Security Accreditation Scheme - Consolidated Security Requirements and Guidelines

Version 8.1

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1 Introduction

1.1 Overview

The GSMA operates Security Accreditation Schemes (SAS) for a number of sensitive processes (SPs). To fulfil the requirements of the relevant Security Accreditation Schemes, Auditees are required to follow the corresponding Standard, including achieving compliance with the relevant security requirements.

To ensure common standards across the schemes the GSMA publishes this Consolidated Security Requirements and Guidelines (CSRG) document. This document sets out:

- Statements of requirement that are relevant to SAS Auditees;
- Guidelines associated with the requirements that provide practical guidance to SAS Auditees to help them design, implement and operate security controls that meet the requirements.

The guidelines in this document are intended to help Auditees understand how to interpret and apply the GSMA SAS standard operationally. The guidelines should be read and used in conjunction with the statements of requirement and relevant scheme Standard and Methodology and are not intended to replace or supersede these statements of requirement or documents.

1.2 Audits

The SAS Audit itself will remain the basis on which compliance with the SAS Standard is assessed. Certification by the GSMA will be based on the Audit Team's assessment and recommendation.

The Audit Team will consider the quality and effectiveness of the implemented solutions and security management system to ensure that:

- They are integrated into the normal operations of the business
- They make appropriate consideration of security risks at the Site
- They are sustainable
- Evidence exists of their ongoing successful application
- They comply with the basic principles of the Standard
- The quality of the solution is consistent with that judged acceptable at other, similar, Sites.

Where the Audit Team is not satisfied that sufficient evidence exists that the solutions in place satisfy the above criteria, certification may not be recommended, even where solutions are based on the guidelines in this document.

It is difficult for the Audit Team to assess processes or controls that are newly introduced due to the lack of evidence. When scheduling certification Audits, Sites are strongly recommended to ensure that evidence exists of 4-6 weeks of continuous operation of the controls to be audited. Where changes are minor, the Audit may consider evidence of

previous versions of the process or control in addition to that in place at the time of the audit. In some cases, shorter periods of evidence may be acceptable.

Alternative solutions to those provided in the guidelines in this document may also be acceptable to the Audit Team if they do satisfy the above criteria.

1.3 Using this document

This document is intended to provide requirements, and guidelines to support those requirements, for all SPs within the scope of the different SAS schemes. Many of the requirements and guidelines are common across all schemes, however some requirements and guidelines are specific to individual SPs. The SPs for which each requirement and guideline apply are indicated in this document as described in section 2.2.

The SAS Standard document relevant to each Auditee's activities and certification will clearly define which of the SPs are, or may, be applicable.

SAS Auditees are responsible for ensuring that they have determined which of the SPs and requirements are relevant to them. In the event of any query, Auditees should contact sas@gsma.com.

1.4 Intended audience

- Security professionals and others within organisations seeking to obtain or maintain accreditation under the GSM Association Security Accreditation Scheme
- Security professionals and others within organisations seeking to procure products or services within the scope of the GSM Association Security Accreditation Scheme
- SAS Subgroup members
- SAS Auditors

1.5 Related documents

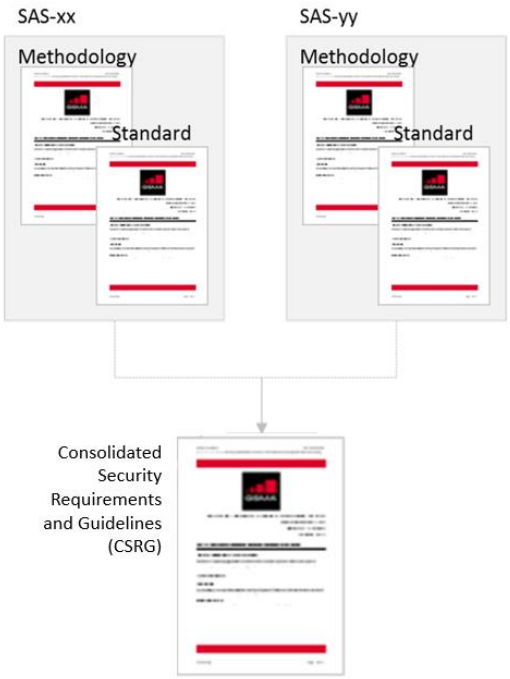
This document is part of the Security Accreditation Scheme documentation published by the GSM Association. Documentation is structured as follows:

Each SAS scheme comprises a **Methodology** and **Standard** relevant to Sensitive Processes (SPs) that should be protected**.**

The **Methodology** describes the purpose of the scheme and how it is administered.

The **Standard** describes the security objectives related to the relevant SPs.

The **Consolidated Security Requirements and Guidelines (CSRG)** describe all of the security requirements that may apply to SPs in



the different SAS schemes and provides examples of how the security requirements may be achieved.

Figure 1 - SAS Documentation Structure

The accreditation schemes and documents are designed such that multiple schemes will utilise the same Consolidated Security Requirements and Guidelines.

References to the Standard and Methodology documents for each SAS scheme can be found in section 1.9.

1.6 Document Updates and Applicability

This permanent reference document is classified by GSMA as an Industry Specification (as defined in GSMA AA.35 – Procedures for Industry Specifications [13]) and is maintained by the GSMA in accordance with the provisions set out in AA.35. In addition to the provisions of AA.35, the following conventions are followed, and the following examples are provided in relation to updates of this document.

1.6.1 Substantive Changes to Requirements

From 1 April 2022, substantive changes to the requirements in this document may normally be made no more frequently than once every six months, with major releases (indicated by an increment in the first digit of the document version number) permitted on 1 April and 1 October only. Substantive changes to the requirements are changes that would materially affect how an Auditee would implement controls to comply with the requirements.

Examples of the contents of substantive changes to requirements are:

- “shall” to “should” or “should” to “shall”;
- the addition, deletion, or revision of requirements, regardless of the number of changes; or
- the addition or modification of mandatory compliance with referenced standards.

Following publication of a major release of this document, a 6-month phased introduction period from the date of issue of the major update is allowed before Auditees are required to demonstrate compliance with the new release. Accordingly, Audit assessments during the phased introduction period are only made against the requirements as specified in the previous version of this document. Audits carried out after the end of the phased introduction period will apply the normal assessment criteria against the latest version of this document.

1.6.2 Non-Substantive Changes

Examples of non-substantive changes are:

- changes to requirements in this document that are not considered as substantive changes. For example:
  - Editorial changes
  - Error corrections and clarifications of requirements previously unclear
  - Changes to informative requirements text that is unlikely to significantly impact Auditees

  or

- any changes to the guidelines in this document

Non-substantive changes (indicated by an increment in the second digit of the document version number) may occur at any time subject to the normal GSMA document approval process. The latest version of the document becomes immediately applicable from its publication date.

1.7 Definitions

Term	Description
Actor	Person who is involved in, or can affect, the Sensitive Process
Audit	The SAS audit carried out by the Audit Team at the Auditee's Site
Audit Team	Two Auditors, one each from different GSMA-selected auditing companies, jointly carrying out the Audit on behalf of the GSMA.
Auditee	The supplier that is seeking SAS certification of its Site(s).
Auditor	A person qualified to perform SAS Audits
Business Continuity	Capability of the operator of a SP to continue to operate the SP at predefined levels (as determined by customer requirements) following a failure incident.
Certificate Authority	Responsible to issue Public Key Certificates. Could be the GSMA CI [11] or an independent eSIM CA [12] issuing certificates for EUM and SM-XX, or the EUM issuing certificates for eUICC
Duplicate	Two or more assets of the same nature showing a set of information that should be individual according to the correct process
Employee	An individual who works part-time or full-time under a contract of employment, whether oral or written, express or implied, and has recognized rights and duties. Also called worker.
Environment	Environment of use of the sensitive process limited to the security aspects

Term	Description
eUICC	A UICC which is not easily accessible or replaceable, is not intended to be removed or replaced in a device, and enables the secure changing of profiles. Note: The term originates from “embedded UICC”.
eUICC Management	A set of functions related to the registration of an eUICC to a SM-SR and the change of SM-SR for an eUICC.
Generation of Data for Personalisation	Generation of Data for Personalisation, or Data Generation, refers to the generation of any data that is to be encoded into a device intended to act as a UICC/eUICC to make it uniquely identifiable. This data may be: • Unique security keys that control future access to the device; • An eUICC Controlling Authority Security Domain (ECASD) and Issuer Security Domain – Root (ISD-R), and/or MNO profile data.
GSMA CI	A Certificate Authority accredited by the GSMA to enable global interoperability within the GSMA eSIM ecosystem in accordance with the GSMA eUICC PKI Certificate Policy SGP.14 [11].
HSM	A physical computing device that provides tamper-evident and intrusion-resistant safeguarding and management of digital keys and other secrets, as well as crypto-processing. FIPS 140-2 specifies requirements for HSMs. In the context of this document an HSM is defined by its FIPS 140-2 boundary.
HSM Partition	HSM Partition: An HSM Partition is an isolated environment in an HSM providing safeguarding and management of digital keys and other secrets, as well as crypto-processing. An HSM partition has its own data, access control, security policies and administration, isolated and independent from other partitions. The isolation might be logical or both logical and physical.
Integrated eUICC	An eUICC conforming to the GSMA SGP.01/02/21/22 eSIM specifications implemented on a Tamper Resistant Element (TRE) that is integrated into a System-on-Chip (SoC), optionally making use of remote volatile/non-volatile memory
Key	Any logical key (e.g., cryptographic key or certificate)
Personalisation	Personalisation is the process of encoding each device intended to act as a UICC/eUICC with the information (Personalisation Data) generated during the Data Generation process.
Personalisation Data	Data generated during the Generation of Data for Personalisation process.
Physical key	Any key and/or combination used for opening a physical lock (e.g., a door, vault, safe or secure cabinet)
PKI Certificate Management	PKI Certificate Management is the process of: • Securely generating a key pair and certificate signing request and submitting this to a recognised certificate authority / issuer. Securely storing the key pair and certificate and making them available under appropriate control for the generation of eUICC certificates. The definition refers only to the management of the key pair and certificate; the process of generating individual eUICC device certificates is included within the definition of “Generation of Data for Personalisation” for eUICCs.

Term	Description
Platform Management	A set of functions related to the transport, enabling, disabling and deletion of a Profile on an eUICC.
Profile	Combination of a file structure, data and applications to be provisioned onto, or present on, an eUICC and which allows, when enabled, the access to a specific mobile network infrastructure.
Profile Management	A set of functions related to the downloading, installation and content update of a Profile in a dedicated eUICC.
Reject	Finished or partially finished product containing sensitive information which has been ejected from the process.
Restricted area	An area, which may or not be a sub-area of an HSA, in which physical access is limited and enforced by access control devices where sensitive systems or components of the SP are installed.
SAS Subgroup	A group of GSMA members and staff that, together with the SAS Auditors, is responsible for maintenance and development of the SAS Standards, Methodologies, Consolidated Security Requirements and Consolidated Security Guidelines,
Sensitive Process	The security evaluation field, covering the processes and the assets within those processes. For the purposes of SAS, SPs can include activities related to UICC production, subscription management and certificate management.
Site	Auditee's physical facility and its relevant controls that are subject to the Audit.
Universal Integrated Circuit Card	A smart card that conforms to the specification written and maintained by the ETSI Smart Card Platform.

1.8 Abbreviations

Term	Description
BCP	Business Continuity Plan
CA	Certificate Authority
CM	Certificate Management
CSP	Cloud Service Provider
CSRG	Consolidated Security Requirements and Guidelines
eUICC	Embedded UICC (as defined above)
EUM	Embedded UICC Manufacturer
FIPS	Federal Information Processing Standard
FS.nn	Prefix identifier for official documents belonging to GSMA Fraud and Security Group
GSMA	GSM Association
HSA	High Security Area
HSM	Hardware Security Module
IT	Information Technology
MNO	Mobile Network Operator

Term	Description
PKI	Public Key Infrastructure
PRD	Permanent Reference Document
SAS	Security Accreditation Scheme
SAS-SM	Security Accreditation Scheme for Subscription Management Roles
SAS-UP	Security Accreditation Scheme for UICC Production
SGP.nn	Prefix identifier for official documents belonging to GSMA SIM Group
SLA	Service Level Agreement
SM-DP	Subscription Manager – Data Preparation
SM-DP+	Subscription Manager – Data Preparation (Enhanced compared to the SM-DP in SGP.02 [6])
SM-DS	Subscription Manager – Discovery Service
SM-SR	Subscription Manager – Secure Routing
SM-XX	SM-DP, SM-SR, SM-DP+, or SM-DS
SP	Sensitive Process
UICC	Universal Integrated Circuit Card (e.g., a SIM card)

1.9 References

Ref	Doc Number	Title
[1]	PRD FS.04	GSMA SAS Standard for UICC Production, latest version available at www.gsma.com/sas
[2]	PRD FS.05	GSMA SAS Methodology for UICC Production, latest version available at www.gsma.com/sas
[3]	PRD FS.08	GSMA SAS Standard for Subscription Manager Roles, latest version available at www.gsma.com/sas
[4]	PRD FS.09	GSMA SAS Methodology for Subscription Manager Roles, latest version available at www.gsma.com/sas
[5]	PRD SGP.01	Embedded SIM Remote Provisioning Architecture
[6]	PRD SGP.02	Remote Provisioning Architecture for Embedded UICC Technical Specification
[7]	PRD SGP.21	Remote SIM Provisioning Architecture
[8]	PRD SGP.22	Remote SIM Provisioning Technical Specification
[9]	RFC 2119	“Key words for use in RFCs to Indicate Requirement Levels”, S. Bradner, March 1997. Available at http://www.ietf.org/rfc/rfc2119.txt
[10]	BSI-CC-PP-0084-2014	Security IC Platform Protection Profile with Augmentation Packages. Version 1.0 (13.01.2014).
[11]	PRD SGP.14	GSMA eUICC PKI Certificate Policy, available from www.gsma.com
[12]	PRD SGP.28	eSIM CI Registration Criteria
[13]	PRD AA.35	Procedures for Industry Specifications

1.10 Conventions

The key words “must”, “must not”, “required”, “shall”, “shall not”, “should”, “should not”, recommended”, “may”, and “optional” in this document are to be interpreted as described in RFC2119 [9].”

2 Security Requirements and Guidelines

2.1 Introduction

In order to consider activities secure, certain requirements must be met. These requirements are considered as minimum-security requirements for the environment in which the SP is used.

These requirements are, in general, non-prescriptive. Participants are permitted to meet requirements by deployment of appropriate controls rather than by using specific tools or solutions, provided that the same security objective is met to an acceptable level. An approach to meeting the security requirements is defined in the guidelines.

NOTE: Numbering of the sections and requirements below restarts at (1) and applies independently of other sections in this document. The requirements should be referenced by the numbering system herein which will be applied consistently across the SAS documentation.

2.2 Application of requirements/guidelines

The applicability of requirements to different activities is indicated through the following scope symbols:

All	Applies to all participants, regardless of activity
UP	Applies to participants conducting UICC production
SM	Applies to participants conducting Subscription Management activities
CM	Applies to participants conducting Certificate Management activities
I	Applies to participants having Integrated eUICC form-factor
DC	Applies to participants conducting Data Centre Operations and Management activities, including those providing Cloud Services that host services subject to SAS certification.

In all cases the scope symbols apply:

- to the statement against which they are marked
- to all subsequent statements of the same numbering depth where no different scope has been indicated

All statements of lower depth in the numbering scheme inherit the scope from the parent, unless an alternative scope is indicated.

2.3 Requirement Statements and Guidelines

Requirement Statements			Guidelines	
1 Policy, Strategy and Documentation				
All	The security policy and strategy provides the business and its employees with a direction and framework to support and guide security decisions within the company and at the location where the SP takes place.			
	1.1	Policy		
	1.1.1	A clear direction shall be set and supported by a documented security policy which defines the security objectives and the rules and procedures relating to the security of the SP, sensitive information and asset management.		A documented security policy should exist, either as a stand-alone document, or as part of a security manual. The policy should be a statement of overall security principles and management intent. The security policy document should be endorsed by senior management at the site. The policy should be supported by appropriate documentation – either as individual policies, or as part of an overall security manual.
	1.1.2	Employees shall understand and have access to the policy and its application should be checked periodically.		Objectives and rules should be available to employees. A mechanism should exist for ensuring that important changes to security rules and documents can be communicated effectively to all affected employees.
	1.2	Strategy		
	1.2.1	A coherent security strategy must be defined based on a clear understanding of the risks. The strategy shall use periodic risk assessment as the basis for defining, implementing and updating the site security system. The strategy shall be reviewed regularly to ensure that it reflects the changing security environment through ongoing		There should be evidence of a coherent security strategy based on a clear understanding of the risks, based on risk assessment, and design of the security management system to address them appropriately. There should be evidence of regular formal security risk assessments taking place. Results of risk assessment should be used to drive revisions to the security strategy and security management system. The risk assessment methodology should demonstrate clear structures for:

Requirement Statements			Guidelines	
		re-assessment of risks.		• Risk identification • Assessment/evaluation of the identified risks. The SAS Standards set out one sample framework for risk identification. Many formal methodologies exist for risk assessment, although most will involve evaluation of likelihood and impact (possibly in conjunction with other factors) on defined scales. Such scales should be clearly defined to ensure that they are applied in a consistent and repeatable way, e.g., by quantitative definition. Whilst the same risk assessment methodology can often be applied to different types of risk it is normally beneficial for a security risk assessment to be undertaken separately from other risk assessments (e.g., business continuity) to ensure correct focus on the relevant assets and threats.
	1.3	Business Continuity Planning		
	1.3.1	Business continuity measures must be in place:		The business continuity plan (BCP) should be developed as a working business document (rather than one developed specifically for SAS compliance). The BCP should reflect the availability requirements of the SP and any specific customer service level agreements (SLAs) in place. SAS compliance will require specific issues to be addressed, including: • Definition of incidents that critically affect the SP based on a business continuity risk assessment and impact analysis • Processes for management of scenarios that affect the SP • Mechanisms and processes in place to ensure continuity of operations • Management of customer contact and customer data • Maintenance of the integrity of the security system and production processes. All personnel with BCP responsibilities should receive formal training. The BCP should be subject to periodic testing (e.g., once per year). Scenario-based testing will normally be appropriate for most periodic tests.

Requirement Statements			Guidelines	
				For the purpose of SAS, a scenario-based test would typically comprise a simulation of a BCP incident: • A sample scenario is defined that could or would lead to a business continuity incident. • Key personnel are presented with the scenario • The BCP team execute the BCP as a simulated desktop-based exercise. Each member of the team role-plays their individual actions and interactions. • Interfaces to external stakeholders (customers, suppliers, corporate teams) may be tested from time to time as appropriate but will normally be simulated. • At the end of each test a review will allow improvements to the plan and to team training to be identified. Scenarios should be selected that exercise all elements of the BCP for response and recovery. Scenarios should be varied for each test to ensure appropriate coverage of all elements of the BCP.
	(i)	to ensure an appropriate level of availability		Availability requirements will vary dependant on the SP, its implementation and the relationship with other entities (e.g., customers). Auditees will always be required to make clear the level of availability that is required for the relevant SPs and the relationships with other entities (e.g., by contract).
				Where high availability is required then appropriate controls should be in place, to consider where applicable: • Continuous, uninterrupted access to electric power • Control of temperature and relative humidity within a defined operating range • Live switchover to an alternative / backup site where necessary.
			CM	Facilities should be sufficient to:

Requirement Statements			Guidelines	
				• Lock out input, finish any pending actions, and record the state of the equipment automatically before a shutdown. • Provide sufficient continued operation for repositories (containing Certificate Authority (CA) Certificates and Certificate revocation status) in the absence of commercial power, to maintain the required level of availability.
			UP	There is no specific requirement within SAS-UP for a backup site, however sites with no backup agreement should ensure that this is contractually acceptable to customers.
	(ii)	to enable response and recovery in the event of a disaster.		
	1.4	Internal audit and control		
	1.4.1	The overall security management system shall be subject to a rigorous programme of internal monitoring, audit and maintenance to ensure its continued correct operation.		A programme of internal checks and audits should be defined that demonstrates appropriate consideration of: • The frequency of checks required for each area addressed by the internal audit mechanism • The structure of the audits themselves, including clear guidance on what should be checked and how The recording / documentation and follow-up process for audits undertaken. The auditors will expect to see evidence that processes and systems are working correctly, and that internal checks have been carried out according to the schedule. There should be appropriate coverage of all aspects of the system; the audit programme should be defined around the need to provide appropriate coverage, rather than the availability of audit resource. The programme should normally consider controls at a number of different levels: • Operational controls and checks should be conducted regularly as part of the normal function of each area, or as an integrated part of

Requirement Statements			Guidelines	
				business processes. Such checks may be conducted by operational or supervisory personnel within the area, or as an independent control by an auditor or audit group from another business area. • Independent checks should be conducted periodically to validate the effectiveness of the operational controls. Checks should be conducted by an auditor or audit group independent of operational or supervisory personnel from the area concerned. ○ Records of operational controls should be checked to ensure their completeness. ○ Independent validations of their effectiveness should also be carried out. • Reviews of the whole audit system should be conducted periodically to ensure the completeness and appropriateness of its coverage • Additional levels may be required in some areas dependant on the scale of the operation. • Care should be taken to ensure that a rigid or prescriptive audit system does not prevent identification of new or emerging issues. Auditors should have received appropriate training in the structure and content of internal audits.

Requirement Statements			Guidelines	
2 Organisation and Responsibility				
All	A defined organisation shall be responsible for ownership and operation of the security management system.			
	2.1	Organisation		
	2.1.1	To successfully manage security, a defined organisation structure shall be established with appropriate allocation of security responsibilities.		The security organisation should be clearly defined and documented as part of the security management system.
	2.1.2	The management structure shall maintain and control security through a cross-functional team that co-ordinates identification, collation, and resolution, of security issues, independent of the business structure.		A cross-functional forum for discussion, escalation and resolution of security issues and solutions should exist and meet regularly (at least once per quarter). The forum should include senior management representatives. Evidence should exist of forum meetings taking place.
	2.2	Responsibility		
	2.2.1	A security manager shall be appointed with overall responsibility for the issues relating to security in the SP.		Security responsibilities of the security manager should be clearly defined. Although it may not always be appropriate to have a dedicated / full-time security manager role, auditees should be able to demonstrate that sufficient time is available for security management activities.
	2.2.2	Clear responsibility for all aspects of security, whether operational, supervisory or strategic, must be defined within the business as part of the overall security organization.		Responsibilities should be clearly documented and well understood within the business. Where security management roles are defined separately (e.g., physical and IT security), suppliers should be able to demonstrate an overall co-ordinated / integrated approach to security management with responsibilities clearly defined.
	2.2.3	Asset protection procedures and responsibilities shall be documented throughout the SP.		Employees should be made responsible and accountable for sensitive assets (both physical and information) within their care throughout the sensitive process.

Requirement Statements			Guidelines	
				Responsibility should be clearly defined, even where assets are in intermediate / temporary storage between sensitive process stages, such that a clear 'owner' can always be identified. Control of access to assets should reflect the assigned responsibility (such as key management, customer interface, IT administration). Procedures for documenting handover of assets should be clearly defined. Asset protection mechanisms applicable at each processing stage should be documented as part of the production process and supporting documentation. Protection mechanisms should be clearly understood by the employees affected.
	2.2.4	Clear security rules shall govern the manner in which employees engaged in such activities shall operate within the SP. Relevant guidelines should be in place and communicated to all relevant staff.		
	2.3	Incident response and reporting		
	2.3.1	An incident response mechanism shall be maintained that includes a process for the investigation and mitigation of:	All	An escalation process / mechanism should be in place where security breaches are identified. When any security breach is identified, an incident management process should be activated including impact analysis, setup of remediation plan and notification to any external third parties possibly impacted. All such security breaches should be tracked and reported.
			CM	The incident response mechanism should require the public key infrastructure (PKI) Policy Authority to be promptly notified of any incidents that may have affected the integrity and trust of the PKI.

Requirement Statements			Guidelines	
	(i)	accidental or deliberate breach of internal regulations and procedures		
	(ii)	suspected or detected compromise of systems, or receipt of notification of system vulnerabilities		
	(iii)	physical or logical penetration of the site		
	(iv)	denial of service attacks on components (where applicable)		
	2.4	Contracts and liabilities		
	2.4.1	In terms of contractual liability, responsibility for loss shall be documented. Appropriate controls and insurance shall be in place.		Contracts with customers and suppliers should clearly define responsibility and liability for loss. Where contracts with customers are not standardised (i.e., different contracts may be agreed with different customers) mechanisms should exist to ensure that all contracts are in line with an overall framework for liability and loss. Evidence should exist that the supplier is able to cover its liabilities for loss of physical assets or data, and for consequential loss where defined within contracts. Normally it will be expected that insurance will be in place to cover such losses.
	2.4.2	Where activities within scope of SAS certification are outsourced or sub-contracted, partners providing or operating these services shall be contractually responsible to ensure an appropriate level of compliance with the SAS requirements.		Outsourcing agreements may relate to: • Personnel (that are not employees of the auditee) conducting activities at the Primary certified location. • Separate physical locations (Secondary or Supporting sites) where substantive elements of the activities within scope of SAS certification are carried out. The concepts of Primary, Secondary and Supporting sites within SAS certification are defined within the respective sections of the SAS-UP (FS.05)

Requirement Statements				Guidelines	
					and SAS-SM (FS.09) Methodologies. The overall objectives are always to ensure that an equivalent level of control is applied to activities that are outsourced, compared to those carried directly by an auditee, and that the auditee has assurance of this.
	(i)	Responsibilities that fall within the scope of the auditee's SAS certification shall be clearly documented and agreed.			Contracts or associated documents (e.g., service level agreements) should clearly define the role and responsibilities of outsourcing partners that provide services to the auditee that fall within the scope of the SAS audit. These documents will often form part of the standard business level agreement, rather than being something created specifically for the purpose of SAS certification. Where the sub-contractor is specifically required to operate or maintain security controls there should be clear references to the internal or external standards that must be maintained. • For outsourced personnel operating at the primary certified site, this may simply be a requirement for them to work in-line with the site's own local security policies. • For physically separate sites, these standards may be the auditee's own internal/corporate standards, specific requirements defined as part of the contract, or may be references to external standards (such as the SAS requirements).
	(ii)	Contracts shall include a "right-to-audit" clause (or equivalent mechanism) to: • Enable auditees to confirm that contractual responsibilities and obligations are maintained at the required level by the outsourcing partner / sub-contractor. • Include the right of the auditee to require the outsourcing partner / sub-contractor to participate in the SAS audit process, where applicable.			New contracts should always have a right-to-audit clause included to enable the auditee's internal audit team to validate the responsibilities of the outsourcing partner or sub-contractor. Where existing contracts do not contain a right-to-audit clause, auditees should work with the external providers to ensure that operational agreements are in place to facilitate reasonable audit requests, with mechanisms to escalate where co-operation is withheld without good reason. Where applicable, contracts should clearly define the responsibility to maintain compliance with the relevant SAS requirements and to participate in the SAS audit process. This applies regardless of whether the external provider is an outsourcing provider working on-site, an independent participant in the scheme, or a secondary or supporting site to the auditee's own certification.

Requirement Statements				Guidelines	
					Auditees should be aware that refusal by an outsourcing partner or sub-contractor to co-operate or participate in an SAS audit process may critically impact the auditee's own ability to achieve certification.
UP CM	2.4.3	For eUICC production, transfer of class 1 assets between sites must enforce integrity of SAS-UP certification throughout the production chain.			The obligation to hold SAS-UP certification applies to destination sites performing PKI Certificate Management, Generation of Data for Personalisation and Personalisation. Destination sites performing post-personalisation packaging of eUICCs only are not required to be SAS-UP certified under this requirement. Where this requirement applies, contracts with destination sites should mandate that the destination site holds SAS-UP certification for the activities in scope of SAS-UP that it performs
	(i)	eUICC production data must only be supplied to SAS-UP sites for further processing or production.			
	(ii)	Physical eUICC devices must only be transferred to SAS-UP certified production sites until/unless: • They are personalised eUICCs already capable of accepting an operator profile in accordance with the GSMA specifications SGP.01 [5], SGP.02 [6], SGP.21 [7] and/or SGP.22 [8] as applicable.			
	(iii)	Specified class 1 information assets must never be transferred unless specifically disclosed and agreed as part of the SAS-UP certification: • PKI certificate key pairs must only be used at designated sites, as described in 6.6.2.			

Requirement Statements			Guidelines	
3 Information				
All	The management of sensitive information, including its storage, archiving, destruction and transmission, can vary depending on the classification of the asset involved.			
	3.1	Classification		
	3.1.1	A clear structure for classification of information and other assets shall be in place with accompanying guidelines to ensure that assets are appropriately classified and treated throughout their lifecycle.		An information and asset classification structure should be documented that is consistent with, or exceeds, those set out within the relevant SAS standard. The classification structure should not exist in isolation. Evidence should exist that the classification structure: • Links to a set of asset protection requirements / standards • Maps onto business processes to identify where sensitive assets are handled, and the asset protection standards are applied • Specifies the treatment during the entire lifecycle (that is, creation, processing, storage, transmission and disposal) The auditors will expect to see evidence of the classification structure being applied throughout the operation during the audit.
	3.2	Data and media handling		
	3.2.1	Access to sensitive information and assets must always be governed by an overall ‘need to know’ principle.		Individual physical and logical access rights should be formally documented. The ‘need to know’ principle should be used to ensure that an individual is granted no more than sufficient access to perform his or her job.
	3.2.2	Guidelines shall be in place governing the handling of data and other media, including a clear desk policy. Guidelines should describe the end-to-end ‘lifecycle management’ for sensitive assets, considering creation, classification, processing, storage, transmission and disposal.		A clear desk policy should be defined that considers both electronic and physical information assets. Guidelines should be in place to assist employees in understanding the asset classification scheme and defining the treatment of assets throughout their lifecycle. Specific controls should be in place for the secure handling of all media at end-of-

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				life. Procedures should be in place for: • the disposal of sensitive information to prevent its unauthorised use, access, or disclosure. • the treatment of sensitive data in electronic form stored on old or faulty equipment.

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4 Personnel Security				
All	A number of security requirements shall pertain to all personnel working within the SP and those with trusted positions.			General requirements should be applied to all personnel working inside the site where SPs are conducted. Trusted positions include all employees (both permanent and temporary), contractors, and consultants that have access to or control:
			All	• Sensitive information or assets

			CM	• Those authentication or cryptographic operations relevant to the SP at the site that may materially affect the following functions (typically applicable only to CAs):
				  ○ The acceptance, rejection, or other processing of Certificate Applications, revocation requests, or renewal requests, or enrolment information
				  ○ The issuance, or revocation of Certificates, including (in the case of Processing Centres) personnel having access to restricted portions of its repository
				  ○ The handling of Subscriber information or requests

	4.1	Security in job description		
	4.1.1	Security responsibilities shall be clearly defined in job descriptions.		All individuals having: • access to sensitive assets • a specific security role or security responsibilities should have a job description in which security tasks are clearly defined. For all other individuals a general security declaration should be defined.
	4.2	Recruitment screening		
	4.2.1	An applicant, and employee, screening policy		All employees should be subject to a screening process that should include:

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		shall be in place where local laws allow		• Formal interview • Validation of education and employment history. Clear policies should be defined for the periods of employment history that should be validated. Where local laws allow, screening should also include: • Criminal background checks • Credit checks. Where permitted, re-checking of criminal background and credit checks should be carried out on a regular basis (e.g., every year / 2 years). All checks should be documented to ensure that there is an auditable record of what checks were carried out, when and by whom.
	4.3	Acceptance of security rules		
	4.3.1	All recruits shall sign a confidentiality agreement.		All employees should sign a confidentiality agreement as part of, or in parallel with, their contract of employment. Temporary employees, contractors and visitors should sign confidentiality agreements.
	4.3.2	Employees shall read the security policy and record their understanding of the contents and the conditions they impose.		All employees should sign to indicate their understanding and accepting of the security policy as part of, or in parallel with, their contract of employment. Employees should be reminded of their acceptance of the security policy on a regular basis. Employees may be requested to re-confirm their acceptance of the policy on a regular basis; this may be done as part of the refresher training programme (see 4.3.3).
	4.3.3	Adequate training in relevant aspects of the security management system shall be provided on an ongoing basis.		All new employees should be provided with induction training covering basic security principles applicable throughout the site. Employees should receive refresher training in security principles on a regular basis (e.g., annually). Employees may be asked to re-confirm their understanding and acceptance of security policy as part of refresher training.

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				Mechanisms should be in place to ensure that all employees receive security training; auditable records should exist of training taking place, and those employees trained. Specific, focused, security training should be conducted for employees with specific security responsibilities.
	4.4	Incident response and reporting		
	4.4.1	Reporting procedures shall be in place where a breach of the security policy has been revealed.		Mechanisms should be in place for employees to make confidential reports of security incidents or suspicions. Follow-up and escalation mechanisms should exist for incidents reported.
	4.4.2	A clear disciplinary procedure shall be in place in the event that a staff member breaches the security policy.		
	4.5	Contract termination		
	4.5.1	Clear exit procedures shall be in place and observed with the departure of each Employee.		Exit checklists should be in place to ensure that company property has been retrieved and all privileges (e.g., physical and logical access) have been revoked. Procedures should exist to escort employees from the premises where appropriate. Employees should be reminded of their obligations under the confidentiality agreement prior to leaving the company.

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5 Physical Security				
All		Physical security controls are required at all sites where SPs are carried out, to consider the location and protection of the sensitive assets (both physical and information) wherever they are stored or processed. Buildings in which sensitive assets are processed or stored shall be of appropriate construction; robust and resistant to outside attack. Sensitive assets must be controlled within high security and restricted areas by using recognised security control devices, staff access procedures and audit control logs.		
	5.1	Security plan		
		Layers of physical security control shall be used to protect the SP according to a clearly defined and understood strategy. The strategy shall apply controls relevant to the assets and risks identified through risk assessment.		Security risk assessments should be conducted / updated on a regular basis (e.g., annually). Risk assessment findings should be used to drive continuous improvement and modification of controls.
	5.1.1	The strategy shall be encapsulated in a security plan that:		
	(i)	defines a clear site perimeter / boundary		The site boundary / perimeter is considered to be the point at which physical security controls - considering physical protection and access control - begin. Sites will vary in their definition of the boundary / perimeter. The boundary / perimeter from a physical security perspective will not always be the same as the boundary of the site itself (for example, where there is no boundary fence). In all cases sites will be expected to have considered, and defined, the site boundary and its role within the overall protection strategy for the site.
	(ii)	defines one or more levels of secure area within the boundary of the site perimeter		It is expected that all sensitive assets will be wholly contained within a high security area (HSA) from the time of receipt of raw materials through to despatch.

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				HSAs should be clearly defined and documented to include: • The perimeter of the HSA • The protection measures used to secure the HSA. Suppliers may choose to define several levels of HSA, to reflect the sensitivity of assets contained.
	(iii)	maps the creation, storage and processing of sensitive assets to the secure areas		The lifecycle of sensitive assets should be mapped against the HSAs defined.
	(iv)	defines physical security protection standards for each level of secure area		The expected, or required, physical protection standard for each level of HSA should be defined, to consider those elements defined in 5.2.1. Where multiple levels of HSA are defined, protection standards should be defined for each.
	5.2	Physical protection		
	5.2.1	The protection standards defined in the security plan shall be appropriately deployed throughout the site, to include:		
	(i)	physical protection of the building and secure areas capable of resisting attack for an appropriate period		Sites should make use of visible security mechanisms to act as a deterrent, which may include: • Fences at the site boundary • Perimeter lighting • CCTV • Access control • Guard presence / site monitoring.
	(ii)	deterrent to attack or unauthorized entry		Response and escalation times for secure areas should be defined. Requirements for attack times for secure areas should be set accordingly. Physical protection of secure areas should achieve, or exceed, stated attack times by ensuring that: • Walls should be of strong construction

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				• Points of access (windows and doors) to HSAs should be minimised • Doors and windows giving direct access into secure areas from outside (e.g., emergency exit doors) should be physically hardened to increase attack time. Suppliers should pay particular attention to the design of hinges and locking mechanisms used on access points to secure areas from outside: Multi-point locking mechanisms (including emergency doors) should be used. Removal or cutting of hinges should not allow doors to be opened.
	(iii)	mechanisms for early detection of attempted attack against, or unauthorized entry into, the secure areas at vulnerable points		When considering attack and response times, a response will be triggered only when an attack is identified. Sites should identify vulnerable points for access to secure areas (doors and windows; walls of weak construction; roof accesses). Detection mechanisms should be in place to identify attacks against these areas when they are taking place, rather than when they are successful. Mechanisms may include: • Movement detection sensors (microwave or infra-red) • Barrier systems (microwave or infra-red) • Seismic and vibration sensors • CCTV movement detection (based on automated image analysis).
	(iv)	control of access through normal entry / exit points into the building and SP to prevent unauthorized access		Automated access control systems should be in use.
	(v)	effective controls to manage security during times of emergency egress from the secure area and building		It is accepted that the priority during emergency evacuation of buildings is to ensure the safety of people. However, emergency evacuations often introduce vulnerabilities in site security, and may be exploited by attackers. Mechanisms should be in place to protect sensitive assets during such evacuations. Evacuation procedures should consider: • Responsibility for ensuring high security areas are cleared of all personnel during evacuation • Attempts to restrict unauthorised re-entry to buildings and high security areas, including:

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				○ Monitoring of emergency exit doors by nominated personnel ○ Use of self-closers on emergency exit doors. Procedures for addressing weaknesses in physical protection introduced as a result of emergency incidents (e.g., damaged security systems or physical controls). Mechanisms to ensure that all assets are accounted for prior to production re-commencing.
	(vi)	mechanisms for identifying attempted, or successful, unauthorized access to, or within the site		Intrusion detection (alarm) systems should be in use. The alarm system should make appropriate use of detection technologies to protect the secure areas, configured as one or more detection zones within the alarm system. Mechanisms should be in place to ensure that alarm zones are armed in accordance with a defined policy. Consideration should be given to automatic arming of alarm zones covering sensitive areas (e.g., data processing rooms, production server rooms, areas used to store or process class 1 assets) when they are not occupied. Alarms should be recorded to a system-generated log. Controls should be in place to enforce the integrity of the log. Actions taken in response to each alarm should be recorded as part of the response process. Independent checks should be carried out to validate that reasons are recorded for all alarms.
	(vii)	mechanisms for monitoring and providing auditability of authorised and unauthorised activities within the SP		CCTV systems should be in use. CCTV images should be recorded and retained for a minimum of: • 90 days where this is legally permissible • The maximum period legally permitted where this is less than 90 days. ○ Sites may be asked to provide evidence of legal restrictions It is acceptable for image capture and recording to be event-driven. Images should be recorded with sufficient frequency to provide good auditability of activities. As a guide:

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				• Cameras providing general coverage of movement of larger assets (e.g., packaged, sealed boxes), or of personnel movement, should typically exceed 3fps • Cameras providing detailed coverage of sensitive processes involving handling of individual UICCs should typically exceed 6fps • Some applications may demand higher frame rates, particularly where cameras are an integral part of the control systems used for counting product. Appropriate illumination should be provided for external CCTV cameras. Stored / archived CCTV images should be retrievable for specified dates / times / locations. Physical and logical controls should be in place to preserve the integrity of the CCTV recordings arising from: • Unauthorised manipulation of / interference with the recorder hardware • Unauthorised access to suppress, delete or overwrite video files. Where digital CCTV systems are in use, mechanisms should be in place to ensure sufficient storage space is available. Compression settings for images should be chosen carefully to ensure that image quality is not adversely affected. Positions of fixed cameras should be clearly defined. Reference images should be available for security / control room personnel to enable positions and live images to be validated. CCTV systems should be checked regularly to identify problems with cameras, images or system equipment, including: • Quality of live images, considering clarity, focus, exposure / light balance • Quality of recorded images, considering clarity, compression, actual frame rate, continuity and retention period • Correct framing of images (using reference pictures) Procedures for maintenance (including regular cleaning of camera housings) should be in place.
	5.2.2	Controls deployed shall be clearly documented		Physical security controls should be clearly documented and available to relevant

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		and up to date.		site personnel. All changes to physical security controls should be documented.
	5.3	Access control		
	5.3.1	Clear entry procedures and policies shall exist which cater for the rights of Employees, visitors and deliveries to enter the SP. These considerations shall include the use of identity cards, procedures governing the movement of visitors within the SP, delivery/dispatch checking procedures and record maintenance.		An access control policy should be in place, enforced by an access control system. The policy should define authorities for access to secure areas by employees, visitors, contractors and security personnel. All employees should be issued with ID cards. Configuration of access rights should be under strict control. All changes to access rights should be auditable and accountable to the operator making the change and awarded on a strict need to access basis. Specific controls should be in place to prevent employees from accessing secure areas in excess of their own privileges resulting from: • Ability to change or re-assign access rights in the access control system • Access to highly privileged access rights or cards intended for employees, visitors or emergency access. Where highly-privileged access cards are handled by, or accessible to, employees additional controls should be in place to prevent unauthorised use. Visitors to secure areas should be authorised by an appropriate authority according to a defined procedure. All visitors requiring access to secure areas should be registered in the access control system. Movement of materials to/from the HSA(s) should be controlled. Transfer of materials should be controlled using an intermediate / buffer zone or materials trap, e.g., within the delivery bay area. In production environments, vehicle movements should be logged and drivers positively identified before being admitted to delivery bays. Separation should be enforced between personnel inside secure areas and delivery drivers / vehicles. All physical keys managed as part of the site's security management system should be catalogued. Issue of keys to employees should be tracked according to an auditable system. Keys to secure areas should be under strict control and

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				subject to regular audit.
	5.3.2	Access to each secure area shall be controlled on a 'need to be there' basis. Appropriate procedures shall be in place to control, authorise, and monitor access to each secure area and within secure areas.		All access to secure areas should be strictly controlled and auditable using the access control system. One-by-one mechanisms should be in use to strictly control access to HSAs. Anti-passback controls should be in place for access to, and within the HSA. All employees, visitors and contractors to the secure areas should be uniquely identifiable to the access control system. Access to sensitive locations within the high security areas should make use of two-factor authentication (e.g., ID card + PIN), or dual control (e.g., 2 people must be present within the area). Sensitive locations may include: • Secure storage (vault areas) • Data processing rooms • Key ceremony rooms • Server rooms Movements into, and out of, the secure areas, and between defined zones within the secure areas should be tracked by the access control system. Attempts to enter access control zones should be logged by the access control system and reviewed; repeated attempts to exceed access privileges should be followed-up with employees. Access to secure production areas where class 1 and class 2 assets are created, stored and processed should be enforced on a one-by-one basis. Access to secure areas where class 1 and class 2 assets are created, stored and processed should be on a strict 'need to be there' basis, covering employees, contractors and visitors to the site. To enforce a 'need to be there' principle, consideration should be given to separation of secure areas where class 1 and class 2 assets are processed.
	5.4	Security staff		
	5.4.1	Security staff are commonly employed by suppliers. Where this is the case, the duties shall		Security staff should have received specific training in their roles and responsibilities and operational procedures. Security staff should have an

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		be clearly documented and the necessary tools and training shall be supplied.		understanding of the operations of the site and the sensitive assets handled. Operational security procedures should be clearly documented, and available to security staff within the control room. Security staff should be familiar with the security systems provided (access control, alarm system, CCTV system). The auditors expect that security staff will demonstrate a basic competence in their operation during the audit.
	5.5	Internal audit and control		
	5.5.1	Physical security controls shall be subject to a rigorous programme of internal monitoring, audit and maintenance to ensure their continued correct operation.		A programme of internal audits/controls should be defined that demonstrates appropriate consideration of: • The frequency of checks required for each area addressed by the internal audit/control mechanism • The structure of the audits/controls themselves, including clear guidance on what should be checked and how • The recording / documentation and follow-up process for audits/controls undertaken. The auditors will expect to see evidence that processes and systems are working correctly, and that internal audits/controls have been carried out according to the schedule. There should be appropriate coverage of all aspects of the system; the audit/control programme should be defined around the need to provide appropriate coverage, rather than the availability of resource. In particular, there should be evidence that the internal audit system has been designed to validate all of the physical security controls in place, including regular testing of systems. Auditors should have received appropriate training in the structure and content of internal audits/controls.

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6 Certificate and Key Management					
All	Technical and procedural controls shall be applied to cryptographic keys and certificates related to the SP at the site. Applicable requirements will vary according to the level of SP. Specific requirements applying to Root CA(s) are highlighted where applicable.				
	6.1	Classification			
	6.1.1	Keys and certificates shall be classified as sensitive information. Logical, physical, personnel and procedural controls shall be applied to ensure that appropriate levels of confidentiality, integrity and availability are applied.			Systems used for processing and storage of keys and certificates should be configured, managed and operated in-line with the relevant requirements for infrastructure security from the CSR and CSG. Specifically, systems should be: • managed consistent with the requirements in section 10 • operated in an environment consistent with the requirements of section 5 • operated by personnel subject to the controls described in section 4
				DC	The same requirements apply to an auditee offering hardware security modules (HSM) managed as a service (see section 6.7).
	6.2	Roles and responsibilities			
	6.2.1	Responsibilities and procedures for the management of certificates and cryptographic keys shall be clearly defined.		UP SM CM I	A key manager should be assigned to manage the overall responsibility of the cryptographic systems and key management. A back-up key manager should also be appointed. Key management activities should be conducted using fully authorized and trained personnel. All personnel should be formally designated and have formally accepted their duties and their responsibility. Re-vetting of members of the key management should be reviewed periodically.

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					Temporary staff should not be involved in key management activities.
				DC	In the case of an HSM managed as a service (see section 6.7), HSM infrastructure management activities should be conducted using fully authorised and trained CSP personnel.
UP SM CM I	6.2.2	Auditable dual control shall be applied to sensitive steps of key management.			All key management activities that take place at the site and are relevant to the SP, except component loading/extraction, should be conducted under dual control. These activities may include some or all of:
				UP SM CM I	• The administration of key management systems and mechanisms: ○ set up ○ configuration ○ maintenance ○ management of user's profiles ○ operations on cryptograms ○ key files back-up and restore.
				CM	and the following activities typically applicable only to the CA itself: ○ validation of information in Certificate Applications ○ acceptance, rejection, or other processing of Certificate Applications, revocation requests, key recovery requests or renewal requests, or enrolment information ○ issuance, or revocation of Certificates, including personnel having access to restricted portions of the repository; ○ handling of subscriber information or requests ○ generation, issuing or destruction of a CA Certificate and the following activities typically applicable only to a sub-CA: ○ loading or removal of a CA to/from a production environment.

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UP SM CM I	6.3	Cryptographic key specification			
	6.3.1	Technical specifications for cryptographic keys and certificates shall be selected that are: • compliant with relevant or applicable standards or • of an appropriate level to the asset(s) protected, based on risk and lifespan.			The CSR/CSG do not describe technical specifications for cryptographic keys and certificates. Requirements will vary dependant on the value of the assets to be protected, the environment(s) in which they are used and the expected lifespan. Advances in computing power and developments in cryptanalysis techniques will drive changes/obsolescence of acceptable algorithms and key lengths over time. Where technical standards or requirements are laid down for keys/certificates (e.g., as part of contractual agreements for participation within an ecosystem) then auditees will be expected to demonstrate that implementations are compliant with the relevant specifications, including: • Section 2.3.3 of SGP.02 [6], which specifies the secure channel key length and algorithm used on the ES5 interface (SM-SR - eUICC). • Section 2.5 of SGP.02 [6], which specifies the secure channel configuration, key length and algorithm to be used on the ES8 interface (SM-DP - eUICC). • Section 2.6.5 of SGP.22 [8], which specifies The key length and algorithm to be used for remote secure communication involving an SM-DP+. Where no specific technical standards are laid down, then auditees will be expected to demonstrate application of appropriate best-practice in selecting cryptographic algorithms and key lengths.
	6.4	Cryptographic key management			
	6.4.1	Cryptographic keys, certificates and activation			Keys should be only used for the purpose intended.

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		data shall be generated, exchanged, stored, backed-up and destroyed securely.			Key management should be governed by the following two major principles: • Knowledge is always split (not accessible by one person alone) • Process activities are conducted under dual control. A key should only be in clear-text form when residing within the HSM. Outside of the HSM, keys may only exist in the form of a cryptogram or be split into a minimum of 2 components. Where keys are split into components, the individual components should be under the sole control of the relevant and designated custodian only. Principles should apply during the whole life cycle. Test Keys and Live keys should never be found on the same operational system. Prototypes are understood to be “test” keys, though “pilot” keys are deemed “live” keys associated to production. Key management activities should be operated in a separate area within the HSA where access to the area is logged via the Access Control system and equipped with intrusion detection and CCTV. Key lifecycle Generation • Entities responsible for the generation of key pairs should ensure that key pairs are generated: ○ By an appropriate mechanism (e.g., during a formal key ceremony) ○ In an environment with appropriate protection Exchange and storage • Key component and related sensitive data should be stored securely under the control of the respective owning custodian. • During key transport, the key received from a 3rd party should be conveyed either as a cryptogram or in minimum 2 components exchanged between authorized custodians and exchanged using tamper evident serialised envelope. ○ Key components should not be opened or accessed outside of the secure environment where the key ceremony takes place. • Keys should be loaded under appropriate control (e.g., during a formal key

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					ceremony) • After successful loading of a key, the key components should be destroyed. • Controls should be in place for the exchange of public keys to ensure trust by the recipient. ○ Specific formal methods for exchange and validation should be used for public keys submitted for signing to a certificate authority. Backup • Where key backups are manually generated, these should be performed under dual control. • Where key backups are automatically generated, restore should be performed under dual control • The security level of the backup should equal at a minimum that of the key being backed up. • CA private signature keys should not be archived or escrowed. Destruction • Appropriate mechanisms should be used for the destruction of keys and key components to prevent their theft, disclosure or unauthorized use. Where relevant to the SP, activation data used to unlock private keys should: • Have an appropriate level of strength for the keys or data to be protected. • Be appropriately protected throughout its lifecycle to prevent loss, theft, modification, disclosure or unauthorized use. • Be updated as appropriate. Auditees should be capable of demonstrating a key ceremony (for example during a dummy/simulated ceremony) which shows that: • at no times are keys or components disclosed to an unauthorised person. • audit log reports are correctly established and maintained. • the dual control and required restraints during the ceremony are effective.

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	6.4.2	The cryptographic key management process shall be documented and cover the full lifecycle of keys & certificates.			This documentation should specify the actors (key custodians), the involved keys, the entire lifecycle management (generation, distribution, loading, storage, usage, backup/recovery, destruction, audit trail) and incident management (compromise).
CM SM DC	6.4.3	The storage and cryptographic computation for keys and certificate generation (derivations, random generations) involved in the protection of the sensitive data (i.e., Class 1 data) shall rely on hardware security modules (HSM) that are FIPS 140-2 level 3 certified.		CM SM	This requirement is mandatory for: • Private keys used in session key derivation and signing for Profile Binding (e.g., SM-DP and SM-DP+), • EUM private keys used to sign eUICC certificates. It is not mandatory for the private keys used in TLS session between server (e.g., SM-DP+ or SM-DS) and LPA or mutual authentication between server (e.g., SM-DP+ or SM-DS) and eUICC as per the protocols defined in SGP.22 [8]. Cryptographic keys related to IT protocols between servers (e.g., between SM-DP and SM-SR) are out of the scope of SAS-SM. The service provider should provide a copy of the FIPS certification proving the identification of the hardware board and associated firmware of the cryptographic device used. Equipment should be subject to a documented commissioning and/or decommissioning process. Customization of cryptographic devices is acceptable as long as native functions (key generation, key diversification, random number generator, algorithmic computation) are not altered. HSMs used for CM (e.g., EUM) or SM (e.g., SM-DP+) functions should be dedicated to those sole purposes. Sites may use a single HSM for EUM and SM functions, provided that: • SM and EUM environments are logically separated, as described described in 10.5.1. • The shared HSM is configured to provide only the required HSM services to the SM and EUM environments, and to prevent any direct connection between the two environments.

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					• The HSM is logically partitioned, with SM and EUM activities utilising different HSM partitions, each exposed only to the relevant logical environment.
					• Each HSM partition is configured with its own Master Key, generated and managed according to secure processes under the control of the relevant team.
					• The HSM is subject to the full scope of the logical, physical, key management and data processing elements of all SAS audits carried out on-site at both a platform and partition level.
					• The auditee accepts that the use of a shared physical HSM for SM and EUM activities will be noted in the site's certificate and be visible to MNOs and other end-users.
					• The HSM is not used for any other purpose where:
					  ○ Lower security levels than those required by SAS-UP/SAS-SM are applied.
					  ○ The management of the HSM is carried out by personnel other than those included in the SAS audit processes.
					  ○ Connections are made to the HSM from outside of the logical or physical environments within the scope of the SAS audit processes.
					Any activity on the HSMs should be logged. The integrity of audit trail logs should be ensured.

				DC	For HSM managed as a service (see section 6.7), the auditee should provide a copy of the FIPS certification proving the identification of the hardware board of the cryptographic device used. Equipment should be subject to a documented commissioning, decommissioning, allocation and/or de-allocation process.
	6.5	Auditability and accountability			
	6.5.1	Key management activities shall be controlled by an audit trail that provides a complete record of, and individual accountability for, all actions.			All key management processes should be documented in an audit trail which: • gives evidence as to all operations, key usage, equipment and roles

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					involved in the process • is clearly documented (who, when, what, why) for the full life cycle of keys and systems deployed All activities related to keys/key management should be logged. Integrity of the audit trails should be ensured and protected against manipulation.
CM SM	6.6	GSMA Public Key Infrastructure (PKI) Certificates			
	6.6.1	Supplier certificates used as part of any GSMA PKI shall be signed by a CA authorised by and acting on behalf of the GSMA			The auditee should verify that the CA is authorised and acting on behalf of the GSMA and that certificate issuance is done in accordance with the official GSMA procedure. Only duly authorized staff of the supplier can request services from the CA.
	6.6.2	PKI certificate private keys shall only ever be installed and used at sites:			The GSMA eUICC certificate policy is published as SGP.14 [11]. Auditees can obtain the certificate policy and details of the scope of SAS certification for each certified site from the GSMA website.
	(i)	That are agreed with the GSMA.			
	(ii)	That are SAS certified with the appropriate scope.			
	(iii)	In accordance with the certificate policy.			
	6.6.3	PKI certificate key pairs shall only ever be transferred and installed to a different operational site:			The GSMA seeks to maintain oversight of where PKI certificates (EUM, SM-DP, SM-SR, SM-DP+ and SM-DS) are in use through a registration process, managed under the control of the RSP Compliance team. All requests and notifications should be communicated via: rspcompliance@gsma.com The availability of PKI certificate private keys at each site is within the scope of the SAS certification and may be subject to validation during the audit process. Evidence of failure to comply with the requirements for notification may be grounds for an NC assessment.
	(i)	With the prior agreement of the GSMA.			
	(ii)	Where the new operational site is SAS certified with the appropriate scope.			
	(iii)	In accordance with the certificate policy.			

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	(iv)	By a mechanism that ensures an appropriate level of security for the transfer of the sensitive assets.			Transfer of certificates and key components should be controlled according to their sensitivity. PKI Certificate private keys are highly sensitive assets and should always be treated accordingly. Auditees will be expected to demonstrate clear compliance with the requirements of 6.6.3 where transfer of key components occurs.

	6.6.4	Where auditees make use of the same PKI certificate private key at multiple sites, in addition to the requirements of 6.6.2 and 6.6.3:			Transfer of private keys should only take place under strict control, with all transfers originating from the nominated site with overall responsibility for control of the key pair. Specifically, auditees should consider how they can demonstrate that:
					• Private keys are always be protected during the transfer process using a wrapping key that is generated, exchanged and controlled using hardware, systems and processes equivalent to the private key itself.
					• Private keys are never available in unwrapped / plaintext form during the import, export or transfer process.
					• Controls in place to ensure that:
					  ○ The wrapped key can only be imported only to nominated key management systems at the destination site.
					  ○ The wrapped key cannot be re-keyed to change the wrapping key used.
					  ○ Once imported into the key management system, the private key cannot be re-exported under the control of the destination site.
					Technical controls to enforce these principles should always be considered as the preferred approach. Procedural controls involving multi-party control may be an acceptable alternative where technical implementation is not feasible or effective. However, involvement of multiple parties should always be enforced, logged and auditable.
					In the event that private keys are found to have been transferred between sites without sufficient security they may be considered to be compromised, necessitating revocation and replacement of the certificate.

	(i)	A single, nominated, site within the auditee organization shall be responsible for control and issue of the certificate key pair.			
	(ii)	All transfer of certificate private keys shall originate from the nominated site.			
	(iii)	Controls shall be in place to prevent certificate private keys being transferred except under the control of the nominated site.			
	(iv)	All transfer of certificate private keys shall be recorded and auditable.			

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UP	6.6.5	Where auditees make use of the same EUM PKI certificate private key at multiple sites, in addition to the requirements of 6.6.4:		Although it is permitted for auditees to install EUM private keys at multiple sites, each auditee remains responsible for demonstrating that it maintains complete traceability of all EIDs to the originating site: • Where sites apply a strict policy of assigning individual EUM private keys for exclusive use of a single site then it is generally acceptable that the certificate provides the necessary level of traceability. Auditees should be able to demonstrate that: ○ Internal records are maintained of the period of use for each EUM PKI certificate at each site. ○ Appropriate controls are in place to preserve the integrity and availability of these records for the period of validity of the PKI certificate. • For any EUM private key that is used across multiple sites, auditees should be able to demonstrate that: ○ A mechanism is in place that records the originating site for each EID. ○ Appropriate controls are in place to preserve the integrity and availability of the mechanism and the associated records for at least the period of validity of the PKI certificate. ○ The mechanism is configured, operated and maintained: ▪ Consistent with the relevant sections of the SAS Consolidated Security Requirements. ▪ At a site that is subject to SAS-UP audit. In most cases, auditees are encouraged to consider the real business need for simultaneous use of EUM private keys at multiple sites. Maintenance of unique certificates for each site is generally considered to be the preferred solution.
	(i)	Auditees shall ensure that all generation and signing of eUICC device certificates shall be traceable to the site where data generation was carried out, based on EID.		
	(ii)	Controls shall be in place to ensure the confidentiality, integrity and availability of the traceability data.		
SM DC	6.7	HSM as a managed service		An HSM as a managed service may be managed and hosted in a SAS certified support site, including a site managed by a subcontractor to the auditee. The subcontractor may be a cloud service provider (CSP) or other entity. Certificate management activities under the scope of SAS-SM are allowed.

<table>
<tr><th colspan="3">Requirement Statements</th><th></th><th colspan="2">Guidelines</th></tr>
<tr><td></td><td>6.7.1</td><td>The auditee shall only use a HSM that is managed by an SAS certified data centre or cloud region.
In addition to the requirements of 2.4.2, the specific responsibilities assignment shall be documented and agreed between the auditee and the subcontractor managing the HSM.</td><td></td><td></td><td>See 6.7.2 for responsibility assignment guidelines.</td></tr>
<tr><td></td><td>6.7.2</td><td>Design, implementation and controls must ensure that cryptographic keys and certificates are only accessible to the SM service provider.</td><td></td><td></td><td>The responsibility assignment matrix and its implementation should demonstrate that only the SM service provider can access cryptographic keys and certificates.
Below is an example of responsibilities and assignments when the HSM managed service is offered by a CSP:
<table>
<tr><th>Operation</th><th>CSP</th><th>SM service provider</th><th>Comment</th></tr>
<tr><td>Physical installation and management</td><td>X</td><td></td><td></td></tr>
<tr><td>Firmware</td><td></td><td>X</td><td>The SM service provider is responsible for the loaded firmware and, ensuring it is a genuine HSM vendor firmware, it has not been tampered with and it complies with the service provider’s security and control policies.</td></tr>
<tr><td>HSM Profile</td><td></td><td>X</td><td>HSM profiles are under the sole control of the SM service provider: key administrator(s), key custodians and applications account.</td></tr>
<tr><td>LMK</td><td></td><td>X</td><td>Local master key provisioning and management is under the sole control</td></tr>
</table></td></tr>
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<table>
<tr><th colspan="3">Requirement Statements</th><th></th><th colspan="2">Guidelines</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>
<table>
<tr><td></td><td></td><td></td><td>of the SM service provider.</td></tr>
<tr><td>Key Ceremony</td><td></td><td>X</td><td></td></tr>
<tr><td>Managing IT Infrastructure</td><td>X</td><td></td><td></td></tr>
<tr><td>Upgrade Management</td><td></td><td>X</td><td></td></tr>
<tr><td>Decommissioning</td><td>X</td><td>X</td><td>The SM service provider “zeroes” the HSM upon releasing it to the CSP.
In order to handle abnormal conditions that could prevent the SM service provider from zeroing the HSM, the CSP zeroes the HSM prior to integrating it back into its pool of HSMs and has a process to securely destroy the HSM at the end of its service life even if the HSM is not functional anymore.</td></tr>
</table>
HSM managed as a service could store the SM service provider cryptographic keys and certificates outside the HSM, wrapped with a storage key under the sole control of the SM service provider and secured within the managed HSM.
</td></tr>
<tr><td></td><td>6.7.3</td><td>Remote key management activities shall be possible only upon demonstrating a trusted path.</td><td></td><td></td><td>Remote key management is the process of performing key management activities from a location different from the HSM location. In all cases, the auditee will be required to demonstrate a trusted path that provides an appropriate level of security, even if direct physical access to the managed HSM by the SM service provider is not possible (as is often the case with CSP services and hosting).</td></tr>
<tr><td></td><td>(i)</td><td>Remote key management activities shall be performed from a certified environment in accordance with the requirements of section 6.4.1</td><td></td><td></td><td></td></tr>
</table>

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		and 10.4.			
	(ii)	Remote key management activities shall be performed through a point-to-point secure channel from the SM service provider's key management system to the HSM. The channel shall provide confidentiality, integrity, authenticity, replay protection and forward secrecy.			The secure channel should connect the SM service provider's key management system directly to the target HSM system. It should be based on a well-established and proven cryptographic system.
	(iii)	The SM service provider shall have controls in place restricting management remote access to trusted sources and authorised personnel only.			A remotely managed HSM typically exposes a management interface on the network; see 6.2.2 for applicable dual-control requirements and 6.4.1, 10.4.2, 10.4.5 and 10.4.7 for applicable requirements.
	6.7.4	An HSM supporting partitions must have all its partitions allocated to a single SM service provider.			

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7 Sensitive Process Data Management				
UP SM	The site shall be responsible for lifecycle management of Class 1 data used within the SP. Information and IT security controls must be appropriately applied to all aspects of lifecycle management to ensure that data is adequately protected. The overall principle shall be that all data is appropriately protected from the point of receipt through storage, internal transfer, processing and through to secure deletion of the data.			
	7.1	Data transfer		
	7.1.1	Sites shall take responsibility to ensure that electronic data transfer between themselves and other third parties is appropriately secured.		A document should identify the relevant data transfer and its associated protection. Appropriate electronic data transfer mechanisms should be agreed with customers including encryption of sensitive data. Suppliers should demonstrate that they have worked to ensure data transfer mechanisms are appropriate to the sensitivity of the data concerned. Where customers demand insecure data transfer mechanisms, suppliers should formally notify (in writing) the customer of the unsuitability of the data transfer mechanism.
			SM	Encryption of sensitive data should be compliant with SGP.02 [6] or SGP.22 [8] when applicable or agreed with external third parties when not applicable.
	7.2	Sensitive data access, storage and retention		
	7.2.1	Sites shall prevent direct access to sensitive process data where it is stored and processed.		Sensitive data should normally be encrypted at all stages of storage, processing and transmission, except where decrypted data is specifically required to complete the processing stage (e.g., Personalisation). Appropriate data encryption technologies should be used to protect sensitive
	(i)	User access to sensitive data shall be possible only where absolutely necessary. All access must		

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		be auditable to identify the date, time, activity and person responsible.		data. Keys should be managed securely. Please refer to the "General Consideration on Algorithm and Key Length" section in SGP.02 [6] to protect sensitive production data. Sensitive data should be deleted after use. Decrypted data should always be deleted using a secure wipe mechanism. Suppliers should be aware of the potential vulnerabilities arising from temporary files and memory paging when evaluating the risks around sensitive data processing. Appropriate controls should be in place to minimise such risks. Data generation and processing mechanisms that require manual intervention / processing of un-encrypted data files should be avoided wherever possible. Automated systems that encrypt data on-the-fly during processing are always preferred. Where manual access to sensitive data is possible or required it must always be auditable. Control of the audit trail must be independent of personnel with access to data.
	(ii)	System and database administrators may have privileged access to sensitive data. Administrator access to data must be strictly controlled and managed. Administrative access to data shall only take place where explicitly authorized and shall always be irreversibly logged.		
	7.2.2	Data shall be stored protected appropriate to its classification.		
	7.2.3	Data retention policies shall be defined, monitored and enforced.		
UP	7.3	Data generation		
	7.3.1	As part of the Personalisation process secret data may be generated and personalized into the UICC. Where such generation takes place:		Guidelines in section 7.3 apply to those sites requiring Generation of Data for UICC Personalisation to be within the scope of the SAS-UP certificate. "Local site" refers to the site participating in the SAS-UP scheme and being audited by the SAS-UP auditors.
	(i)	The quality of the number generator in use shall be subject to appropriate testing on a periodic basis. Evidence of testing, and successful results, shall be available.		Random numbers generated as part of data processing for GSM production should be produced by a source whose quality has been: • Certified to a recognised international standard. Evidence of certification should be available during the audit. Or • Subjected to a series of recognised tests of randomness with results that indicate that an acceptable level of randomness has been achieved.

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				Evidence of the testing process and evaluation of results should be available during the audit. Mechanisms should be in place to ensure that randomness is maintained (periodic re-testing, or re-seeding of PRNG may be appropriate). Evidence should always be available at the local site, even where the random source is part of a 'black box' Personalisation solution (i.e., there is no detailed understanding of its inner workings by local personnel).
	(ii)	Clear, auditable, controls shall be in place surrounding the use of the number generator to ensure that data is taken from the appropriate source.		An auditable mechanism should be in place to ensure that the correct random source is used for generation of data. Appropriate mechanisms may include independent, auditable validation at time of development of data generation applications or configuration profiles. Where applications or configurations are developed by an off-site team the local site should still take responsibility to ensure that: • Validation has been carried out Validation may be carried out: ○ on-site by the local team as part of the process to receive the new application/configuration and install it into the production environment. ○ OR ○ off-site as part of the development process, provided that the evidence of independent, auditable validation is available to the local site for review as part of the process to receive the new application/configuration and install it into the production environment. • Evidence exists of the validation being carried out. Where data generation applications or configuration profiles are used, integrity controls should be considered to ensure that: • the correct application / profile is used for data generation / processing • the application / profile cannot be changed from that approved / validated. Controls may include:

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				○ Restricted logical access to locations that applications / profiles are stored. ○ Encryption / encoding of applications or profiles to limit the ability of operational personnel to modify the applications / profiles. ○ Checksum / hashing mechanisms that seek to validate integrity at run-time.
UP SM	7.4	Auditability and accountability		
	7.4.1	The sensitive process shall be controlled by an audit trail that provides a complete record of, and individual accountability for the lifecycle of information assets to ensure that:		A complete, automated audit trail should be in place for all data processing and manipulation activities. The audit trail should record: • the identity of the user carrying out the action / processing stage • the date and time of the action • the nature of the action • the success / failure of the action (including attempts to exceed privileges). Where data processing activities are normally handled by a set of dedicated applications, parallel audit trails should exist for any attempted / successful manipulation of data outside of these applications (e.g., using operating system or generic database tools) The integrity of the audit trail should be preserved. The audit trail should be subject to regular review to identify irregular or unauthorised activity. Role separation should ensure that the audit trail cannot be modified / deleted by members of the data processing team. Based on the asset lists, a log should exist for the entire lifecycle of the asset. A log should exist for the entire user access lifecycle.
	(i)	all assets created, processed and deleted are completely accounted for		
	(ii)	access to sensitive data is auditable		
	(iii)	responsible individuals are traceable and can be held accountable		
	7.4.2	The audit trail shall be protected in terms of integrity and the retention period must be defined.		Audit trails should not be modified via technical or procedural processes. Retention period guidelines shall be defined. The retention period is expected

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		The audit trail shall not contain sensitive data.		to be in accordance with the customer SLA (maximum or minimum).
	7.4.3	Auditable dual-control and 4-eyes principle shall be applied to sensitive steps of data processing.		Sensitive data processing steps will include any action that introduces a risk of unauthorised or duplicate production, and may include: • Manual generation or manipulation of production data • Changes to the status of production data (e.g., resetting UICCs already produced).
UP	7.4.4	For UICC production the audit trail shall include:		Management of the UICC audit trails should be consistent with the controls in sections 7.4.1-3.
	(i)	Generation of Data for Personalisation and processing of that data		
	(ii)	Personalisation		
	(iii)	re-Personalisation		
	(iv)	access to sensitive data		
	(v)	Production of customer output files		
	7.5	Duplicate production		
	7.5.1	Controls shall be in place to prevent duplicate production.		Prevention of duplicate production is a fundamental principle of SAS. Systems for data processing and production must be designed to prevent opportunities for duplicate production from occurring except where: • These have been explicitly requested and authorised by the customer MNO • The creation of the duplicate does not violate the relevant technical standards or undermine the integrity of the ecosystem. Where production systems are reliant on file-based mechanisms, multiple levels of control should be in place to restrict access to data files. Experience shows that single levels of control (e.g., third-party software limiting access to

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				operating-system tools) are vulnerable; weaknesses can often be introduced. Where production systems are reliant on centralised or database-driven mechanisms, access to manipulate the database / system status should be strictly controlled and fully auditable. Where mechanisms exist for exchange of data between different production sites additional controls should be in place to ensure that duplicate production across sites is prevented.
UP SM	7.6	Data integrity		
	7.6.1	Controls shall be in place to ensure that the same, authorized, data from the correct source is used for the sensitive process and supplied to the customer.		Control of authentication should be done between actors as per the functional specifications (for example, the certificate chain in the reference document SGP.02 [6]) when applicable. When not applicable, there should be a specific authentication mechanism with the third party (for example, specific communication link or specific data transfer process) equivalent to the above document.
	7.7	Internal audit and control		
	7.7.1	Sensitive data controls shall be subject to a rigorous programme of internal monitoring, audit and maintenance to ensure their continued correct operation.		A programme of internal audits/controls should be defined that demonstrates appropriate consideration of: • The frequency of checks required for each area addressed by the internal audit/control mechanism • The structure of the audits/controls themselves, including clear guidance on what should be checked and how • The recording / documentation and follow-up process for audits/controls undertaken. The auditors will expect to see evidence that processes and systems are working correctly, and that internal audits/controls have been carried out according to the schedule. There should be appropriate coverage of all aspects

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				of the system; the audit/control programme should be defined around the need to provide appropriate coverage, rather than the availability of audit resource. Auditors should have received appropriate training in the structure and content of internal audits/controls.

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8 SM-DP, SM-SR, SM-DP+ and SM-DS Service Management				
SM	8.1	SM-DP, SM-SR, SM-DP+ and SM-SR Service		

	8.1.1	Systems used for the remote provisioning, management of eUICCs and management of Profiles shall support the secure interfaces as defined in SGP.01 [5], SGP.02 [6], SGP.21 [7] and/or SGP.22 [8] as applicable.		The objective is not to demonstrate that the system is compliant with the functional specifications but to show the existence of the different secure interfaces
				The auditee will be expected to follow Annex D of the FS.09 Methodology document and ensure that the solution can be fully demonstrated for each of the following:
				• SM-SR and SM-DP
				  ○ Unpersonalised profile creation
				  ○ Profile ordering and personalisation
				  ○ Processing of eUICC registration
				  ○ Download of a profile with personalised data
				  ○ Installation of a profile
				  ○ Enabling of a profile
				  ○ Disabling of a profile
				  ○ Deletion of a profile
				• SM-DP+
				  ○ Unpersonalised profile creation
				  ○ Profile ordering and personalisation
				  ○ Download of a profile with personalised data
				  ○ Installation of a profile
				  ○ Enabling of a profile
				  ○ Disabling of a profile
				  ○ Deletion of a profile

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				• SM-DS
				  ○ Certificate enrolment and verification
				  ○ Event registration and retrieval
				In order to support the demonstration, audit trails should be available. These should include but are not limited to application log files and firewall log files.

	8.1.2	Exchange of data within the SM-DP, SM-SR, SM-DP+ or the SM-DS IT system shall be secured to the level required by its asset classification.		Refer to SGP.02 [6] or SGP.22 [8] to identify sensitive data exchanges.
	8.1.3	The SM-DP, SM-SR, SM-DP+ and SM-DS must prevent cross-contamination of assets between different customers.		Prevention should be ensured by use of key segregation (SM-SR, SM-DP, SM-DP+), access rights allocation (SM-DS).
	8.1.4	Multi-tenant SM-DP, SM-SR, SM-DP+ and SM-DS solutions on the same physical hardware shall ensure customer data is logically segregated between different customers.		Logically segregated means the same hardware, the same instance but different access rights.
	8.2	Remote Entity Authentication		
	8.2.1	All authorized entities in the SM-DP, SM-SR, SM-DP+ and SM-DS processes shall be authenticated by appropriate authentication protocols for example, SM-SR, SM-DP, SM-DP+, SM-DS, MNO.		Control of authentication should be done between actors as per the functional specifications (for example, the certificate chain in the reference document SGP.02 [6] or SGP.22 [8]) when applicable. When not applicable, there must be an equivalent specific authentication mechanism with the third party (for example, specific communication link or specific data transfer process)
	8.3	Audit trails		
	8.3.1	The SP shall be logged in an audit trail that provides a complete record of, and individual accountability for:		
	(i)	Profile Management, Platform Management, IT		The minimum information related to the application (Profile Management,

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		system and eUICC Management procedures, events management, and communication with other entities through the secure interfaces.			Platform Management, and eUICC Management) which should be logged are: • Initiator of the request (if applicable) • ID of the request (if applicable) • Type of the request (if applicable) • Timestamp of the request (if applicable) • Timestamp for the completion (if applicable) • Profile identifier (if applicable) • eUICC ID (if applicable) • MNO_ID (if applicable) • SM-SR ID (if applicable) • SM-DP ID (if applicable) • SM-DP+ ID (if applicable) The minimum information related to the IT system which should be logged are: • Users' logins (successful/unsuccessful) • Resource access • Activity description
	(ii)	Access to sensitive data			The minimum information related to the access to sensitive data which should be logged are: • Users' logins (successful/unsuccessful) • Reason for accessing sensitive data • List of sensitive data accessed • Timestamp of the log in and log out
	8.3.2	The audit trail shall be managed in accordance with the requirements of 7.4.			

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9 Logistics and Production Management				
UP	UICC production processes shall be subject to appropriate controls that ensure integrity of, and accountability for, all sensitive assets and prevent duplicate production.			
	9.1	Order management		
	9.1.1	The ordering format shall be agreed between operator and supplier and rules to preserve the integrity of the ordering process shall be in place.		
	9.2	Raw materials		
	9.2.1	Raw materials classified as lower than class 2 (plastic sheets, GSM generic components, blank mailers, etc.) are not considered to be security sensitive. However, appropriate controls shall be established for stock movements. The availability of these assets must be ensured.		Low sensitivity assets for GSM production should be subject to basic stock controls and reconciliation. Complete accountability for individual assets is not expected.
	9.2.2	Raw materials classified as class 2 (e.g., non-personalised devices) are considered to be security sensitive. Controls shall be established that:		Asset control mechanisms should be applied to class 2 assets. Where class 2 assets are stored and/or processed in separate environments to class 1 assets (with physical separation and independent access control – e.g., separate workshops) different control mechanisms may be applied. Where assets of different classes are processed in unified physical environments appropriate controls should be applied to ensure that the expected level of control for the highest level of assets is maintained and that the risks of uncontrolled assets and cross-contamination are managed appropriately. Auditees are encouraged to seek specific guidance on the acceptability of controls for unified environments in advance of their first audit via the GSMA

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				and/or audit team.
	(i)	account for stock movement		
	(ii)	prevent unauthorized access		
	(iii)	preserve the integrity of batches		
	(iv)	prevent availability of class 2 assets within the production environment undermining the quantity control and reconciliation mechanism for class 1 assets.		
	9.3	Control, audit and monitoring		
	9.3.1	The production process shall be controlled by an audit trail that:		
	(i)	ensures that the quantities of class 1 assets created, processed, rejected and destroyed are completely accounted for		The audit trail should record quantities of class 1 and class 2 assets by type (e.g., card bodies, modules) and status (e.g., good, surplus, rejected) at each processing stage. It is accepted that the quantity of modules is difficult to control. Suppliers should, however, track quantities of modules used / remaining for each module reel. It is acceptable to use the manufacturer's reported quantity of 'good' modules on each reel as a starting point for the module tracking process. Modules that cannot be used, or are wasted, in setting up equipment should be classed and treated as rejects and recorded in the audit trail. Card bodies can be controlled effectively. Quantities of card bodies entering embedding should be subject to 100% control. Quantities of card bodies throughout processing of class 1 and class 2 assets should be subject to 100% control.
	(ii)	ensures that the responsible individuals are traceable and can be held accountable		Accountability for class 1 and class 2 assets should always be in place. Responsibility for assets should be documented within the audit trail. Assets should be subject to a formal, auditable, handover where responsibility

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				changes. Quantities of assets should be subject to 100% control as part of the handover process.
	(iii)	demands escalation where discrepancies or other security incidents are identified.		An escalation process / mechanism should be in place where discrepancies are identified. It is expected that all such discrepancies are tracked and reported. Where discrepancies cannot be resolved, a risk assessment should be carried out and appropriate action taken. A register of unresolved incidents/discrepancies should be maintained.
	9.3.2	The stock of all Class 1 assets must be subject to end-to-end reconciliation in order that every element can be accounted for.		The audit trail described in section 9.3.1 should be independently reviewed at the end of production to carry out a reconciliation of all assets. Interim reconciliations within the production process are strongly recommended to aid identification and resolution or discrepancies. Any discrepancies should be documented and escalated. Where class 1 assets are temporarily held within production areas between production stages, they should be appropriately stored to preserve their integrity. Locked cages, trolleys, or storage cupboards are sufficient, provided that keys are controlled. Responsibility and accountability for assets should be identified. Appropriate re-counting of assets should take place prior to sensitive production stages (e.g., Personalisation). Asset control mechanisms should ensure that all elements of each asset are accounted for. Where assets incorporate removable or re-pluggable elements (e.g., plug-ins) these should be verified as part of the asset at each stage. Missing elements should be identified and treated as incidents.
	9.3.3	Auditable dual-control and 4-eyes principle shall be applied to sensitive steps of the production process, including:		
	(i)	control of the quantity of assets entering the Personalisation process		Quantities of assets entering Personalisation should be counted under dual control (either two separate 100% counts by two different individuals, or a single count under 4-eyes principle).
	(ii)	authorization of re-Personalisation for rejected UICCs		Authorisation of re-Personalisation should take place under auditable 4-eyes principle. Prior to re-Personalisation, rejects should be electrically disabled and

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				physically marked to indicate their rejected status. Disablement should take place under 4-eyes principle.
	(iii)	control of the quantity of assets packaged for dispatch to customers		During production assets should be controlled 100% on a one-by-one basis. At the point of initial packaging, control will normally change from one-by-one to box-by-box control. At the point of packaging: Assets should be subject to a final count / control. For cards, the count may be undertaken using a card counter. For cards packaged with card carriers, or other fulfilment mechanisms, the count may be undertaken by machine counter, weight check or another counting device. Auditees will be expected to show that the counting mechanism used is accurate. The counted assets should be packed and sealed using a tamper-evident seal immediately following the final count / control. The final count / control should be under clear CCTV coverage Assets must be under clear, continuous CCTV coverage from the point of counting to the point the box being sealed. Appropriate CCTV coverage is best achieved using an overhead camera covering the counting / packing workstation. Where possible, auditees should increase the integrity of the control process by implementing automated audit trails of the assets counted. Counting and sealing of boxes under 4-eyes principle is also accepted. Good CCTV coverage is still required to provide auditability of the application of 4-eyes principle. Where fulfilment results in the UICC being wholly contained within other packaging (e.g., an envelope or box), mechanisms should be in place to validate that each package contains a UICC prior to the final count / control taking place.
	(iv)	destruction of rejected assets		Destruction of rejected assets should take place under 4-eyes principle.
	9.3.4	Application of 4-eyes principle shall be auditable through production records and CCTV.		Time and date of each control, and identities of employees responsible, should be documented within the audit trail. Recording of time and date will enable

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				CCTV records to be identified and checked.
	9.3.5	Regular audits shall be undertaken to ensure the integrity of production controls and the audit trail.		Audit trails within production must be subject to regular internal control to ensure that processes are being followed. Discrepancies should be investigated and appropriate follow-up actions taken.
	9.3.6	Suppliers must demonstrate an ability to prevent unauthorised duplication within the production process during Personalisation and re-Personalisation.		Appropriate controls must be in place around the availability of Personalisation Data, as described in section 7.2. Availability of embedded card bodies should be under appropriate control at point of issue. Reconciliation of production should ensure that all assets are accounted for. Authorisation of re-Personalisation should require rejected UICCs to be disabled under 4-eyes principle (as described in section 9.3.3) prior to re-Personalisation taking place.
	9.3.7	Suppliers must demonstrate an ability to preserve the integrity of batches within the production environment to prevent:		Within the production environment it is normal for different batches to be processed at the same time. This may include batches in 'live' production and batches being held between processing stages. The 'production environment' to which these controls apply will always include the physical environment in which Personalisation takes place. Other activities included within the same physical environment should be subject to appropriate controls to prevent the asset control and reconciliation mechanism being undermined by uncontrolled assets and/or cross contamination of products and/or batches. These activities may include Personalisation of other products (e.g., payment cards) or less sensitive processes (e.g., card body manufacturing, embedding). Activities taking place in other physical environments (e.g., physically separate workshops under separate access control with different operational personnel) could be carried out with different asset controls appropriate to their sensitivity.
	(i)	cross-contamination of assets between batches		Auditees should demonstrate that appropriate controls are in place to prevent accidental or deliberate cross-contamination of assets from different batches. Typically controls would include use of one or more of the following: • locked trolleys or cabinets for temporary storage of materials in process or

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				between processing stages • sealing of individual boxes of assets. Such controls help to restrict unauthorised access and preserve the integrity of counts and may also provide evidence of any unauthorised access / tampering.
	(ii)	uncontrolled assets in the production environment undermining the integrity of the asset control mechanism.		Asset control mechanisms often rely on counting systems / technologies that do not individually identify each asset. For example, card counters typically count a quantity of cards by identifying the edge of each card in a stack. Any uncontrolled assets within the production environment could, intentionally or accidentally, undermine the integrity of counts and controls if they are mixed with assets in the production process. To help manage this risk all assets entering the production environment should be controlled. Quantities should be checked before new assets are transferred into the production environment.
	9.4	Destruction		
	9.4.1	Rejected sensitive assets must always be destroyed according to a secure procedure and logs retained.		Destruction should take place regularly to avoid large stocks of rejected assets being accumulated (e.g., daily or weekly), and to simplify reconciliation. Destruction of class 1 and class 2 assets should take place locally, on-site under most circumstances. Rejected card / module assets should always be destroyed on-site. Assets for destruction should be reconciled against records of assets rejected immediately prior to destruction taking place. Reconciliation should take place under 4-eyes principle (4EP). Reconciliation may be based on: • Counting of individual assets immediately prior to destruction • Packs of assets counted at the point of rejection under 4EP and sealed using a tamper evident mechanism. The integrity of the tamper evident seal must be checked immediately prior to destruction, and the number and identity of sealed packs verified The destruction process for class 1 and class 2 assets should always be controlled under 4EP. Control may be achieved by: Either:

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				• Both parties responsible for destruction witnessing all of the assets entering the body of the destruction device to a point from which they cannot normally be retrieved intact. Or: • Both parties witnessing the entry of all of the assets into a feeder for the destruction device, access to which is completely and solely under the control of the two parties taking responsibility for the destruction. The feeder may be locked and sealed and left unsupervised during the destruction process provided that: o The feeder can only be re-opened by the two designated parties. o The feeder can only be re-opened in the presence of both designated parties simultaneously. o A means is in place for the two designated parties to confirm that the locking mechanism has not been opened. • Locking of the feeder may be achieved by restricting access to the device itself, or to a self-contained area where the feeder device is located. In either case: • The complete destruction process should be auditable using the CCTV system. There should be complete continuity of coverage between reconciliation and destruction; this is best achieved by performing reconciliation within the destruction area. • Processes should be in place to ensure that all materials entering the shredding/destruction process have been destroyed. Destruction equipment should be inspected under 4EP at the end of each destruction to ensure that all materials have been destroyed. For 4EP to be effective, the two employees performing reconciliation and destruction should be from separate business areas. Wherever possible, the combination of employees carrying out destruction should be varied. The date, start time, end time and identities of the 2 employees carrying out reconciliation and destruction should always be recorded against an inventory of

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				those items destroyed. Output from the shredding / destruction process should ensure that the active area of the device is reduced to half its original size in at least one dimension. For 2FF and 3FF plug-ins this is typically 3-4mm. For 4FF micro-SIMs this is typically 2-3mm. Measurements for embedded devices will be significantly smaller and require specialist destruction equipment. Output from the shredding / destruction process should be periodically checked to ensure that the mechanism in use is effective.
	9.5	Storage		
	9.5.1	Personalised product shall be stored securely prior to dispatch to preserve the integrity of the batches. Where personalised product is stored for extended periods, additional controls shall be in place.		Following final control and sealing of finished boxes, goods should be packaged ready for despatch. It is sufficient for packaged goods to be held in secure production or despatch areas prior to despatch, provided that they are: • visible on CCTV • dispatched within 48hrs. If goods are to be dispatched more than 48hrs after packaging, they should be stored in a physically separate area under separate access control. CCTV coverage should be provided.
	9.6	Packaging and delivery		
	9.6.1	Packaging of goods shall be fit for the intended purpose and strong enough to protect them during shipment. Appropriate measures shall be in place to ascertain whether or not goods have been tampered with.		Appropriate packaging should provide protection against damage or unauthorised tampering. All transfers of finished or part-finished product, including intra- and inter- site transfers, should be included.
	9.6.2	Secure delivery procedures shall be agreed between the customer and the supplier which shall include agreed delivery addresses and the method of delivery.		-

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	9.6.3	Collection and delivery notes must be positively identified. Goods shall only be handed over following the production of the appropriate authority documents. A receipt should be obtained.		-
	9.7	Internal audit and control		
	9.7.1	Production security controls shall be subject to a rigorous programme of internal monitoring, audit and maintenance to ensure their continued correct operation.		A programme of internal audits/controls should be defined that demonstrates appropriate consideration of: • The frequency of checks required for each area addressed by the internal audit/control mechanism • The structure of the audits/controls themselves, including clear guidance on what should be checked and how • The recording / documentation and follow-up process for audits/controls undertaken. The auditors will expect to see evidence that processes and systems are working correctly, and that internal audits/controls have been carried out according to the schedule. There should be appropriate coverage of all aspects of the system; the audit/control programme should be defined around the need to provide appropriate coverage, rather than the availability of resource. In particular, there should be evidence that the internal audit/control system has been designed to validate correct operation of the security controls in each part of the production process. Appropriate coverage should be provided of different shifts, products and fulfilment activities. Auditors should have received appropriate training in the structure and content of internal audits/controls.

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10 Computer and Network Management				
All		The secure operation of computer and network facilities is paramount to the security of data. In particular, the processing, storage and transfer of Class 1 information, which if compromised, could have serious consequences, must be considered. Operation of computer systems and networks must ensure that comprehensive mechanisms are in place to preserve the confidentiality, integrity and availability of data.		Requirements should be applied to all networks that support functions relevant to the scope of certification. IP networks and their associated systems used for physical security (e.g., CCTV, access control, alarm systems) should be treated as IT networks and be subject to appropriate IT security controls.
	10.1	Policy		
	10.1.1	A documented IT security policy shall exist which shall be well understood by employees.		An IT security policy should be defined and available to all employees as part of the site security documentation.
	10.2	Segregation of roles and responsibilities		
	10.2.1	Roles and responsibilities for administration of computer systems shall be clearly defined. Administration of systems storing or processing sensitive data shall not normally be carried out by users with regular operational responsibilities in these areas. Roles for review of audit logs for sensitive systems should be separated from privileged users (e.g., administrators).		Roles and responsibilities for administration of computer systems should be clearly defined. Users whose function it is to handle and process production data should not have the capability to administer the production systems. Where exceptions are necessary to the segregation of security-related and operational duties, additional controls should be in place.
	10.3	Access control		
	10.3.1	Physical access to sensitive computer facilities shall be controlled.		Servers and sensitive computer facilities (e.g., data processing) should be located in restricted areas within one or more HSAs. Access to such rooms should be restricted on a need-to-be-there basis. Access

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				should be auditable. Sensitive computer facilities should be protected by the site alarm system when not in use.
	10.3.2	An access control policy shall be in place and procedures shall govern the granting of access rights with a limit placed on the use of special privilege users. Logical access to IT services shall be via a secure logon procedure.		A process should be in place for requests for access to computer systems. The process should be auditable and include an authorisation mechanism. The process should cover creation, modification and deletion of access rights. The authorisation process should apply to all access, including the creation of administrator and 'machine' accounts. Access should not be provided without the appropriate authorisation process having been completed. Details of authorised users and user accounts should be maintained in a consolidated list, independent of the systems themselves, as a reference. Processes should be in place to reconcile the reference list against the systems periodically.
	10.3.3	Passwords shall be used and managed effectively.		A clear password policy should be defined and enforced for all users of all systems and applications. The password policy should normally include: • Length • Complexity • Regular change • Control of re-use of earlier passwords. Where systems are not capable of enforcing the policy, additional procedural controls should be used to ensure the policy is applied. Where split passwords are used to attempt to enforce dual control: • The scope of the dual control should be clearly defined to determine whether this is only applicable to the logon itself, or for the entire session resulting from the logon. • Additional mechanisms should be in place to make sure that dual control is effective, including: ○ Application of password policy over each component of the password.

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				○ Independent audit of account activity to ensure that logon has taken place under dual control; for example, by use of CCTV to confirm that logons (and, where appropriate, the resulting sessions) recorded in the system audit trail were carried out with the correct individuals present.
	10.4	Remote Access Remote access for a user to connect to a network, system or service from a location other than as part of the certified secure area(s) at the site shall only be permitted in accordance with the requirements of 10.4. Remote access requirements shall be applied to any environment containing assets (networks, systems or information) within the scope of SAS certification. The remote access requirements describe connection from a remote **endpoint** via a secure **channel** to the **target** environment.		Remote access requirements described in 10.4 are not intended to address system-to-system connections involving networks, systems or services at different certified sites. Such connections will be assessed against the requirements of section 10.5. Remote access to target networks where sensitive data is transmitted, stored or processed can introduce significant risks. Any remote access must be carefully considered to ensure that these risks are avoided altogether or managed appropriately. It is recognised that both SAS-UP and SAS-SM environments require secure data exchange: • For SAS-UP, customer access to data transfer platforms (e.g., secure file transfer servers) on dedicated networks (e.g., customer data transfer DMZ) is typically required solely for the exchange of input, response and production data. Such access normally involves remote interaction with an exposed service that offers limited capability. Controls within the secure network environment should assure the integrity, authenticity and confidentiality of the data transferred. • For SAS-SM the transfer of data occurs in a similar manner as for SAS-UP with additional data returned to the customer in respect of the profiles that have been provisioned to eUICCs on-board the M2M or consumer devices. Where remote access is considered necessary or beneficial beyond these basic data exchange mechanisms auditees will be required to demonstrate clear and effective controls that enforce equivalent levels of logical and physical security to those that protect the target system. The requirements and guidelines in section 10.4 are intended to provide auditees with a model of how such access should be implemented to comply with the

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				requirements of SAS for: • Physical and logical security of the endpoint from which remote access originates. • Logical security of the channel from the endpoint to the target environment. • Logical security of the termination of the channel and the connection into the target environment.
	10.4.1	Where remote access is implemented, it shall: • Enforce appropriate protection of sensitive systems, networks and information. • Be implemented based on strict principles of minimum access. • Be fully auditable. • Be subject to a clear, documented risk assessment. Be governed by a defined remote access policy and procedure.		Remote access may be permissible under highly controlled circumstances where the risk of such access has been fully evaluated. The risk methodology must take into account the classification of the data on the systems being remotely accessed and whether the remote access is: • Read-only, providing access only to view information about the status of systems at the certified site with no access to modify information, configuration or system operation, or to view sensitive data. • Connecting to a pre-defined service, designed to allow remote triggering of an activity or function with little or no ability to affect the operation of that activity. • Interactive or administrative access, enabling the user to modify system configuration or operation, access or manipulate data being stored or processed, or affect the processing of data in a way equivalent to a user on-site using a command line or graphical environment. Evaluation of the risk assessment by the audit team will consider the risks related to the audit site and to the overall eUICC eco-system. Where an auditee has assessed the risks of remote access as acceptable at an internal business level, this may not always be accepted for certification if the auditors consider that the risks to the overall eco-system are not adequately addressed. Where remote access is provided, this should be limited to support from known and trusted personnel within specialist or dedicated teams for remote support or maintenance of key systems (e.g., dedicated firewall management or production platform teams). Where third party-remote access is required for support and involves remote

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				access to environments containing networks, systems or data within the scope of SAS certification it is expected that this would be declared prior to the audit. The third party will normally be subject to an SAS audit on the basis of being a supporting site/organisation – see section 10.4.6 for more details.
	10.4.2	Remote access controls secure the connection from the remote user to the target environment. All operations carried out across the remote access connection shall enforce an equivalent security level to corresponding activities conducted locally on-site.		The remote access mechanism will typically combine a secure channel with appropriate user authentication and logging, Once the channel is established, the remote user will connect to systems at the target site to perform operational activities. These activities should always be carried out using equivalent security to activities carried out on-site. Where an equivalent security level cannot be assured through the remote channel then activities should not be carried out remotely.
	10.4.3	Where remote access for operational **read-only** monitoring of systems is granted, such connections shall take place with/via systems on a DMZ rather than directly into a high security network. Access to view sensitive data shall not be possible.		Examples of such remote operational access include: • Monitoring - access to network or system performance, status or event data published by a system. Examples of sensitive information include: • Class 1 or class 2 data related to the SAS-certified activities. • Information about system or security configuration that could be of use to a potential attacker e.g., firewall rules. Technical controls in place at the site to restrict the level of access for remote users should be demonstrated at the audit. The auditors will expect to see evidence that these controls are implemented at and managed from a site whose activities are SAS certified.
	10.4.4	Where remote access for connection to **pre-defined services** is granted, such connections shall take place with/via systems on a DMZ rather than directly into a high security network. Access to view sensitive data or perform key management shall not be possible.		Examples of such remote operational access include: • Pre-defined service access – Initiating a service or process either: • With some limited variability or user input but where the scope of activity is limited and clearly controlled e.g., a file transfer mechanism • As a fixed process with no variability e.g., triggering of a data processing operation. Access to view sensitive data (key material) or access to configuration data

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				(access control, system configuration) must not be possible. These activities may be carried out from outside of a high-security area where a full risk assessment has been conducted but should not include key management activities. Technical controls in place at the site to restrict the level of access for remote users should be demonstrated at the audit. The auditors will expect to see evidence that these controls are implemented at and managed from a site whose activities are SAS certified. Control of the pre-defined services exposed to remote users should be demonstrated at the audit. The auditors will expect to see evidence that services are designed, implemented and executed in a way that: • Limits the scope to clearly defined roles. • Restricts any visibility of sensitive information. Examples of sensitive information include: • Class 1 or class 2 data related to the SAS-certified activities. • Information about system or security configuration that could be of use to a potential attacker e.g., firewall rules.
	10.4.5	Where remote **interactive** access to sensitive systems and networks within SAS certified sites is granted for administration or operational reasons, such access shall take place from clearly designated, physically controlled environments. The originating system shall have at least the same level of physical and logical security controls as the target systems, up to the level required for SAS compliance.		Examples of sensitive systems for SAS include: • Personalisation system • Key management system • Network firewalls or switches • Back-end data transfer server • Data generation server (SAS-UP) Examples of such remote interactive access include: • An interactive shell or desktop session on a workstation, server or network component such as a firewall This level of access carries the highest level of risk. By default, certified sites that permit this level of inbound access are expected to demonstrate that these activities are carried out from within an environment where the logical and

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				physical security controls and associated processes comply with the requirements of SAS. In most cases this will require the site hosting the endpoint(s) to be subject to an SAS audit from the relevant scheme (UP or SM) as part of the certification process. Where remote management is provided through an administration portal or tool that permits administrative actions but no direct access to the system; the portal or tool itself may also fall within the scope of the audit (e.g., portal/tool audit logs, evidence of patch management, penetration testing against portal/tool). SAS does allow for exceptions to the above to be considered in specific circumstances, as described in 10.4.6. If a system is presented as off-line / air-gapped for the purpose of the SAS certified activities, then no level of remote access would be expected.
	10.4.6	Remote access carried out other than according to 10.4.3, 10.4.4 and 10.4.5 shall not normally be accepted at SAS certified sites. Where auditees wish to utilise other solutions as exceptions to those normally accepted, they shall provide evidence that either: • The remote access does not allow access to networks, systems or information within the scope of SAS certification. Or, for SAS-SM only: • A full and appropriate risk assessment, accepted by the audit team prior to implementation, has been conducted that considers both the access to systems and the visibility of sensitive information. And • The site containing the endpoint		Remote access to sensitive systems and networks may be carried out from a non-SAS-certified environment only in exceptional circumstances. Remote access may be permitted where auditees demonstrate that clear, auditable controls are in place that prevent any access to networks, systems or information within the scope of SAS certification, e.g., remote monitoring or logging not involving any systems within the scope of SAS certification. Given the distributed nature of some SAS-SM installations there may be a need for remote access sessions to occur from physical areas of a lower security level. Such access may be accepted provided that all of the applicable requirements in 10.4.6 are satisfied. The risk assessment should be presented prior to implementation either: • At an SAS-SM audit. or • Via a major change notification to the GSMA (in accordance with the SAS-SM Methodology) for projects that do not align with the site's audit schedule. Remote access permitted under the exception should be temporary (during authorised and controlled periods only), with each access monitored from a SAS-

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		systems is owned by the auditee or its contracted supplier(s). And • The remote access is temporary, monitored and controlled in real-time from a SAS-SM certified environment, with no ability to export data. In all cases, controls described in 10.4.7 shall apply.		SM site. The access should be restricted in scope and controlled from the SAS-SM environment - typically via session monitoring - with no data exporting capabilities and virtual escorting (ability for an operator in the SAS-SM environment to monitor the remote session in real-time and terminate it if needed). The procedure describing this type of remote access must be documented and demonstrated during the audit.
	10.4.7	Connectivity between the originating endpoint and the targeted system(s) must be appropriately secured, as follows:		
	(i)	Endpoint security The security of the endpoint from which remote access originates shall enforce appropriate logical and physical security controls to ensure a level of protection equivalent to those applied to direct access to the target system. Specifically, endpoints shall be: • Positively identified, with access strictly limited to pre-authorised devices that are: Owned and controlled by the auditee organisation. Subject to appropriate hardening controls. Configured according to a defined security policy Up to date with the latest security patches at the time of the connection. • Only located in clearly designated		The workstations utilized for remote access shall be pre-approved and subjected to a filtering mechanism (IP filtering, MAC address…) to limit potential connections. The devices should be hardened, up to date with the latest security patches, and running appropriate and up-to-date anti-malware controls. The location where the remote end point workstation is hosted should be placed either in a HSA for the SAS–UP standard or in a secure area subject to a risk assessment in the case of the SAS–SM standard.

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		physically secure environments to which access is controlled on strict-need-to-be-there principles. • Connected to a local network dedicated to the purpose of remote access to sensitive network systems that can only be accessed from within the designated physically secure environments.		
	(ii)	Security of the channel The channel used to connect from the endpoint network to the target network environment shall be secured: • End-to-end between devices that are configured and managed under physical and logical security controls within the scope of the SAS certification process. • Using appropriate technologies to ensure the required level of security. ○ Keys and credentials used for authentication and encryption of the channel should be generated, stored and exchanged according to secure processes.		Channels for remote access will often be established between different sites across public, shared, or lower-security networks. Channels should be established using appropriate technologies to ensure mutual authentication and confidentiality (typically through encryption). Appropriately configured IPsec or SSL VPNs are generally considered acceptable solutions to provide manageable and controlled connection using pre-specified security mechanisms.
	(iii)	Security of the target network The remote access channel used for user access shall terminate in a dedicated remote access network containing one or more jump hosts configured to control and monitor access for authorized endpoints and end users to connect to pre-determined target systems. The remote access network shall be configured		Jump hosts provide a mechanism of authenticating a user connecting from a lower security zone to a higher security zone when this type of connectivity would normally be prohibited by network security policies.

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		to permit access:
		• Inbound only via the secure channel.
		• Outbound:
		  • Via one or more firewalls.
		  • Only to those target systems to which remote access is specifically required.
		  • Only using pre-determined methods of connection (e.g., RDP, SSH) for each system.
		Jump hosts shall be used within the frontend/DMZ zone to connect to devices or servers in that zone.
		Additional jump hosts shall be used within the backend zone to connect to devices or servers in that zone.
		A jump host shall be used within the relevant network security zone in which the targeted servers are logically and physically located.		

	(iv)	Authentication Remote user access mechanisms must employ enhanced authentication mechanisms (e.g., multi-factor authentication), whenever remote access is granted: • across networks of lower security level than that being connected to • from off-site locations		Multi-factor authentication mechanisms increase the resistance any system has to unauthorized access by requiring the end user to have knowledge of a password and a possess access to a token device or application that generates a secondary code to be authenticated prior to the user being granted system access.
	(v)	Audit trails and logs Monitoring and full logging shall be in place to ensure full traceability of all access sessions.		Logs for all remote access should be generated and stored according to a defined and documented policy. Logs should typically include: • Authentication of the remote user to the relevant jump host.

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		Integrity of these logs and logging mechanisms shall be protected to prevent modification, deletion or disabling.		• Authentication of the remote user within the target environment (e.g., Active Directory/LDAP). • Establishment of the VPN. • Access to network devices, systems and applications by the remote user. Additionally, where remote access is permitted under the exceptions described in 10.4.6, logs should also include: • The authentication of the user fulfilling the role of the virtual escort. • Each action performed on the target systems.
	10.5	Network security		
	10.5.1	Systems and data networks used for the processing and storage of sensitive data shall be housed in an appropriate environment and logically or physically separated from insecure networks.		Network configuration should be clearly documented. Secure networks should be defined and separated according to function/use. • Auditees operating SM and EUM environments at the same site should implement these as logically separate networks. ○ Connections for transfer of data between SM and EUM environments should normally be treated as external connections to reinforce this separation. All processing of customer data should take place on secure networks. Secure networks should be dedicated networks that are physically or logically separated from insecure networks (which would typically include those used for general business administration purposes such as office networks, HR, accounting etc.). Where multiple networks are defined, the relative security levels of the networks should be documented as part of the network security strategy. Where secure networks are logically separated, the secure network should be protected using one or more firewalls.
	10.5.2	Data transfer between secure and insecure networks must be strictly controlled according to a documented policy defined on a principle of minimum access.		There should be no direct connections made between the secure network and systems on uncontrolled, untrusted or third-party networks, even where these connections are made through the firewall(s). Systems used for data exchange between the secure network and uncontrolled, third-party, networks (e.g., customers), should be positioned on de-militarized

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				zones (DMZs). Extension of secure networks across multiple sites may be compliant with the requirements of SAS where: • each site is SAS certified • inter-site connections are made using appropriately secured channels (e.g., VPN) Where secure networks are extended across multiple sites and these criteria are not met for one or more of the sites, the overall secure network is unlikely to meet SAS requirements. Controls should be in place to prevent creation of unauthorised connections to secure networks, including implementation of port-level security. Where virtual server environments are in use physical server platforms should not be used to support virtual servers on networks of different security level.

	10.5.3	The system shall be implemented using appropriately configured and managed firewalls incorporating appropriate intrusion detection systems.		The configuration of firewalls and change process must be documented with the validation of the request prior to the effective change and the control after the implementation.
				• Firewalls should be managed from the protected (i.e., secure) network.
				• Firewalls should be configured to provide the minimum access required only, restricted by address and port. Connections across the firewall should be originated from the secure network.
				• Services used for permitted connections should be selected to minimise the risks to the integrity of:
				  ○ Sensitive data
				  ○ Secure clients
				  ○ Secure networks.
				• A business-level firewall policy document should be defined, documenting access to be provided by the firewall and the business-level requirement for it. All changes to the policy should be subject to authorisation. Authorisation should be independent of the firewall and network administrators.
				• Firewalls should be configured in accordance with the firewall policy and

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				subject to periodic review.
				• It should not be possible for unauthorised changes to be made to firewall configuration (even by authorised personnel). Appropriate preventative controls could include:
				  ○ All changes to firewall configuration being possible only under dual control.
				  ○ Automated mechanisms being in place that provide real-time notification to independent personnel of any change to firewall configuration.
				• Firewalls should be configured to log key events; logs should be reviewed regularly (e.g., weekly).
				It should be demonstrated that intrusion detection systems are implemented, and alerts are treated, including an escalation process.

	10.5.4	Controls shall be in place to proactively identify security weaknesses and vulnerabilities and ensure that these are addressed in appropriate timescales		Programmes of penetration testing should be in place to proactively identify potential weaknesses and vulnerabilities. Penetration tests should consider: • networks and identified hosts that are intentionally exposed to networks and clients of lower security level (e.g., data transfer networks) validating that other networks and hosts are not exposed. Penetration tests should normally be conducted at least 1-2 times per year or when significant changes are made to network or security configuration (e.g., creation of new data transfer networks, migration of firewalls to new platforms)
	10.5.5	Systems providing on-line, real-time services shall be protected by mechanisms that ensure appropriate levels of availability (e.g., by protecting against denial-of-service attacks).		
	10.6	Systems security		
	10.6.1	Systems configuration and maintenance		

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	(i)	Security requirements of systems shall be identified at the outset of their procurement and these factors shall be taken into account when sourcing them.		An up-to-date inventory list of the IT systems should be available including their configurations.
	(ii)	System components and software shall be protected from known vulnerabilities by having the latest vendor-supplied security patches installed.		The entire IT system environment should be maintained with the latest vendor-supplied security patches as and when they become available. Whilst immediate application of patches may not always be possible, they should be applied within reasonable timescales. Out-of-support environments should not normally be in use. Migration strategies should be in place where environments are approaching end-of-life or end-of-support by the vendor.
	(iii)	System components configuration shall be hardened in accordance with industry best practice		A hardening policy should be defined and applied to systems or components based on risk. • Security devices (e.g., firewalls) should always be hardened. • Sensitive systems (systems in networks where sensitive data is stored, processed or transmitted) should be hardened, particularly where commodity OSs are used (e.g., Windows, Linux). • Exposed systems (e.g., customer data transfer servers) should be considered as sensitive. Auditees should be able to demonstrate how the policy has been applied to systems or components. A range of recognised international standards, recommendations and guidance for OS and system hardening are available and should be considered by sites, including: • Centre for Internet Security (CIS) Benchmarks https://benchmarks.cisecurity.org/downloads/benchmarks/ • US National Security Agency (NSA) Security Configuration Guides https://www.iad.gov/iad/library/ia-guidance/security-configuration/ • SANS Institute Checklists and Guides https://www.sans.org/score/checklists

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				(Links correct at March 2017)
	(iv)	Change control processes and procedures for all changes to system components shall be in place.		Any change to IT systems should be subject to a documented change management process with a formal validation process.
	(v)	Processes shall be in place to identify security vulnerabilities and ensure the associated risks are mitigated.		A programme of regular vulnerability scanning should be in place to consider: • All systems on the secure network(s) • All systems on networks used for customer data transfer • Scans should be completed: • After each major change • Monthly for internal ‘secure’ networks • Monthly for externally-facing networks used for customer data transfer. Sites should monitor vendor and industry sources for announcements of vulnerabilities and patches. Local policies should be in place that define target timescales for implementation of patches based on the level of risk. The level of risk may be determined based on: • the severity of the vulnerability • the context of the system where the vulnerability exists Critical vulnerabilities should always be prioritised for implementation. Critical vulnerabilities in externally facing system components should always be remediated as an immediate priority (e.g., within 7 days). Critical vulnerabilities in system components within secure networks should be remediated as high priority (e.g., within 30 days).
	(vi)	Comprehensive measures for prevention and detection of malware and viruses shall be deployed across all vulnerable systems.		The malware control strategy should always emphasise prevention of infection as the primary control. Detection mechanisms should be used as a final line of defence in the event that prevention measures fail. Response mechanisms should be in place where possible infections occur. The prevention strategy should consider general best practice through a combination of:

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				• Regular application of security patches and updates
				• Appropriate network segmentation and separation
				• Restrictions on the use of uncontrolled external media
				• Definition of a malware perimeter for the site. All incoming data (including application software) crossing the perimeter should be explicitly checked, including:
				  ○ Email
				  ○ Direct data transfer (e.g., FTP)
				  ○ Physical media (e.g., CD/DVD-ROM, external USB storage device, USB memory key).
				Detection mechanisms (e.g., anti-virus software) should be:
				• installed on all vulnerable systems
				• updated regularly with virus definitions
				• subject to regular checks to identify systems that have not been updated.
				Where systems cannot support anti-virus software, controls should be in place to ensure viruses cannot be introduced. Such controls should include:
				• scanning of data and applications software prior to introduction to the system.
				• isolation of network segments containing such systems.
				Where possible infections are detected, mechanisms should be in place to ensure that these are reported and escalated quickly.
				Clear response procedures should be in place. Possible infections in systems and networks used for the processing of sensitive data should always be treated as security incidents. Root-cause of infections should always be identified, and the anti-virus strategy reviewed and updated as appropriate.

	(vii)	Unattended terminals shall timeout to prevent unauthorised use and appropriate time limits shall be in place.		Configuration of timeouts should be controlled by the administrator; users should be prevented from changing timeout settings.
	(viii)	Decertification/decommissioning of assets		The requirements of section 9.4 should be applied to network devices (routers,

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		(such as IT systems) used as part of the SP shall be documented and performed in a secure manner.		firewalls etc.)
	10.6.2	System back-up		
	(i)	Back-up copies of critical business data shall be taken regularly. Back-ups shall be stored appropriately to ensure confidentiality and availability.		A programme of regular back-ups should be defined. Back-up frequency and retention period should be defined based on the importance of the data contained Sensitive data should be appropriately protected in accordance with the site's security classification and data handling guidelines. Such controls should normally include encryption of data and physical security of storage media. Storage media used for back-ups should be selected, implemented, managed and maintained to ensure adequate protection from: • Environmental threats (e.g., fire, flood, temperature extremes, electrical and electro-magnetic effects) • Accidental or deliberate corruption • Unauthorised access Typically, media should be stored separately from the systems themselves. Back-ups retained on-site should be stored away from server rooms in a data / media fire safe. Off-site storage of one generation of back-ups should be considered. Procedures for restoration of data from back-up should be checked periodically (typically once or twice per year). Procedures should be in place to ensure that production status can be reinstated to the correct point when/if such data is restored from back-up.
	10.7	Audit and monitoring		
	10.7.1	Audit trails of security events shall be maintained and procedures established for monitoring use.		Systems and applications on the secure network should implement logging of security relevant events including: • Logon attempts (successful and unsuccessful)

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				• Logoff • Password changes • Attempts to exceed permissions • Changes to audit logs. Audit logs should be reviewed regularly (e.g., weekly) to identify suspicious behaviour. Specific applications on the secure networks (e.g. data processing, Personalisation) should be implement full logging of all events relevant to the sensitive process, as described in section 7.4.1.
	10.8	External facilities management		
	10.8.1	If any sub-contracted external facilities or management services are used, appropriate security controls shall be in place. Such facilities and services shall be subject to the requirements stated in this document.		Where operations are outsourced, auditees should demonstrate that appropriate controls are in place to enforce the IT security policy. Auditees should take responsibility for auditing and controlling external facilities management partners.
	10.9	Internal audit and control		
	10.9.1	IT security controls shall be subject to a rigorous programme of internal monitoring, audit and maintenance to ensure their continued correct operation.		A programme of internal audits/controls should be defined that demonstrates appropriate consideration of: • The frequency of checks required for each area addressed by the internal audit/control mechanism • The structure of the audits/controls themselves, including clear guidance on what should be checked and how • The recording / documentation and follow-up process for audits/controls undertaken and actions identified. The auditors will expect to see evidence that processes and systems are working correctly, and that internal audits/controls have been carried out according to the schedule. There should be appropriate coverage of all aspects of the system; the audit/control programme should be defined around the need to provide

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				appropriate coverage, rather than the availability of resource. In particular, there should be evidence that the internal audit/control system has been designed to consider the different IT systems in use and the sensitivity of the data stored or processed. All IT systems should be audited against application of the IT security policy. Auditors should have received appropriate training in the structure and content of internal audits/controls.
SM	10.10	Software Development		
	10.10.1	The software development processes for the SM-DP, SM-SR, SM-DP+ or SM-DS shall follow industry best practices for development of secure systems.		The software development processes should be resistant against the top 10 security flaws described by the OWASP (www.owasp.org). The software development processes should follow the standard of the industry, for example, W3C standard. (The World Wide Web Consortium (W3C) is an international community that develops open standards to ensure the long-term growth of the Web)
DC	10.10.2	The software development processes for applications and bespoke software deployed within the SM environment shall follow industry best practices for development of secure systems.		The development processes for the software/cloud services available for use for hosting the SM service should be resistant against the top 10 security flaws described by the OWASP (www.owasp.org). The software development processes should follow the standard of the industry, for example, W3C standard. (The World Wide Web Consortium (W3C) is an international community that develops open standards to ensure the long-term growth of the Web)
DC	10.11	Multi-Tenancy Environments		
	10.11.1	Multi-tenant solutions must prevent cross-contamination of assets between different customers.		Prevention should be ensured by assigning access rights for customers to their own environments only, with no possibility of customers to access another customer's environment.
	10.11.2	Multi-tenant solutions on the same physical hardware shall ensure customer data is logically segregated between different		Logically segregated means the same hardware, the same instance but different access rights.

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		customers.		
	10.11.3	Each customer running their own applications must use a unique ID for that customer for the running of these application processes		Applications running on shared infrastructure should only be run using a unique ID for each customer. Any Common Gateway Interface (CGI) scripts in use by customers must run as a unique ID for each customer.
	10.11.4	Restrictions shall be put in place for all customers on shared infrastructure by restricting use of shared system resources.		Controls should be established to ensure that SAS-SM customer SLAs can be adhered to, and these monitored internally to ensure suitable restrictions on shared system resources (i.e., one customer cannot monopolize).
DC SM	10.11.5	The auditee shall ensure that customer data is only stored within SAS certified physical locations, including any Sites where data may be replicated to as part of business continuity plans, meeting all requirements detailed in section 5 of this document.		The auditee should prevent any data replication or other form of backup to outside of the certified sites or regions. Controls should ensure that all SM data is only stored at a SAS-SM certified data centre location, that is also permitted under customer SLAs.

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11 Two-Step Personalisation Process				
I	Personalisation may be carried out as a two-step process (Perso_SC and Perso_UICC). The process may involve a different entity in each step. SAS-UP requirements apply to both Personalisation steps. SAS-UP certification must be applied to each step for UICC production flows requiring SAS-UP compliance (e.g., eUICC). SAS-UP assessment of two-step Personalisation process can currently only be applied to the following product types: • Integrated eUICC			Requirements for the two-step Personalisation process are not intended to apply where the full Personalisation process takes place in the same physically secure EUM environment. Requirements in this section have been added to enable SAS-UP to support products, such as Integrated UICC, where the two Personalisation steps may be carried out at different times, potentially in different environments under the control of different entities. Production processes for product types other than those listed in this requirement are not currently supported for SAS-UP certification, although this may change in the future. Auditees involved in the eUICC production chain will be expected to demonstrate that the combined solution is secure.
	11.1	Control of duplicate production		
	11.1.1	Each Personalisation step shall incorporate controls to ensure that: • Personalisation Data is only used once. • Creation of duplicate devices containing the same Personalisation Data is prevented.		Auditees should demonstrate controls for preventing duplicate production. Personalisation Data for each eUICC should exist and be used in exactly one instance. A mechanism should be implemented to prevent the duplicate use of Personalisation Data.
	11.2	Generation of hardware security credentials		
	11.2.1	The generation of hardware security credentials, and their provisioning into the device hardware shall be considered a sensitive process, and be evaluated according to the requirements in section 7 of this document.		Auditees must demonstrate that hardware credentials are generated and provisioned in a secure manner. Credentials should be generated using security modules (HSM) that are FIPS 140-2 level 3 certified. Where generation and provisioning to Integrated eUICC hardware occur in separate facilities, a secure exchange mechanism should be in place.

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	11.3	Personalisation of security credentials (Perso_SC)		
	11.3.1	The Personalisation of a hardware device with security credentials shall be considered a sensitive process, and be evaluated according to the requirements in section 7 of this document.		Auditees should demonstrate that hardware credentials are provisioned in a secure manner.
	11.3.2	Perso_SC can occur only once within the device lifecycle.		Auditees should demonstrate that hardware credentials can be used only once.
	11.4	Generation of UICC OS credentials		
	11.4.1	The generation of UICC OS credentials shall be considered a sensitive process and be evaluated according to the requirements in section 7 of this document.		Auditees should demonstrate that OS credentials are generated and in a secure manner. Credentials should be generated using security modules (HSM) that are FIPS 140-2 level 3 certified.
	11.5	Personalisation of UICC OS credentials (Perso_UICC)		
	11.5.1	Generated UICC OS credentials shall be provisioned to authenticated hardware instances that have previously been personalised with security credentials in a Perso_SC process that has been SAS-UP certified.		Auditees should demonstrate that OS credentials are to be provisioned only to authenticated Integrated eUICC hardware that has been personalised at an SAS-UP certified site. Auditee may include in such demonstration mechanisms based on cryptographic means and legal obligations.
	11.5.2	Personalisation of UICC OS credentials to a device shall be carried out by establishing a secure channel that:		[10] 7.3.2, Package 2: Loader defines a set of security requirements for as part of a protection profile.
	(i)	Utilises unique security credentials personalised to the device in the Perso_SC step.		Auditees should demonstrate that:

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	(ii)	Can only be initiated by an appropriately authorized entity in possession of the security credentials.		• OS credentials provisioning process, combined with capabilities provided by Integrated eUICC hardware manufacturer satisfy requirements equivalent to those described in Package 2: Loader. • the means to establish a secure channel is rooted in a certified part of the target hardware. • The communication channel itself is secure. • The service it provides is secure. • The combined solution is secure. • Its hardware includes the additional authentication requirements of [10] 7.2 Authentication of the Security IC.
	(iii)	Enforces: • Mutual authentication. • Confidentiality. • Replay protection.		
	11.5.3	The Personalisation process shall ensure that:		
	(i)	UICC OS credentials are provisioned only to pre-determined secure locations within the device.		
	(ii)	UICC OS credentials are protected within the device after Personalisation to prevent disclosure and manipulation.		

Annex A Document Management

A.1 Document History

Version	Date	Brief Description of Change	Editor / Company
1.0	26 Jul 2016	Created based on SAS-UP Guidelines document v5.0. Added Certificate Management requirements and PKI Certificate Policy security requirements.	James Messham, FML
2.0	31 Mar 2017	Incorporated SAS-SM requirements, including SM-DP+ and SM-DS.	RSPSAS subgroup
2.1	2 Jan 2018	Updated guidelines on external network connections (section 10.4.2)	SAS subgroup
3.0	26 Jun 2019	Added two-step personalisation process (Integrated eUICC) guidelines. Added guidance on use of a single HSM platform for EUM and SM functions and network separation at such sites. Added guidance on SM solution demonstration expectations.	Or Elnekaveh, Qualcomm James Messham, FML Neil Shepherd, NCC Group
4.0	25 Jul 2019	Added guidelines for transfer of sensitive assets between sites.	SAS subgroup
5.0	18 Jun 2020	Development of remote user access guidelines	SAS subgroup
6.0	20 Nov 2020	Add specific guidelines for auditing of cloud service providers.	SAS subgroup
7.0	2 Jul 2021	Add guidelines for new requirement at 2.4.2 – clarify subcontractor responsibilities	James Messham, FML & Neil Shepherd, SRC
7.1	22 Sep 2021	Clarifications to HSM guidelines. Addition of SAS-UP definitions.	Saïd Gharout, Kigen
8.0	1 April 2022	Enable auditing and certification of certain cloud service provider-managed HSMs used in SM solutions. Make this PRD the single source of SAS requirements and guidelines, allowing withdrawal of PRD FS.17.	David Maxwell, GSMA
8.1	1 Jun 2022	Clarification to guidelines for HSM as a managed service.	Vincent Bourdaraud, Idemia; James Messham, FML; David Maxwell, GSMA.

A.2 Other Information

Type	Description
Document Owner	GSMA Fraud and Security Group
Editor / Company	David Maxwell, GSMA

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Your comments or suggestions & questions are always welcome.