existing IT security capability; and/or

b) improved capability of its IT security mechanisms.

Each assurance method has its own application as well as pros and cons, depending on individual security requirements. It is necessary to understand how each assurance method establishes assurance in order to decide if a particular assurance method will satisfy the assurance requirements.

For example, when a system is deployed, consisting of a set of products (whose level of assurance may or may not be known or accepted due to the assurance method used) the recognisable level of assurance is usually determined by the system certification prior to operation.

Technical considerations impact the decision, as some assurance methods may be better for simple versus complex deliverables. For example, it is usually easier to verify a deliverable with minimal security functionality (i.e. thousands of lines of code) and achieve a high assurance result than a deliverable with extensive security functionality composed of millions of lines of code.

The type and level of assurance possible from a particular assurance method is determined by the assurance method's features, i.e. the particular life cycle stages assessed, and the security element assessed.

5.6 Optimisation considerations

Deciding on the assurance methods and amount of assurance required is not an exact science and requires the assurance authority to determine the correct mix of assurance methods and the appropriate assurance to satisfy the organisation's requirements. To that end, the IT system and assurance method attributes must be taken into account.

If several assurance methods are applied, more weight may be given to the assurance results derived from the last assurance method applied just prior to final acceptance of the deliverable. Therefore, the assurance authority for the last assurance method must weigh the current assurance results and may have to make a

judgement call if any previous assurance results are not satisfactory. Furthermore, as authority for the last assurance activity, they will ultimately be accountable for the operation of the deliverable.

Assurance may be derived incrementally through the vendor of an IT security product, systems integrator or service provider in some form of guarantee or warranty of performance of the product or service.

With respect to deliverables with adequate assurance it should be noted that in particular the integration of one or more deliverables into their final target environment generally has a negative impact on the resulting security assurance level. Consequently, additional assurance may be required.

6 Framework

6.1 Assurance approach

Assurance methods can be categorised into three high-level assurance approaches:

a) assessment of the deliverable, i.e., through evaluation and testing;

b) assessment of the processes used to develop or produce the deliverable; and

c) assessment of the environment, such as personnel and facilities.

Assessment of a deliverable involves an examination of the deliverable (product, system, service, etc.). In this case, these assurance methods examine the deliverable and its associated security design documentation independent of the development processes.

Assessment of a process involves an examination of the organisational processes used in the production and operation of the deliverable throughout its life cycle (development, deployment, delivery, testing, maintenance, disposal, etc.). Assurance is gained through the inference that the processes implemented by people affect the quality of the development and implementation of the deliverable and therefore yield security assurance when applied to IT security deliverables.

Assessment of the environment involves an examination of the environmental factors that contribute to the quality of the processes and the production of the deliverable (It does not examine a deliverable or process directly). These factors include personnel and physical facilities (development, production, delivery, operation, etc.).

NOTE By contrast, assurance approaches such as evaluation assurance obtained from applying evaluation criteria such as ISO/IEC 15408 assess the TOE directly over a subset of its life cycle and offer a unique blend of assurance.

Examples: ISO/IEC 15408 examines the TOE directly and produces evaluation assurance which is an agreed upon set of development, assessment, and testing assurances whereas ISO 9001 focuses on examining the manufacturing processes.

6.2 Assurance methods

ISO/IEC TR 15443 covers a broad range of existing methods to obtain assurance. This includes official national or international standards, de-facto standards, and other accepted methods, which have or utilize a specified and systematic method.

An example of a de-facto standard is the SSE-CMM Appraisal Method (SSAM), which is a well-documented assurance method; however, it is not a national or international standard. An example of another de-facto standard is the Trusted Product Evaluation Process (TPEP) assurance method. Although, the TPEP is an acceptable standard used successfully by some governments for the evaluation of IT security products, it is an undocumented proprietary evaluation method.

Assurance methods produce specific types of assurance depending on their technical and life cycle focus, which facilitates categorizing them according to assurance approaches. Table 1 lists some of the more widely

known assurance methods according to their focus and approach. Later parts of this Technical Report will contain a more comprehensive listing of assurance methods and address technical details and comparisons.

Table 1: Examples for assurance methods

Assurance Approach	Assurance Focus	Assurance Method Examples (includes the respective criteria or model)
Process	Quality and Development process	• ISO 9000 • ISO/IEC 15504 • HCD • SSAM (SSE-CMM (ISO/IEC 21827))
Deliverable, Process, Environment	Branding – Recognition of company to produce quality deliverables (based on historical relationship or data)	• Developer's Pedigree
Deliverable	Insurance (supported by manufacturer's promise to correct flaw in deliverable)	• Warranty Assurance
Deliverable	Self Declaration	• Supplier's declaration
Environment	Personnel expertise and knowledge	• Professional certification & licencing • Secure facilities
Deliverable	Direct Assessment of deliverable	• CEM (ISO/IEC 18045) • ITSEM (ITSEC) • TPEP (TCSEC) • TPEP (CTCPEC) • Rating Maintenance (RAMP (TCSEC)) • Rating Maintenance (RM (CTCPEC)) • Certification and Accreditation Assurance • ISO/IEC 14598-1 Software product evaluation
Deliverable, Process, Environment	Security Management	• Information security management systems - specification and guidance for use (BS 7799.2) • GISA/BSI Base Line Protection Manual • ISO/IEC 13335 • ISO/IEC 17799

6.3 Life cycle aspects

As human error, equipment failures, new vulnerabilities, and threats can occur in any life cycle stage of the deliverable, appropriate assurance is required at each of the deliverable life cycle stages (i.e. concept, development, integration, deployment, operation, and disposal). Therefore, the assurance methods must be appropriate for the specific stage.

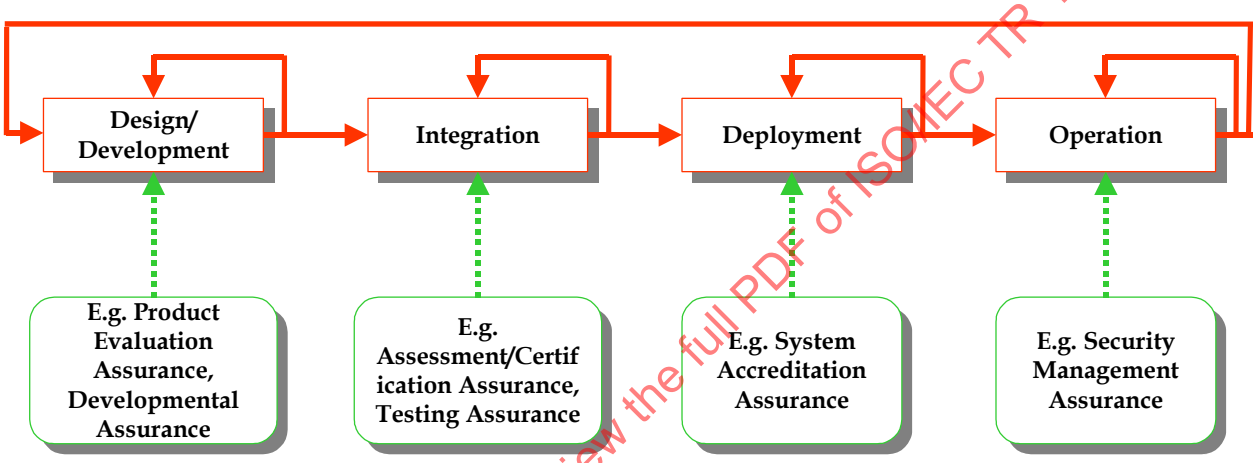
Functional deficiencies, change in requirements, and new vulnerabilities will affect assurance and require earlier life cycle stages to be entered again. Therefore, life cycle models must allow for a repetitive, overlapping or iterative relationship between the stages.

A sample life cycle model (Figure 1) is used to demonstrate relation of the assurance methods to a deliverable's life cycle stage. The sample life cycle model contains four basic stages general enough to be mapped to any specific life cycle model. Although the pictorial representations of each stage in Figure 1 are

similar, the activities and feedback will vary due to the unique assurance method employed. For example, some assurance methods use a maintenance phase method (i.e. TPEP Rating Maintenance) embedded in the operation stage to address faults and change requirements that affect only the operational assurance. This example demonstrates that the model can support a particular assurance method that will dictate whether the feedback is to its own stage or back to the beginning of the deliverable's Design/Development Stage.

Assurance methods may be specific to a particular stage (i.e. System Accreditation) or apply to several life cycle stages of a deliverable as can be seen by examining ISO 9000, ISO/IEC 15408, and the SSE-CMM (ISO/IEC 21827).

To achieve the resultant assurance, the assurance gained at each stage must be carried forward to the next stage where it will be factored into the assurance of that stage. This method of incrementing the assurance continues to the last stage of the life cycle model, which is the *operation stage* in the sample model shown in Figure 1.



NOTE: The life cycle model shown in Figure 1 is an example to demonstrate a model compatible with other life cycle models and frameworks to facilitate the analysis of assurance methods within ISO/IEC TR 15443. It is not intended to prescribe or recommend a particular life cycle model.

Figure 1: Assurance methods in relationship to a simplified model life cycle stages

6.4 Correctness versus effectiveness assurance

Correctness assurance refers to the assessment of the deliverable to verify the correct implementation according to the design. In contrast, effectiveness refers to the suitability of the deliverable's security functions to counter the perceived or identified threats. The next paragraph demonstrates that effectiveness and correctness assurance are both important assurance properties and neither can stand alone as they each address important aspects of the deliverable.

If the deliverable's security functionality addresses the potential threats, but the functionality has not been analysed to establish its correct design and implementation, then one cannot have confidence that the deliverable will withstand an attack. In this example, it is seen that the effectiveness assurance has been established but the correctness assurance has not due to the lack of verified security functionality. Similarly, if analysis has found the design and implementation of the deliverable's security functionality as correct; however, the design does not contain the appropriate functionality to address the probable threats, then one can not have confidence that the deliverable will withstand an attack by those threats. In this example, although the correctness assurance is there, it lacks effectiveness assurance due to the implementation of ineffective security functionality against the probable threats. In order to achieve comprehensive assurance, the deliverable must be assessed to ensure the correct design, implementation, and operation (correctness element) and the deliverable must provide the appropriate security functionality to counter the identified threats (effectiveness element).