EMV Card Personalization Specification

Version 1.1
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1. Purpose

Card personalization is one of the major cost components in the production of EMV cards. This specification standardizes the EMV card personalization process with the objective of reducing the cost of personalization thus facilitating the migration to chip.

In today's environment, there are numerous methods of personalizing EMV cards and many vendors providing the systems to personalize these cards. Each time a native card is developed, or a new application released, issuers and personalization vendors are obliged to expend significant time and money to develop the corresponding personalization process. In addition, these cards are typically personalized using proprietary commands, often making it difficult for card issuers to source cards from alternative suppliers or bureaus.

This specification standardizes EMV card personalization leading to faster, more efficient and more economical solutions. It offers benefits which include: lower set up costs, faster time to market, greater choice of supplier (card and personalization bureau) and an enhanced ability to switch suppliers.

Changes in version 1.1

This release incorporates Specification Update Bulletins no. 23 and no.40.
This release also introduces a new feature presented as personalization Direct method. It also brings clarifications for the DGIs containing CRT key components in Annex A.2. This is possible to have more than one Secure Channel key set as defined in section 3.2.5. New DGIs for EMV application internal data are defined in Annex A.2. An optional file structure creation mechanism is defined in Annex A.5. All revisions and insertions are marked with a sidebar.

2. Scope

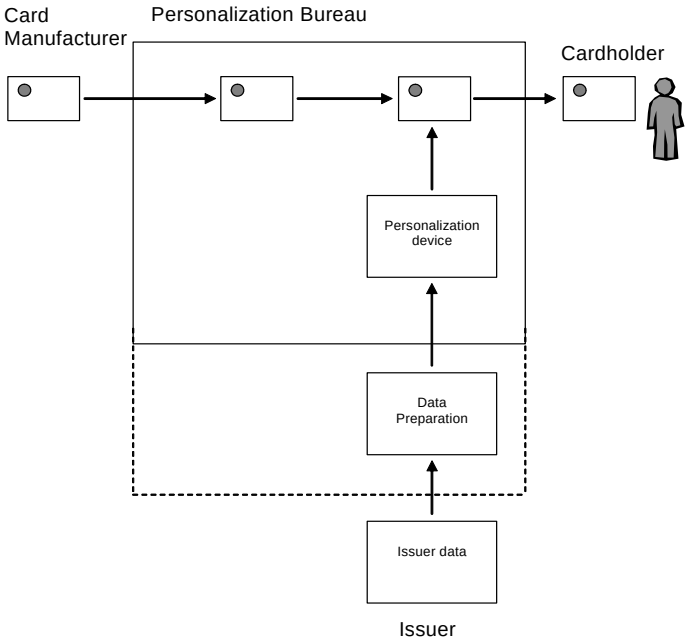
In this specification, card personalization means the use of data personalization commands that are sent to a card that already contains the basic EMV application. This is sometimes referred to as “on-card” personalization. The specification does not cover cards where an application load file is personalized before being loaded onto the card.

In terms of the lifecycle of the card, card personalization is assumed to take place after pre-personalization (see Definitions) and prior to card issuance. However non-EMV applications may well use the same personalization process as defined in this specification. Other card personalization activities – embossing, magnetic stripe encoding and the personalization of non-EMV IC applications – are not covered.

The interface between the card issuer and the data preparation system is not covered.

Involved Entities

These terms are described in the Definitions section below.



Indirect & Direct Methods of Establishing & Using Secure Personalisation Channels

Two methods are included in this specification – the indirect method and the direct method.

Indirect Method

This method is defined in both the current version (1.1) and the original version (1.0) of the EMV Card Personalisation Specification. The rationale is that the Data Preparation System should not need to have knowledge of the ICC data used to establish the secure channel for a particular target card/application. The method assumes two security zones, one between the Data Preparation System and the Personalisation Device, and a second zone between the Personalisation Device and the ICC.
The role of the Personalisation Device is:

- To receive the DGI data and Personalisation Device Instructions (PDI) from the Data Preparation System
- To establish the secure channel to the card
- To decrypt/re-encrypt the sensitive data (application keys & PIN), and
- To create and send personalisation APDU commands to the card.

An example of the process of Indirect method is shown in Annex B.

Direct Method

This method has been added in the current version (1.1) of the EMV Card Personalisation Specification. The rationale is to reduce the time taken by the Personalisation Device by pre-computing APDU commands in the Data Preparation System. The method assumes a single security zone between the Data Preparation System and the ICC. The Personalisation Device does not need to create APDU commands; it simply passes on the commands received from the Data Preparation System.
However the Data Preparation System needs to carry out additional preparation work. If the Secure Channel Key Set in the card (K_{ENC}, K_{MAC}, K_{DEC}) is not known, a pre-personalisation process is needed to load a derived key set known by the Data Preparation System on to the ICC. The ICC needs to produce a **pseudo**-random number, which the Data Preparation System can predict. The Data Preparation System also needs to be able to predict the Secure Channel Sequence Counter. The Data Preparation System uses this information to pre-compute the personalisation APDU commands for the ICC application.

Note: In terms of the interface between the ICC and the Personalisation Device, the formats of the personalisation messages are the same for either the indirect or the direct method. The main difference between the two methods is the allocation of processing between the Personalisation Device and the Data Preparation System.

3. Audience

There are three intended audiences for this document:

1. **Designers of EMV applications**
   This audience will use this document as one of the inputs to their design process. The areas that are impacted by this document are:
   - Design of the file and data structure for the EMV application on the IC card.
   - Design and processing of the personalization commands.

2. **Designers of Personalization Device systems**
   This audience will use this document as a specification for part of the design for their processing, in particular the input and output interfaces.

3. **Designers of Data Preparation systems**
   This audience will use this document as a specification for part of the design for their processing, in particular the output interface.

4. Normative References

The following documents contain provisions that are referenced in this specification. The latest version shall apply unless a publication date is explicitly stated:

EMV Version 4.1	Integrated Circuit Card Specifications for Payment Systems Book 1 – Application Independent ICC to Terminal Interface Requirements
	Integrated Circuit Card Specifications for Payment Systems Book 2 – Security and Key Management
	Integrated Circuit Card Specifications for Payment Systems Book 3 – Application Specification
EMVCo Specification Update: Bulletin no. 23 First edition	EMVCo Specification Update: Bulletin no. 23: First edition October 2003: Corrections and Clarifications to EMV Card Personalization Specification
EMVCo Specification Update: Bulletin no. 40 First edition	EMVCo Specification Update: Bulletin no. 40: First edition February 2005: Additional Corrections and Clarifications to EMV Card Personalization Specification
GlobalPlatform Card Specification	GlobalPlatform Card Specification V2.2
GlobalPlatform Messaging Specification	GlobalPlatform Messaging Specification V1.0
GlobalPlatform Systems Profiles Specification	GlobalPlatform Systems Profiles Specification - V1.1
ISO/IEC 7816-3	Identification cards - Integrated circuit(s) cards with contacts - Part 3: Electronic signals and transmission protocols
ISO/IEC 7816-4	Identification cards - Integrated circuit(s) cards with contacts - Part 4, Inter-industry commands for interchange
ISO/IEC 7816-5	Identification cards - Integrated circuit(s) cards with contacts - Part 5, Numbering system and registration procedure for application identifiers
ISO/IEC 7816-6	Identification cards - Integrated circuit(s) cards with contacts - Part 6, Inter-industry data elements

ISO/IEC 9564-1	Banking – Personal Identification Number (PIN) – Part 1- Basic principles and requirements for online PIN handling in ATM and POS systems
ISO/IEC 9797-1	Information Technology – Security Techniques – Message Authentication Codes – Part 1: Mechanisms using a block cipher
ISO/IEC 10116	Information Technology – Modes of Operation of an n-bit block cipher algorithm
ISO/IEC 18033-3	Information Technology – Security techniques – Encryption Algorithms – Part 3: Block Ciphers

5. Definitions

The following terms are used in this specification.

Application – An application resident in an EMV card.

Application Command – For this document specifically, an APDU command acceptable to an application after the application has been selected.

Card – An IC payment card as defined by a payment system.

Card Personalization – The personalization of application data within a card, using personalization commands.

Data Preparation – The process of preparing and formatting data, ready for sending to a personalization device.

Payment System – For the purposes of this specification JCB, MasterCard International, or Visa International Service Association.

Personalization – The personalization of application data to enable a card to be used by a cardholder.

Personalization Command – A command sent to a selected EMV application in order to personalize application data.

Personalization Device – A device that accepts data from a data preparation system, and sends personalization commands to a card.

Pre-personalization – The initialization of card data prior to personalization.

Processing Step – The action to be performed by the personalization device.

6. Abbreviations and Notations

The following abbreviations and notations are used in this specification. Additional abbreviations can be found at the end of this specification in chapter 6.

AID	Application Identifier
ASCII	American Standard Code for Information Interchange
ATR	Answer-to-Reset
BER	Basic Encoding Rules
BIN	Bank Identification Number
CBC	Cipher Block Chaining
CDA	Combined DDA Application Cryptogram Generation Authentication
CLA	Class Byte
C-MAC	Command Message Authentication Code
CPLC	Card Production Life Cycle
CPS	Card Personalization Specification
CRN	Card and Application Management System (CAMS) Reference Number
CRT	Chinese Remainder Theorem
CSN	Chip Serial Number
DDA	Dynamic Data Authentication
DES	Data Encryption Standard
DF	Dedicated File
DGI	Data Grouping Identifier
ECB	Electronic Code Book
EF	Elementary File
EMV	Europay, MasterCard and Visa
FCI	File Control Information

FCP	File Control Parameter
HSM	Hardware Security Module
IC	Integrated Circuit
ICC	Integrated Circuit Card
ICV	Initial Chaining Vector
ID	Identifier
IEC	International Electrotechnical Commission
IIN	Issuer Identification Number
INS	Instruction Byte
ISO	International Organization for Standardization
IV	Initialization Vector
KMC	DES Master Key for Personalization Session Keys
LSB	Least Significant Byte
M/O	Mandatory or Optional
MAC	Message Authentication Code
MIC	Module Identifier Code
MSB	Most Significant Byte
PAN	Application Primary Account Number
PDI	Personalization Device Instructions
PIN	Personal Identification Number
PK	Public Key
RFU	Reserved for Future Use (values to be ignored)
RSA	Rivest, Shamir and Adleman (Cryptographic Algorithm)
SDA	Static Data Authentication
SFI	Short File Identifier

SKU	Personalization Session Key
TK	Transport Key
TLV	Tag, Length, Value
var.	Variable

The following notations apply:

Hexadecimal Notation
Values expressed in hexadecimal form are enclosed in single quotes (e.g., '_'). For example, 27509 decimal is expressed in hexadecimal as '6B75'.

Letters used to express constant hexadecimal values are always upper case ('A' - 'F'). Where lower case is used, the letters have a different meaning explained in the text.

Binary Notation
Values expressed in binary form are followed by a lower case "b". For example, '08' hexadecimal is expressed in binary as 00001000b (most significant bit first).

Length Fields
Length fields are "big-endian" encoded. For example if a two-byte length field has a hexadecimal value of '13F' (319 in decimal), it is encoded as '013F'.

Operators and Functions

$\wedge$	Logical AND.
$\vee$	Logical OR.
:=	Assignment (of a value to a variable).
( ) or [ ]	Ordered set (of data elements).
$B_1 \mid\mid B_2$	Concatenation of bytes B_1 (the most significant byte) and B_2 (the least significant byte).
$[B_1 \mid\mid B_2]$	Value of the concatenation of bytes B_1 and B_2.
DES( )[ ]	The data in the square brackets is encrypted using DES encryption and the key in the normal brackets.
DES^{-1}( )[ ]	The data in the square brackets is decrypted using DES decryption and the key in the normal brackets.

DES3( )[ ]	The data in the square brackets is encrypted using triple DES encryption and the key in the normal brackets. Triple DES consists of encrypting an 8-byte plaintext block X to an 8 byte ciphertext block Y using a double length (16 byte) secret key $K = (K_L \| K_R)$ where K_L and K_R are DES keys. This is done as follows: $Y := DES3(K)[X] := DES(K_L)[DES^{-1}(K_R)[DES(K_L)[X]]]$ The encryption process is illustrated in section 5.7.1.1.
$DES3^{-1}$( )[ ]	The data in the square brackets is decrypted using triple DES decryption and the key in the normal brackets. Triple DES consists of decrypting an 8-byte plaintext block X to an 8 byte ciphertext block Y using a double length (16 byte) secret key $K = (K_L \| K_R)$ where K_L and K_R are DES keys. This is done as follows: $X := DES3^{-1}(K)[Y] := DES^{-1}(K_L)[DES(K_R)[DES^{-1}(K_L)[Y]]]$
XOR	Exclusive OR

Requirement Numbering

Requirements are highlighted by being indented and numbered with a four digit reference namely, section, subsection and requirement number. All requirements in this specification are therefore uniquely numbered with the number appearing next to each requirement. This convention is adopted to allow test specifications to be conveniently developed.

A requirement can have different numbers in different versions of the specifications. Hence, all references to a requirement must include the version of the document as well as the requirement's number.

Document Word Usage

The following words are used often in this document and have specific meanings:

- "Shall" or "Must"
  Defines a product or system capability that is required, compelled and mandatory.
- "Should"
  Defines a product or system capability that is highly recommended.
- "May"
  Defines a product or system capability that is optional.

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1 Card Personalization Data Processing

1.1 Overview of the Process

Within a personalization bureau environment the processing of Personalization Device Instructions (PDI) and IC card personalization data processing requires the following three functional steps:

1. Data preparation
2. Personalization device set-up and processing
3. IC card application processing.

Each of these steps, together with the two interfaces (1 to 2, 2 to 3), is briefly described below and discussed in detail in subsequent chapters.

An overview diagram of the complete EMV Card Personalization process Indirect method appears in Annex B.

Data Preparation

Data preparation is the process that creates the data that is to be placed in an IC card application during card personalization. Some of the data created may be the same across all cards in a batch; other data may vary by card. Some data, such as keys, may be secret and may need to be encrypted at all times during the personalization process.

Data preparation may be a single process or it may require interaction between multiple systems.

Much of the definition of data preparation is application specific. This document focuses on the data preparation processes that are commonly used for EMV cards and a description of these is given in Chapter 2.

Data Preparation-Personalization Device Interface

The output of the data preparation process is a file of personalization data, which is passed to the personalization device. The format of the file records is shown in Table 8.

The data preparation system must protect the completed personalization data file for integrity and authenticity (e.g. MAC or signed hash). An example of implementation in XML format is provided in the GlobalPlatform Messaging Specification section 5.

Personalization Device

The personalization device is the terminal that acts on Processing Step and Personalization Device Instruction data to control how personalization data is selected and then sent to the IC card application. The Processing Step indicates the format of the personalization data to be sent t the IC card application. Depending on the Processing Step for IC card personalization processes this device must have access to a security module (HSM) to establish and operate a secure channel between the personalization device on the one hand and the application on an IC card on the other. If the Processing Step indicates the pre-computed APDU commands as personalization data then the commands to establish the secure channel are part of the pre-computed APDU commands therefore the personalization device is not required to explicitly establish the secure channel with the IC card application. The secure channel services consist of MAC verification/ generation e.g. on commands sent to the application, and decryption and re-encryption of secret data e.g. PIN values. Personalization device processing is described in Chapter 3.

Personalization Device-ICC Interface

The personalization device sends a series of personalization commands to the ICC. The personalization command flow is shown in Figure 6.

The IC Card Application

The IC card application receives the personalization data from the personalization device and stores it in its assigned location, for use when the EMV card application becomes operational.

Section 4.1 describes the processing requirements for an EMV card application that must be performed prior to the start of personalization. The actual processing of the EMV card prior to personalization (pre-personalization) is outside the scope of this specification. However it is assumed that the EMV card application will have secure channel keys established for personalization prior to the start of the personalization process.

1.2 The Infrastructure of Card Personalization

The personalization process described in this document is designed to facilitate the personalization of the EMV application on IC cards. It creates a personalization infrastructure that allows for upgrades to EMV applications without requiring a change to the personalization device processing, and one that can also be extended to other applications in a generic way.

The personalization infrastructure consists of:

- Standard security between the personalization device and the IC card. This is summarized in section 1.3.
- Standard commands for sending personalization data to the IC card application. These are summarized in section 1.4.
- A standard record format for the personalization data sent to the personalization device. This is summarized in section 1.5.

1.3 Secure Messaging

At the beginning of processing by the personalization device, a secure channel is established between the personalization device and the IC card EMV application. Depending on the personalization method (see section 2), the secure channel is established either by the personalization device for the Indirect method or through the pre-computed APDU commands for the Direct method. The commands used to establish this secure channel are the INITIALIZE UPDATE command and the EXTERNAL AUTHENTICATE command. These commands are described in sections 3.2.5 and 3.2.6 respectively.

Two derived keys on the IC card are used during the establishment of the secure channel. These are the K_{ENC}, used to generate a session key SKU_{ENC} which is in turn used to create and validate authentication cryptograms, and the K_{MAC}, used to generate a session key SKU_{MAC} which is in turn used to compute the MAC of the EXTERNAL AUTHENTICATE command. Both of these keys (K_{ENC} and K_{MAC}) are derived from the same master key, the KMC. When the secure channel is to be established explicitly by the personalization device the IC card provides the personalization device with the identifiers of the KMC and the derivation data used to create the derived keys. The identification of the KMC is described in section 3.1.1. The creation of derived keys is described in section 4.1. Once a secure channel is established, personalization data can be sent to the IC card application. Based on the security level set in the EXTERNAL AUTHENTICATE command, the SKU_{ENC} may also be used to encrypt the command data field, and the SKU_{MAC} to produce the Command Message Authentication Code (C-MAC). In Direct method the APDU commands are pre-computed according to the requested security level by the data preparation system rather than by the personalization device.

1.4 The STORE DATA Command

The STORE DATA command is used to send personalization data to the card application; it is described in detail in section 3.2.7.

In order to reduce personalization time, the data preparation process organizes the personalization data to be sent to an EMV card application by the personalization device into data groupings. A Data Grouping Identifier (DGI) identifies each data grouping. The IC card application uses the DGI to determine how the data grouping is to be processed after it is received from the personalization device. Much of the data for an application is organized into records within the application when the application is designed. Where this is the case, the easiest way to create data groupings for an application is to make each record in the application a data

grouping. The principles of data grouping are described in section 2.2. In the Indirect method the personalization devices parse the input record and create a STORE DATA command for each data grouping or group of data groupings (see section 2.4.5) in the input record.
Some data groupings will contain data that must be kept secret during transmission from the personalization device to the card application; this can be done using a secret key known on either side of this interface. In this case an additional derived key (K_{DEK}) on the IC card is used to generate a session key SKU_{DEK}. The K_{DEK} is derived from the same master key (KMC) as the K_{ENC} and K_{MAC}. The IC card provides the personalization device with the identifiers of the KMC and the derivation data used to create the derived key. The SKU_{DEK}, described in section 5.3 may be used for this encryption. In addition to this requirement for security, the secure messaging described in section 1.3 provides the option for two additional security features: the C-MAC and command data field encryption for all subsequent STORE DATA commands.

In the Direct method the data grouping or group of data groupings are wrapped into the pre-computed STORE DATA commands and the data groupings containing secret data have been encrypted under the IC card's SKU_{DEK} by the data preparation system.

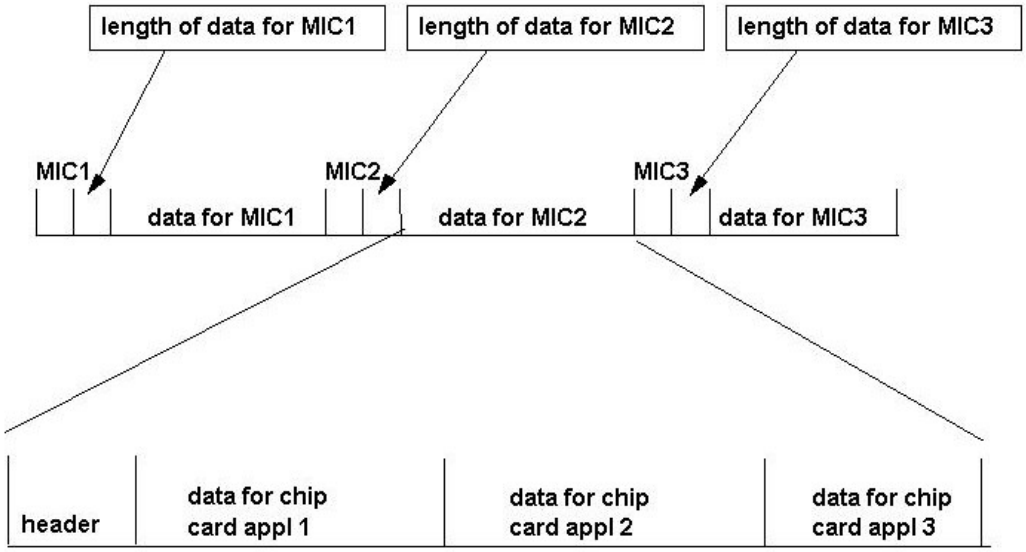
1.5 The Common Personalization Record Format

The common personalization approach requires a common personalization record format. This record format is described in section 2.6. This format has been developed to support the personalization of one or more applications on a single IC card.

The overall card personalization process normally consists of a series of processing modules that perform personalization tasks (e.g. embossing and magnetic stripe encoding). Each processing module uses data from the input record for a card to perform its task for that card. In the format defined in this document, the data for a processing module is identified by a Module Identifier Code (MIC). Each MIC is followed by the data to be processed for that processing module. Many processing modules also require a length field that specifies the length of the data for that processing module. The input for the personalization process for non IC card application data is defined in documentation provided by the personalizer, however, the basic structure of the most commonly used personalization record format allows all types of personalization data to be included in the same file.

There will be a MIC that identifies data to be placed on an IC card. The exact MIC used for personalization data must be established between the data preparation processing system(s) and the personalization device processing system(s). In Figure 1, which shows the organization of personalization data for the IC card module, MIC2 is used to represent the IC card personalization data. MIC1 and MIC3 indicate non-ICC personalization data.

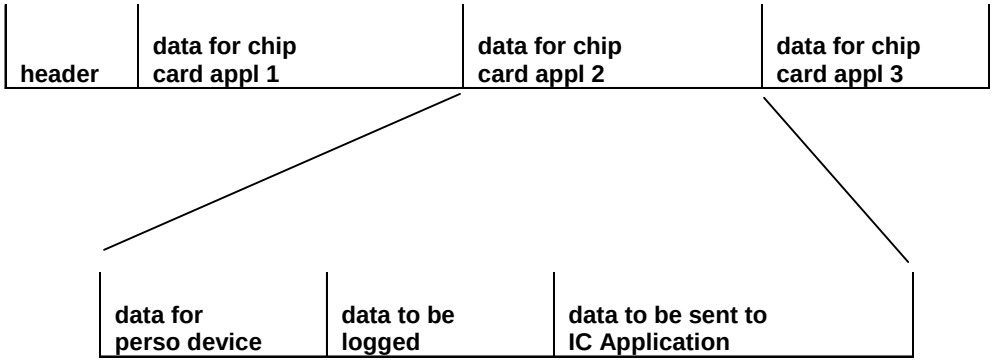
Figure 1 – Overview of IC Card Personalization Data Format



The header portion of this record contains information that is common to all IC card applications to be personalized. Header information is described in Table 8.

An overview of the format of the data for each application is shown in Figure 2.

Figure 2 – Overview of Personalization Data for an IC Card Application



- **data for personalization device**
  The first part of the data for an IC card application is data that provides processing information to the personalization device. This data consists of the AID for the application, if required the identifier of the Transport Key (TK) used to encrypt secret data in the record for the application (see section 6.36), processing steps and if required the processing instructions for the personalization device. The creation of personalization device instructions is described in section 2.4.

- **data to be logged**
  The second part of the data for an IC card application is the data to be logged for that application. However, the personalization device is not aware of what data is contained in the data groupings. Therefore, data that must be logged must be sent to the personalization device in a manner that indicates that this is data that must be logged. The data preparation process for the application must perform this task and instruct the personalization device. The data to be logged may be a duplicate copy of some of the data to be sent to the IC card application. See section 2.5 for additional information.

- **data to be sent to the IC application**
  The data to be sent to the IC card application is in the third part of the data for an IC card application. Depending on the Processing Step this data may consist of one or more data groupings with a Data Grouping Identifier (DGI) and a length field for Processing Step '0F' in Indirect method. See section 2.2 for additional information on the format and creation of this data. For Processing Step '0B' in Direct method this data consists of one or more pre-computed APDU command pre-pended by an indicator of the APDU command case and the length of the APDU command. See section 3.2 for additional information on the format and creation of this data. Note that the information provided in section 2.2 applies to each individual data grouping within a pre-computed STORE DATA command.

A complete description of the format for the personalization data for an IC card application is given in section 2.6.

2 Data Preparation

The data preparation process creates application data that is used to personalize the IC card application and depending on the Processing Step the Personalization Device Instructions (PDI) data that are used to direct the personalization process. Whatever is produced by the data preparation process must be transported securely to the personalization device itself (unless it is created in an HSM attached to the personalization device). Any secret data created by the data preparation process remotely from the personalization device must therefore be encrypted before transmission and all data files generated remotely from the personalization device must be protected by a Message Authentication Code (MAC) before transmission.

For Indirect method where the personalization device computes the APDU commands the data preparation process consists of the following five steps:

1. Creating personalization data.
2. Combining personalization data into data groupings.
3. Creating personalization instructions.
4. Creating data to be logged for the application.
5. Creating the input file to the personalization device.

For Direct method where the data preparation system computes the APDU commands the data preparation process consists of the following five steps:

1. Creating personalization data.
2. Combining personalization data into data groupings.
3. Pre-computing APDU commands.
4. Creating data to be logged for the application.
5. Creating the input file to the personalization device.

2.1 Creating Personalization Data

The EMV CPS compliant application developer must determine what data is to be placed in the application at personalization time, and must determine the source of the data. In some cases a single data preparation process will create all of the data. In other cases, the data will come from multiple sources. The data falls into three categories:

1. Issuer Master Keys and Data
2. Application Keys and Certificates
3. Application Data

2.1.1 Issuer Master Keys and Data

EMV personalization cannot take place unless the card issuer creates master keys and other specific data. The master keys are used in two ways, firstly to support secure transmission of personalization data and secondly to create application-level data for personalization of an EMV application. Some of the data may be used to manage the personalization process and some will be placed on the card during personalization.

Other processes may also use one or more of the master keys used by the personalization process. In this circumstance, a method of importing or exporting master keys to allow appropriate data sharing between processes will be required. Prior to the personalization process the identifier of the personalization master key KMC_{ID}, key version number, KEYDATA and the corresponding relevant keys, must be placed onto the card. KMC_{ID} and key version number are used to access the issuer personalization master key (KMC) in order to derive the card unique static keys using diversification data (KEYDATA).

The 6 byte KMC_{ID} (e.g. IIN right justified and left padded with 1111b per quartet) concatenated with the 4 byte CSN (least significant bytes) form the key diversification data that must be placed in tag 'CF'. This same data must be used to form the response to the INITIALIZE UPDATE command.

Table 1 – Data Content for tag 'CF'

Data Element	Description	Length	Format
KEYDATA	Key derivation data: - KMC_{ID} (6 bytes) - CSN (4 bytes)[1]	10	Binary

2.1.2 EMV Application Keys and Certificates

For EMV applications an issuer RSA key pair must be generated and certified by the Payment System Certification Authority, for use in SDA and DDA/CDA.

Application level symmetric DES secret keys for transaction certificate generation etc. must be created during data preparation. In most cases such keys are derived from appropriate issuer master keys.

If public key technology (DDA/CDA) is supported in the card, then a card level EMV application RSA key pair must be generated and certified by the issuer. A second

[1] If the CSN does not ensure the uniqueness of KEYDATA across different batches of cards other unique data (e.g. 2 right most bytes of IC serial number and 2 bytes of IC batch identifier) should be used instead.

application RSA key pair may be required for PIN decipherment. The issuer certificate(s) corresponding to the issuer private key used to certify the application public key(s) must also be stored in the application.

2.1.3 Application Data

Application data will fall into two categories. It may be common across all IC cards for an issuer (e.g. the identifier of the issuer) or it may be unique to the IC card (e.g. the PAN of a debit/credit application).

2.2 Creation of Data Groupings

After the personalization data for the IC card application has been created, it must be placed into the correct data grouping.

The design of the data groupings plays a key part of the personalization process. The application designer will have created default file and record definitions. An optional file structure creation mechanism is defined in Annex A.5.

In general, a data grouping should be a record for the application. As all of the data in a grouping will be sent to the IC card application in a single command, having a data grouping based on a record will reduce the processing required by the IC card application.

The following requirements and guidelines shall be used when creating data groupings:

1. All data elements to be sent to the IC card during the personalization process must be placed in a data grouping.
2. DES keys must be placed in a data grouping that consists of only DES keys. More than one data grouping of DES keys may be created.
3. For ease of IC card management, most, if not all, of the content of each data grouping should be identical to the content of a record for the application.
4. When assigning identifiers for data groupings, use of a combination of the SFI and the record number is recommended. For the DGIs with the first byte equal to '01' through '1E', the first byte indicates the SFI in which the data is to be stored and the second byte indicates the record number within the SFI.
5. The first two or three data bytes of any DGI for the EMV application in the range '01xx' through '0Axx' will consist of a record template tag '70' and the length of the remaining record data.
6. There are benefits from grouping all fixed length data elements together, and placing all variable length data elements into another data grouping.
7. It is recommended that the length of data in a data grouping does not exceed 237 bytes.
8. Application designers do not usually place data elements that are only used by internal IC card application processing in records. However, these data elements must be placed in one or more DGIs. It is recommended that these DGIs contain only data elements used exclusively for internal IC card application processing.
9. If an application contains information in its FCI (the response to the SELECT command) that is dependent on the personalization data, one or more data groupings must be created for the FCI data.
10. Data grouping identifiers (DGI) '9F60' through '9F6F' are reserved for sending payment systems proprietary data, e.g. card production life cycle (CPLC) data to the IC card (rather than the application) and must not be used as a DGI by an EMV CPS compliant application.

11. Data grouping identifiers (DGIs) '7FF0' through '7FFE' are reserved for application-independent personalization processing and must not be used as a DGI by an EMV CPS compliant application.
12. Data grouping identifiers (DGIs) '8F01', '7F01' and '00CF' are reserved respectively for the secure channel derived keys, the key related data and the key derivation data and must not be used as a DGI by an EMV CPS compliant application for other purposes.
13. Data grouping identifiers (DGIs) '0062' is reserved for file structure creation and must not be used as a DGI by an EMV CPS compliant application for other purposes.
14. The number of data groupings should be minimized to improve performance during the personalization process.
15. If the data grouping is to be encrypted and the data is a DES key or PIN Block data, no padding is required. Otherwise all data must be padded. Such padding is accomplished by appending an '80', followed by 0-7 bytes of '00'. The length of the data part of the data grouping must be a multiple of 8-bytes.
16. The Key Check Value for any DES key will be computed by encrypting 8 bytes of '00' using ECB 3DES with the key concerned. The Key Check Value is defined in section 6.15.
17. It is recommended that the data preparation system generate the Reference PIN Block according to ISO 9564-1 format 1. The card application must reformat the PIN Block if necessary.
18. The data within a DGI with a leftmost byte of the identifier in the range of '80' to '8F' is always encrypted. Nevertheless, encrypted data may also be included in a DGI outside this range.

The DGI must be coded on two bytes in binary format, followed by a length indicator coded as follows:

- On 1-byte in binary format if the length of data is from '00' to 'FE' (0 to 254 bytes).
- On 3-byte with the first byte set to 'FF' followed by 2 bytes in binary format from '0000' to 'FFFE' (0 to 65 534), e.g. 'FF01AF' indicates a length of 431 bytes.

2.3 Completion of Personalization

If specific data needs to be sent to the IC card application at the end of the personalization process, this can be indicated to the Personalization Device by using a special Data Grouping Identifier ('7FFF') that will be included in the last STORE DATA command. The contents of this DGI are shown in Table 2.

Table 2 – Data Content for DGI '7FFF'

Data Element	Description	Length	Format
DGI	'7FFF'	2	Binary
Length	Length of data	1 or 3	Binary
	Data	var.	var.

This DGI can in turn be used as the command body of a final STORE DATA command issued in the personalization of the EMV application. The DGI '7FFF' is not mandatory.

Independently of the DGIs (including '7FFF'), the personalization device shall set b8 of the P1 parameter in the last STORE DATA command to 1b, indicating the completion of personalization for the application.

2.3.1 Multiple Transport Key Capability

It is also possible to encrypt secret data per application under different Transport Keys while the data is being transferred from the data preparation system to the personalization device. See Table 9 for an explanation of this process. The usual reason for having multiple TKs would be to encrypt PINs under a PEK (PIN Encryption Key) and encrypt other secret data under a different Transport Key. This use of multiple TKs allows separation between true KEKs (Key Encryption Keys), PEKs and DEKs (Data Encryption Keys).

2.4 Processing Steps and Personalization Device Instructions

A Processing Step (PS) describes what action is to be performed by the personalization device. For EMV cards the only action to be performed is personalization based on DGIs and immaterial of whether the personalization APDU commands are computed by the personalization device (i.e. DGIs within the ICC data field) or by the data preparation system (i.e. pre-computed APDU commands within the ICC data field).

For Indirect method as the APDU commands are to be computed by the personalization device the value of the ACT field (see Table 11) within the PS data element (see Table 8 section 3a.2) for this step must be set to '0F'.

For Direct method as the personalization is performed using the pre-computed APDU commands by the Data Preparation System this value must be set to '0B'.

The personalization device instructions are special instructions that are created during the data preparation process and are used by the personalization device during the personalization process. The personalization device instructions are not sent to the card.

At this point no personalization device instructions are defined for the Processing Step '0B'.

The personalization device instructions for Processing Step '0F' are:

Order – The order in which data groupings must be sent to the IC card application is specified in this instruction.

Version Control – As IC card applications are modified and different versions of their specifications are created, the required data groupings for the application may change. Data groupings that vary by application version, and which may be rejected by the IC card application without causing the personalization process to terminate with an error, are specified in this instruction.

Encryption – Data groupings that must be decrypted and re-encrypted by the personalization device are specified in this instruction.

Random Number – If a random number is required for any processing of this application, the random number in this field must be used.

Group – Any set of data groupings that must be sent to the IC card application within one STORE DATA command is specified with this instruction.

Security Level – The expected security level of the secure channel to be established between the personalization device and the IC card application.

Update CPLC – This is used if the personalization device is required to generate the DGI '9F66' with the appropriate CPLC data and send it to the card within one STORE DATA command.

The personalization device instructions for personalization must be placed in a PDI field within the Processing Step.

2.4.1 Order that Data must be sent to the IC Card

In general, the data for an IC card application should be organized into data groupings in a manner that allows the data groupings to be sent to the IC card application in any order. However, there may be applications where it is not possible to organize data in this manner. To inform the Personalization Device of these situations, the ORDER field in the PDI field (see Table 12) must be created. The contents of the ORDER field are shown in Table 3. If a DGI is part of a group of DGIs (See section 2.4.5) then only the first DGI listed for that group should be included in this ORDER field. Multiple data grouping orders may be created. It is also possible to indicate to the personalization device the order in which the DGI or a group of DGIs is to be sent to the IC application. A DGI can only occur once within the value fields of all ORDER statements taken together.

If the orders of STORE DATA command are set to '00' for Order #1 and Order #n then there is no requirement that Order #1 must be sent to the IC card before Order #n.

The DGI entries must be concatenated together without separators. For example, if DGIs '0101' and '0019' were the DGIs in Order # 1, they would be coded '01010019'.

When a DGI is part of a set of GROUPed DGIs, for example DGI '0129' is part of GROUP '02080129' and should be sent to the IC application after DGI '0101' then the Order #n should be '01010208'.

Table 3 – Data Content for the Field ORDER

Data Element	Description	Length	Format
Order #1	'01'	1	Binary
Order of STORE DATA command for Order #1	'00' order does not matter '01' must be placed in the first STORE DATA command '02' must be placed in the second STORE DATA command 'nn' must be placed in the 'nn'th STORE DATA command 'FF' must be placed in the last STORE DATA command	1	Binary
Length	Length of Order#1	1	Binary
Order of DGIs	List of DGIs in Order #1	var.	Binary
…			
Order #n	'nn'	1	Binary
Order of STORE DATA command for Order #n	'00' order does not matter '01' must be placed in the first STORE DATA command '02' must be placed in the second STORE DATA command 'nn' must be placed in the 'nn'th STORE DATA command 'FF' must be placed in the last STORE DATA command	1	Binary
Length	Length of Order #n	1	Binary
Order of DGIs	List of DGIs in Order #n	var.	Binary

2.4.2 Support for Migration to New Versions

The data preparation process does not necessarily know the version of the application it is creating data for. Given that applications will reject all unknown DGIs with error responses, migrating application versions will require synchronization between the data preparation process and the personalization process. This is undesirable. In order to ease migration between new versions, one approach would be to produce personalization data that is a superset of the personalization data for all possible application versions. By itself this does not completely ease migration problems, it is necessary to inform the personalization device of such a transition process so that it can detect allowed rejections. The

version control field (VERCNTL) in the IC Card Application Data (see Table 12) is the mechanism to signal to the personalization device what are acceptable rejections. The contents of the VERCNTL field are shown in Table 4. If a DGI is listed in VERCNTL field and the response from the IC card application is '6A88' (considered a rejection of a data grouping), the personalization process must not be aborted.

Table 4 – Data Contents for the Version Control Field VERCNTL

Data Element	Description	Length	Format
List of DGIs	List of data grouping identifiers that may be rejected without error.	var.	Binary

The DGI entries must be concatenated together without separators. For example, if DGIs '0101' and '0029' may be rejected without error, they would be coded '01010029'.

2.4.3 Encrypted Data Groupings

To inform the personalization device of data groupings that must be encrypted, the ENC field in the IC Card Application Data (see Table 12) must be created. All of the data, not just the secret data, in the data grouping is encrypted. The DGI and the length field for the data grouping are not encrypted. The contents of the ENC field are shown in Table 5.

The specifications for the encryption process appropriate to a given data grouping for the IC card application must match the equivalent encryption process, either in the data preparation process or in a local process associated with the personalization device.

Normally the encryption process of the card application mirrors that of the data preparation process. Since the encryption process for the EMV application is in ECB mode (if the $FORMAT_{TK}$ '00' is used), the encryption of the prepared data must also be done in ECB mode. In this case the personalization device decrypts the DGI in ECB mode using the Transport Key before re-encrypting it in ECB mode under the card secure channel session key SKU_{DEK}.

Table 5 – Data Content for the Field ENC

Data Element	Description	Length	Format
DGI #1	The identifier of the first data grouping to be encrypted	2	Binary
Encryption type	Type of encryption needed '11' – to be encrypted using SKU_{DEK} in ECB mode	1	Binary
DGI #n	The identifier of the n^{th} data grouping to be encrypted	2	Binary

Data Element	Description	Length	Format
Encryption type	Type of encryption needed '11' – to be encrypted using SKU_{DEK} in ECB mode	1	Binary

2.4.4 PIN Block Format and Random Numbers

Between the data preparation system and the personalization system the simple encryption of secret data is sometimes insufficient for protecting the exchanged data. If the encrypted data is not sufficiently diverse (e.g. a PIN-block having only PIN-digits as variations), a random number can be used to XOR the secret data before encryption. To inform the personalization device that the random number is to be used for processing of this application, the RANDOM field in the IC Card Application Data (see Table 8) is the mechanism that must be used.

The use of this random number mechanism must be indicated by the setting of $TYPE_{TK}$. In particular the $TYPE_{TK}$ in Table 10 takes a value of "TK using RANDOM field and XOR operation" (b7=1, b6=0) as described in Table 25. In this case the secret data must be XORed with the random number prior to encryption and after decryption.

If the RANDOM field is shorter than the data to be XORed, the data to be XORed must be divided into blocks the length of the RANDOM field. If the final block is shorter than the RANDOM field, the leftmost bytes of the RANDOM field must be used to XOR the short block.

The random number to use is contained in the RANDOM field as shown in Table 8.

If ISO 9564-1 format 1 is used to transport the PIN block, the use of the above random number method to diversify the PIN block during transportation is unnecessary. In this case, if the PIN block format stored within the card application is different from ISO 9564-1 format 1, the IC application must reformat the PIN block (e.g. to the format defined in the EMV VERIFY command).

2.4.5 Grouping of DGIs

DGIs may be grouped using the GROUP mechanism described below. Personalization devices must not group DGIs within a single STORE DATA command without a GROUP field within the Processing Device Instruction specifying the DGIs to be applied jointly. Where a STORE DATA command is to process multiple DGIs, DGIs within a group shall be concatenated in the same order indicated in the GROUP field.

The DGI entries must be concatenated without separators. For example, if DGIs '0208' and '0029' were the Grouped DGIs in GROUP # 1, they would be coded '02080029'. The Personalization Device must set the STORE DATA command with

DGI '0208' followed by DGI '0029' (including identifier, length and content of each DGI).

Table 6 – Data Content for the Field GROUP

Data Element	Description	Length	Format
Group #1	'01'	1	Binary
Length	Length of Group #1	1	Binary
List and order of DGIs for Group #1	List of DGIs in Group #1	var.	Binary
…			
Group #n	'nn'	1	Binary
Length	Length of Order #n	1	Binary
List and order of DGIs for Group #n	List of DGIs in Group #n	var.	Binary

2.4.6 Security Level Indicator of Secure Channel Sessions

While not required, it is possible for a data preparation system to define different security level of secure channel for different DGIs in the personalization process of an application. This could be achieved by duplicating the SECLEV field within the PDI as many times as it is required by the Issuer. The following requirements exist:

- When only one security level is required for the entire personalization session of an application only one SECLEV field shall be present in the PDI.
- A value of 'FF' in the SECLEV indicates that more than one security levels of secure channel are required for the personalization of the application.
- If several security levels are specified, a DGI shall appear only once in the DGI list associated to security levels.
- When several security levels are specified, each security level requires to a new secure channel initiation.

Performance objectives may be achieved by regrouping and ordering DGIs according to their security level requirements.

The LASTSCS field indicates whether the personalization is complete and the personalization device shall set b8 of P1 of the last STORE DATA command to 1 or not. If value of this field is set to '01' it indicates that the personalization of the application is not complete yet and further process is required. Note that further process may be in a subsequent Processing Step or in another personalization session that is out of scope of this document.

Table 7 – Data Content for the Field SECLEV

Data Element	Description	Length	Format
SECLEV	- Security level for the only secure channel of the personalization session (See Table 19 for the value of this field) - 'FF' = more than one security level for secure messaging of the personalization session defined (see next field)	1	Binary
NBSECLEV	Number of different security levels defined for the personalization session	0 or 1	Binary
SECLEV #1	Security level for secure channel assigned to the first set of DGIs. See Table 19 for the value of this field	0 or 1	Binary
$NBDGI_{SECLEV\#1}$	Number of DGIs assigned to the SECLEV #1	0 or 2	Binary
$DGI_{SECLEV\#1}$	List of DGIs assigned to the security level SECLEV #1. For grouped DGIs only the first DGI of the group shall be listed	0 or Var.	Binary
SECLEV #2	Security level for secure channel assigned to the second set of DGIs. See Table 19 for the value of this field	0 or 1	Binary
$NBDGI_{SECLEV\#2}$	Number of DGIs assigned to the SECLEV #2	0 or 2	Binary
$DGI_{SECLEV\#2}$	List of DGIs assigned to the security level SECLEV #2. For grouped DGIs only the first DGI of the group shall be listed	0 or Var.	Binary
SECLEV #n	Security level for secure channel assigned to the remaining DGIs (those that are not assigned to a previous security level). See Table 19 for the value of this field.	0 or 1	Binary
LASTSCS	'00' = Last STORE DATA command shall have b8 of P1 set to 1 '01' = Last STORE DATA command shall have b8 of P1 set to 0	0 or 1	Binary

2.5 Creation of Personalization Log Data

Issuers may need data from the personalization process to be logged. However, the personalization device is not aware of what data is contained in the data groupings. Therefore, data that must be logged must be sent to the personalization device in a manner that indicates that this is data that must be logged. The personalization device must handle the logging of data that the personalization device is aware of, such as personalization date. To inform the personalization device of application data that must be logged, the LOGDATA field in the IC Card Application Data (see Table 8) must be created. The data contained in this field usually duplicates some of the data in the data groupings to be sent to the IC card application. This is the actual data to be logged; it is not a list of DGIs.

One example of the possible contents of LOGDATA would be all of the personalization data for the application. In that case, the contents of LOGDATA and ICCDATA (see Table 8) would be the same. Another example would be to only include an identifier of the card/cardholder for the application in LOGDATA. For a credit/debit application, this could be just the PAN.

2.6 Data Preparation-Personalization Device Interface Format

This section describes the format for sending EMV card application data to the personalization device.

The record format allows card management data for personalization as well as functions other than personalization to be included in the file. These functions are referred to in this document as processing steps. Examples of other types of card management data are load or install application.

Table 8 provides the details of the format for the EMV card application data.

Sections 1 and 2 of the data format provide the details for the data that is common to all IC card applications. Section 3 provides the details of the data for the first IC card application (the EMV application); there must be as many section 3s as the value of $COUNT_{AID}$. They must be presented in the same order as in the list of AIDs in section 2 of Table 8.

The data for an application has four parts. These are identified as a, b, c and d in sections 3 of Table 8.

The first part (a) is processing data for the personalization device for the IC card application. This part of the data is subdivided into parts “a1” and “a2”.

The second part (b) is the data for the IC card application to be logged by the personalization device.

The third part (c) is the data to be sent to the IC card application.

The fourth part (d) is the MAC related information for the IC card application data.

Table 8 – IC Card Application Data sent to the Personalization Device

Section	Data Element	Description	Length	Format
1	MIC (Module Identifier Code)	An identifier that specifies that this is data for an IC card application(s). This field matches current personalization standards for identifying the type of data that follows. The length and values of this field are established when the personalization device is configured and is fixed format and length thereafter.	1 - 7	ASCII
	LCCA	Length of the IC card application data - includes all of sections 2 and 3 below. This is coded as ASCII-represented decimal digits, padded at the most significant end by zeros (ASCII "30").	7	ASCII
2	VNL	Version number of this layout - shall be "02.2"[2]	4	ASCII
	L_{DATA}	Length from L_{HDR} to the end of the last application's MAC_{INP} inclusive	2	Binary
	L_{HDR}	Length of the header data for IC card applications. The length of the data from the byte immediately following this length field up to and including the AID for application #n	2	Binary
	L_{CRN}	Length of the CRN, this field may be zero meaning no CRN present	1	Binary
	CRN	Shall be unique per record - see GlobalPlatform Messaging Specification	var.	Binary
	$STATUS_{COLL}$	Collator (see GlobalPlatform Messaging Specification) Status: '00' – Not Applicable '01' – request for collation '02' – request for collation and collation data '03' – collation data only '04' – collation complete	2	ASCII
	$NUMBER_{PID}$	Number of Profile Identifiers ID_{VC} see GlobalPlatform Messaging Specification, '00' means no Profile ID present	1	Binary
	L_{IDVC1}	Length of ID_{VC}	1	Binary

[2] A personalization system implementing VNL 02.2 shall accept a MIC with VNL = 02.1

Section	Data Element	Description	Length	Format
	ID_{VC1}	Identifier(s) of the first card profile (see GlobalPlatform Systems Profiles Specification)	var.	Binary
	…			
	L_{IDVCn}	Length of ID_{VC}	1	Binary
	ID_{VCn}	Identifier(s) of the n^{th} card profile	var.	Binary
	$COUNT_{AID}$	Number of Application IDs	1	Binary
	L_{AID1}	Length of the AID for application #1	1	Binary
	AID_1	Application ID#1 in its correct relative position	var.	Binary
	…			
	L_{AIDN}	Length of the AID for application #n	1	Binary
	AID_N	Application ID n in its correct relative position	var.	Binary
3	L_{APPL}	Length of the data for IC card application #1. The length of the data from the byte immediately following this length field to and including the MAC for application #1	2	Binary
3a.1	L_{PDD1}	Length of the non-script driven personalization device data for application #1. The length of the data from the byte immediately following this length field up to but not including the field L_{PDD2} for application #1	1	Binary
	L_{AID}	Length of the AID for application #1	1	Binary
	AID	AID for application #1	5 to 16	Binary
	L_{TK}	Length of the two TK fields that follow. Set to '0D' if $FORMAT_{TK}$ = '00'	1	Binary
	$FORMAT_{TK}$	The format of the TK fields that follow. See Table 9.	1	Binary
	TKDATA	See Table 10.	var.	Binary
3a.2	L_{PDD2}	Length of the second part of the personalization device data for application #1. The length of the data from the byte immediately following this length field up to but not including the length field for LOGDATA for application #1	2	Binary
	$L_{IDOWNER}$	Length of ID_{OWNER} field	1	Binary
	ID_{OWNER}	The identifier of the owner of the specifications for this application	var.	Binary
	L_{PS}	Length of processing steps (PS)	2	Binary
	PS	Processing steps for application #1. See Table 11.	var.	Binary

Section	Data Element	Description	Length	Format
3b	$L_{LOGDATA}$	Length of LOGDATA – if there is no data to be logged, this field must be '0000'	2	Binary
	LOGDATA	See section 2.5 for a description of this field.	var.	Binary
3c	$L_{ICCDATA}$	Length of the data for application #1 to be sent to the IC card. The length of the data from the byte immediately following this length field to but not including the length field for MAC data for application #1	2	Binary
	ICC Data	The data for application #1 to be sent to the IC card (see Figure 3)	var.	Binary
3d	$L_{MACDATA}$	'14' = Length of the MACkey and MAC_{INP} for application #1. If this field is '00' the data has not been MACed (if generated remotely from the personalization device the data for IC card application must be protected by a MAC)	1	Binary
	MACkey	Key used to compute the MAC for the data for application #1. For $FORMAT_{TK}$ = '00' this key is encrypted under the TK listed in the TKDATA field. For all other values of $FORMAT_{TK}$, this key is encrypted under the TK marked for MACkey encryption	16	Binary
	MAC_{INP}	MAC of the data for application #1. The leftmost bytes of the computed MAC are used; the MAC is computed using the fields starting with the length of IC card application #1 (L_{APPL}) up to but not including the key used to compute the MAC (MACkey field) for the data in application #1; the MAC is computed with encrypted data still encrypted	0 or 4	Binary

Table 9 – $FORMAT_{TK}$ Codes and Associated Data

L_{TK}	$FORMAT_{TK}$	Description of TKDATA
'0D'	'00'	The identifier of the Transport Key (TK) used to encrypt secret data for the application. This field has two parts, the first 4 bytes are the Issuer ID (the issuer BIN/IIN right justified and left padded, if necessary, with 1111b per quartet), the last 8 bytes are the version identifier of the TK
'00' to 'FF'	'01'	See Table 10

Table 10 – Layout of TKDATA for FORMAT$_{TK}$ '01'

Field	Description	Length	Format
For entry #1			
ID$_{TK}$ #1	The identifier of the Transport Key (TK) used to encrypt secret data for the application. This field has two parts, the first 4 bytes are the Issuer ID (the issuer BIN/IIN right justified and left padded, if necessary, with 1111b per quartet), the last 8 bytes are the version identifier of the TK	12	Binary
TYPE$_{TK}$ #1	See Table 25	1	See Table 25
CMODE for TK #1	Algorithm associated with the TK to encrypt the secret data. '11' indicates ECB	1	Binary
Number of DGIs for TK #1	The number of DGIs in the following list.	1	Binary
DGIs for TK #1	A list of the DGIs encrypted under this TK. There are no delimiters in this string. If a TK encrypts DGIs '9101' and '9104', this list would be coded '91019104'	var.	Binary
…			
For entry #n			
ID$_{TK}$ #n	The identifier of the Transport Key (TK) used to encrypt secret data for the application. This field has two parts, the first 4 bytes are the Issuer ID (the issuer BIN/IIN right justified and left padded, if necessary, with 1111b per quartet), the last 8 bytes are the version identifier of the TK	12	Binary
TYPE$_{TK}$ #n	See Table 25	1	See Table 25
CMODE for TK #n	Algorithm associated with the TK to encrypt the secret data. '11' indicates ECB	1	Binary
Number of DGIs for TK #n	The number of DGIs in the following list.	1	Binary
DGIs for TK #n	A list of the DGIs encrypted under this TK. There are no delimiters in this string. If a TK encrypts DGIs '9101' and '9104', this list would be coded '91019104'	var.	Binary

Table 11 – Layout of Processing Steps Field

Field	Description	Length	Format
L_{S1}	Length of the information for Processing Step #1	1	Binary
ACT_{S1}	Action to be performed in Processing Step #1. The action depends on the ICC Data format: '0B': Pre-computed APDU commands in the ICC Data field within the TAG_{S1} data field '0F': DGI in the ICC Data field within the TAG_{S1} data field	1	Binary
REQ_{S1}	Processing Step #1 mandatory ('01') or optional ('00') For example if the action is "initialize" and the application is already initialized, a setting of mandatory says re-initialize, a setting of optional says do not re-initialize	1	Binary
TAG_{S1}	TAG of the data within the ICC data field where the Processing Step #1 must apply. 'EE' for Pre-computed APDU commands 'EF' for DGIs as personalization data	1	Binary
L_{PDI}	Length of the Processing Device Instructions	2	Binary
PDI_{S1}	Processing Device Instructions for Processing Step #1. Currently only defined for the personalization step. See Table 12.	var.	Binary
$L_{POINTER}$	Length of the POINTER	2	Binary
$POINTER_{S1}$	RFU	var.	Binary
	…		
L_{Sn}	Length of the information for Processing Step #n	1	Binary
ACT_{Sn}	Action to be performed in Processing Step #n. The action depends on the ICC Data format: '0B': Pre-computed APDU commands in the ICC Data field within the TAG_{Sn} data field '0F': DGI in the ICC Data field within the TAG_{Sn} data field	1	Binary
REQ_{Sn}	Processing Step #n mandatory ('01') or optional ('00'). For example if the action is "initialize" and the application is already initialized, a setting of mandatory says re-initialize, a setting of optional means do not re-initialize	1	Binary
TAG_{Sn}	Tag of the data within the ICC data field where the Processing Step #n must apply. 'EE' for Pre-computed APDU commands 'EF' for DGIs as personalization data	1	Binary
L_{PDI}	Length of the Processing Device Instructions	2	Binary
PDI_{Sn}	Processing Device Instructions for Processing	var.	Binary

Field	Description	Length	Format
	Step #n. Currently only defined for the personalization step. See Table 12		
$L_{POINTER}$	Length of the POINTER	2	Binary
$POINTER_{Sn}$	RFU	var.	Binary

The PDI Field

The data in the personalization device instruction (PDI) field may be part of each Processing Step field. It also contains instructions for the Processing Step. The contents of the field for the personalization Processing Step '0F' are shown in Table 12.

Table 12 – Personalization Device Instructions for the Personalization Processing Step '0F'

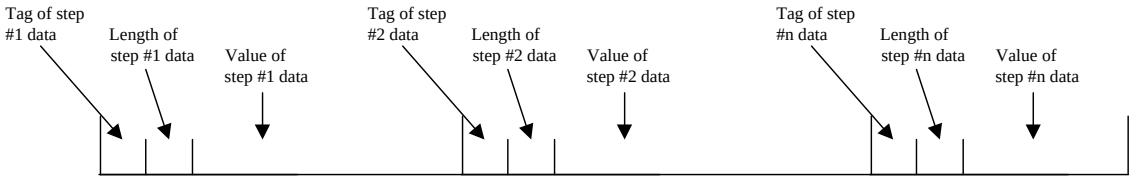
Field	Description	Length	Format
L_{ORDER}	Length of ORDER – if no order is required for data groupings, this field is '0000'	2	Binary
ORDER	See section 2.4.1 for a description of this field	var.	Binary
$L_{VERCNTL}$	Length of VERCNTL – if there is no version control required, this field is '0000'	2	Binary
VERCNTL	See section 2.4.2 for a description of this field	var.	Binary
L_{ENC}	Length of ENC – if there is no data to be encrypted, this field is '0000'	2	Binary
ENC	See section 2.4.3 for a description of this field	var.	Binary
L_{RANDOM}	Length of RANDOM –if there is no random number, this field is '0000'	2	Binary
RANDOM	See section 2.4.4 and Table 25 for a description of this field	var.	Binary
L_{GROUP}	Length of GROUP – if there is no grouped DGIs, this field is '0000'	2	Binary
GROUP	See section 2.4.5 for a description of this field	var.	Binary
SECLEV	Security level for secure messaging. See section 2.4.6 for a description of this field	1 or var.	Binary
$UPDATE_{CPLC}$	'00' means no update – If other values, see requirement for specific applications	1	Binary

There is no personalization device instruction (PDI) for the personalization Processing Step '0B'.

The ICC Data Field

The data in the ICC Data field has been "tagged" to allow it to contain data for other processing steps and personalization data. The format is shown in Figure 3.

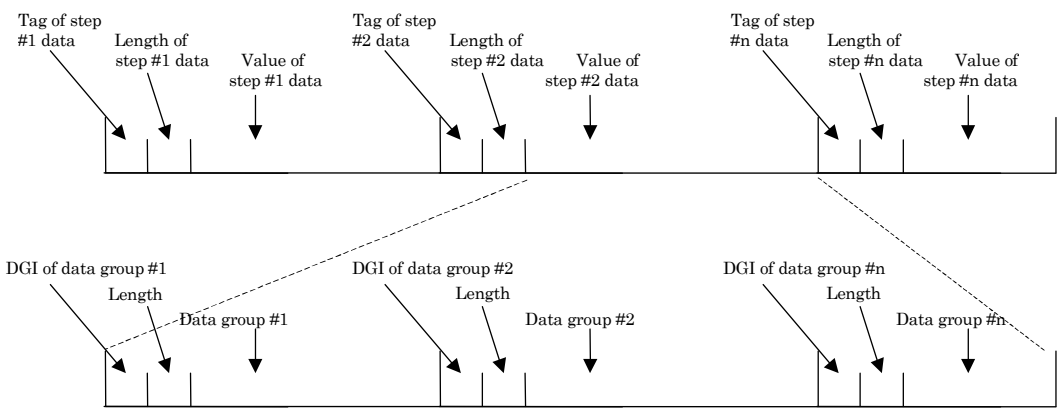
Figure 3 – Layout of ICC Data Portion of Record (Section 3c of Table 8)



The ICC Data Field for the Processing Step '0F'

If personalization using DGIs within the ICC Data field is step #2 of the processing steps, Figure 4 shows how the value portion for step #2 is expanded into the data layout for personalization data. The value of the field TAG for this format is 'EF' so personalization data within ICC data field for step #2 will be identified by tag 'EF'. The length field for this tag is BER-TLV encoded. The data for this tag is the data groupings for the IC application.

Figure 4 – Formatting of Personalization Data using DGIs within ICC Data Portion of Record

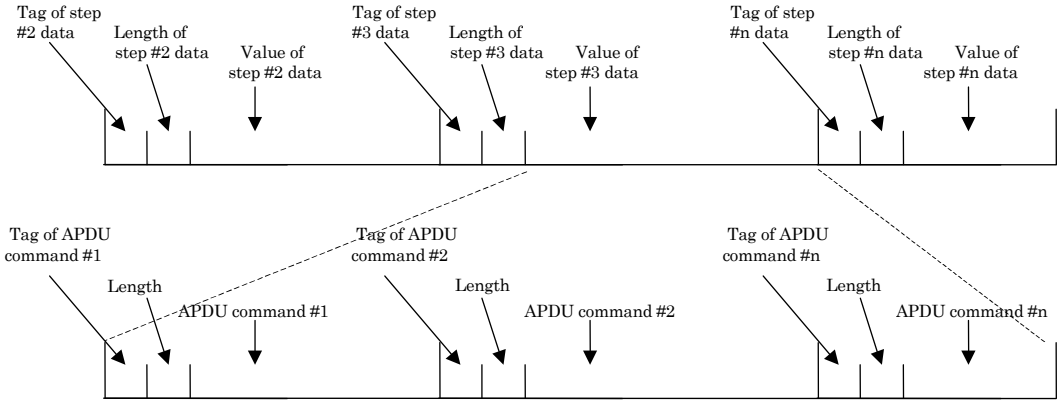


If the data to be sent to the IC card is to be encrypted based on the ENC field (see section 2.4.3), only the value portion of the data grouping is encrypted. The DGI and the length field are not encrypted.

The ICC Data Field for the Processing Step '0B'

If personalization using pre-computed APDU command is step #3 of the processing steps, Figure 5 shows how the value portion for step #3 is expanded into the data layout within the ICC data field. When this portion contains pre-computed APDU commands the tag value of step #3 shall be 'EE'. The data preparation system incorporates a pre-computed APDU command as the value of a BER–TLV structure as shown in Figure 5. The length of a tag itself is one byte.

Figure 5 – Formatting of pre-computed APDU commands within ICC Data Portion of Record



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3 Personalization Device-ICC Interface

3.1 Processing Step '0F'

For the Processing Step '0F' the personalization device activates the IC card (Reset) and the IC card responds with Answer To Reset (ATR). At this point protocol selection and a warm reset may be used to allow more efficient communications to speed up personalization.

The SELECT command is used, with the AID retrieved from the input data, to select the application to be personalized.

The INITIALIZE UPDATE command provides the IC card with a personalization device random number to be used as part of cryptogram creation. The IC card responds with:

- A card-maintained sequence counter (for each secure channel key set) to be used as part of the session key derivation.
- A card challenge to be used as part of cryptogram creation.
- A card cryptogram that the personalization device will use to authenticate the IC card.
- An identifier and a version number of the KMC and the derivation data for the K_{ENC}, K_{MAC} and K_{DEK}.
- The Secure Channel Protocol identifier.

The personalization device authenticates itself to the IC card application via the EXTERNAL AUTHENTICATE command by providing a host cryptogram for the IC card application to authenticate. The level of security to be used in subsequent commands is also specified in the EXTERNAL AUTHENTICATE command.

The application is personalized using one or more STORE DATA commands. Personalization is completed with a last STORE DATA command that usually concludes the personalization process for the application.

If there are more applications to be personalized, then the next AID is retrieved from the input data and the process described above is repeated with a new SELECT command.

After personalization is complete for all applications, subject to payment system rules, the personalization data for the card production life cycle (CPLC) data may be placed on the IC card.

3.1.1 Key Management

3.1.1.1 The personalization device and the entity that loads the K_{ENC}, the K_{MAC} and the K_{DEK} to the IC card application prior to personalization, share the KMC. Personalization device processing must be able to identify the KMC in the personalization device key storage by an issuer identifier and a version number. The identifiers of the KMC for use with a specific IC card will be retrieved from the IC card itself (see Table 15).

3.1.1.2 The TK must be used without modification. The KMC must be used to create card static derived keys which must in turn be used to create session keys for communicating with the IC card application (see section 5.3).

3.1.2 Processing Flow

The following requirements exist for the Processing Step '0F':

3.1.2.1 The personalization device must read an IC Card Application Data record (see Table 8) for each IC card to be personalized, and reset the IC card.

3.1.2.2 For each IC card application to be personalized, the TK identified in the input record (ID_{TK}) must be located in the key storage.

3.1.2.3 If present, data grouping '7FFF' must be retrieved from the input record and must be used as the data to be sent to the IC card application with the last STORE DATA command. The ORDER within PDI field may override this requirement.

3.1.2.4 The AID of each application to be personalized must be retrieved from the data record for the IC card (see Table 8).

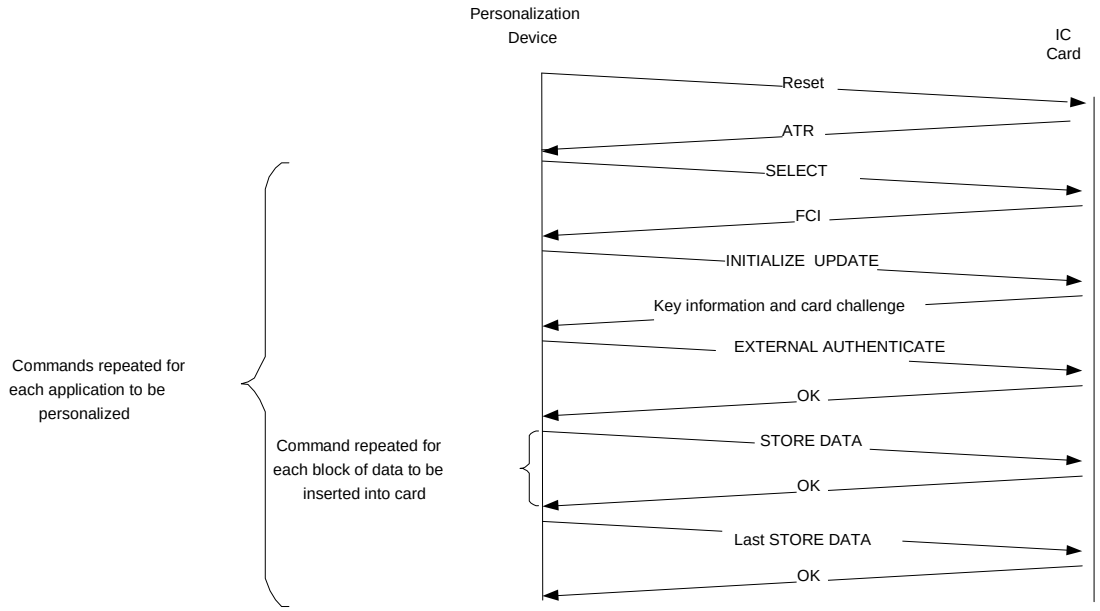
3.1.2.5 A series of STORE DATA commands are sent to the IC card application, followed by a final STORE DATA command (see also LASTSCS in Table 7).

3.1.2.6 The card, the application and the personalization device must be compatible with the interface requirements defined in EMV Version 4.1 Book 1.

3.1.2.7 The personalization device must use the information contained within the Answer to Reset (for example negotiable mode) to determine the card capabilities as a basis for choosing a mode of operation to minimize personalization time.

Figure 6 summarizes the flow of commands and responses that must occur between the personalization device and the IC card.

Figure 6 – Personalization Command Flow



3.2 Processing Step '0B'

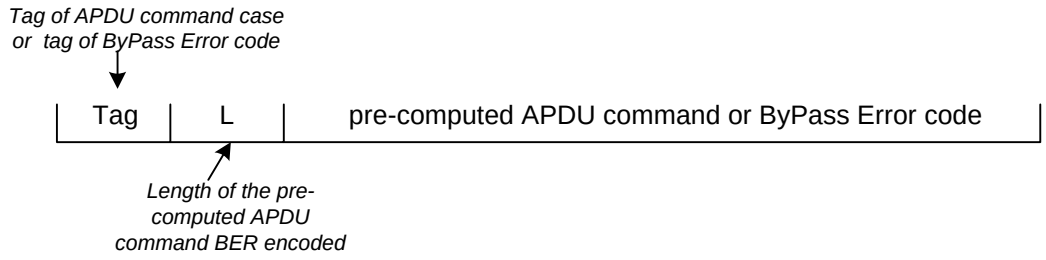
The objective of such a feature is to pre-compute APDU during data preparation process so that APDUs can be directly interpreted by the card. Thus, application keys and PIN do not require to be decrypted and re-encrypted by the personalization device.

The Processing Step with the indicator '0B' as value for the field ACT is used with pre-computed APDU commands. The value of the field TAG for this format is 'EE'. There are no explicit Personalization Device Instructions and therefore the PDI field is empty.

For the Processing Step '0B' the personalization device activates the IC card (Reset) and the IC card responds with Answer To Reset (ATR).

For each pre-computed APDU command the parsing information for APDU case (see *ISO/IEC 7816-3*) related instructions and the length (BER encoded) of the pre-computed APDU are pre-pended to the pre-compute APDU command. The data preparation system incorporates a pre-computed APDU command as the value of a BER–TLV structure as shown in Figure 7. The length of a tag itself is one byte.

Figure 7 – Pre-computed APDU command placed in BER–TLV structure



3.2.1.1 The following tag values shall be supported:

- **Tag '86' - Push command**: The card command or the command response shall not be returned to the issuer.
- **Tag 'C1' - Pull command**: The command response shall be returned to the issuer.
- **Tag 'C7' - Dialogue command**: The card command and the command response shall be returned to the issuer.
- **Tag 'C9' - Error Bypass flag**: The error bypass flag see requirement 3.2.1.4.

The different types of pre-computed APDU commands are coded as concatenations of TLV elements. The tags used for the different commands and the error bypass flag are coded in a single byte and have all primitive encoding. Each of three commands can have an error bypass flag. Note that LOGDATA field could be used should any command response data be returned to the issuer. Other examples of implementation for return data are provided in the GlobalPlatform Messaging Specification section 19.

3.2.1.2 If the value field of a tag is not present, the personalization device shall interpret this as a request to perform a card reset.

3.2.1.3 If the pre-computed APDU command in the value field of the tag is present and its length is shorter than 4 bytes or longer than 261 bytes, then it implies a syntax error.

In some cases, card-reader specific protocols may impose upper limits on the length of commands. If the command cannot be sent due to this reason, a length limit error shall be generated.

3.2.1.4 Requirements for coding of error bypass flag – tag 'C9':

- The value field of the error bypass flag is a single byte equal to '01'. If the value is different, a syntax error shall be generated.
- A command has an error bypass flag if the error bypass flag TLV element precedes the pre-computed APDU command TLV element. An error bypass flag that is not followed by a command shall generate a

syntax error.

3.2.1.5 A command with an error bypass flag shall not result in termination of the personalization process in case of APDU command processing error.

3.2.2 Key Management

If the card secure channel keys are not known by the data preparation system it is required that data preparation system generates a new secure channel key set for the preparation of pre-computed APDU commands. The data preparation system should place the new secure channel keys according to section 4.2. Prior to Processing Step '0B' the personalization system shall switch the card secure channel derived keys by the ones used in the generation of pre-computed APDU commands. Once the card secure channel keys are updated the pre-computed APDU commands could be sent to the card. Note that updating of secure channel keys are performed using a Processing Step '0F' after which the Processing Step '0B' could be performed.

3.2.3 Processing Flow

The same sequence of pre-computed APDU commands should have been generated for a Processing Step '0B'. The processing flow of messages across the interface is shown in Figure 6.

3.2.4 SELECT Command

The SELECT command is used to select each IC card application to be personalized. Application selection is described in EMV Version 4.1 Book 1.

The SELECT command will be issued once for each IC card application to be personalized.

3.2.4.1 The SELECT command must be coded according to EMV Version 4.1 Book 1. There are no application-dependent status conditions associated with this command.

3.2.4.2 The AID in the SELECT command for the Processing Step '0F' is obtained from section 3a.1 of the input data record for the application (see Table 8).

3.2.4.3 The response to the SELECT command is not used to direct processing by the personalization device. The data in the FCI (the response to the SELECT command) may be added or changed during the personalization process.

3.2.5 INITIALIZE UPDATE Command

The INITIALIZE UPDATE command is the first command issued to the IC card after the personalization device selects the application. INITIALIZE UPDATE is used to establish the Secure Channel Session to be used during personalization. The data to perform mutual authentication is exchanged. The identifier and version number for the KMC and the data to be used to derive the K_{ENC}, the K_{MAC} and the K_{DEK} for the application are also returned.

The INITIALIZE UPDATE command will be issued once for each secure channel initiation. It shall be issued at least once for each IC card application to be personalized.

3.2.5.1 Information relating to a Secure Channel Session shall be destroyed and the Secure Channel Session terminated for any one of the following reasons:

- Loss of power or card reset.
- If the command immediately following this INITIALIZE UPDATE command is not an EXTERNAL AUTHENTICATE command.
- If an Application other than the Application that initiated the setting up of a Secure Channel is selected, the current Secure Channel shall either be already terminated or shall be terminated at this point.
- Secure Channel failure. These errors are caused by:
    - The inability to verify the host cryptogram of the EXTERNAL AUTHENTICATE command.
    - The inability to verify a MAC (if the security level requires MAC) of any command received within the Secure Channel Session.
    - The padding resulting from command data field decryption (if the security level requires MAC and encryption) is not correct.
    - A message that did not have the required level of security.
- At any point within a current Secure Channel Session, the INITIALIZE UPDATE command can be issued to the card in order to initiate a new Secure Channel Session.

3.2.5.2 The INITIALIZE UPDATE command must be coded as shown in Table 13. R_{TERM} is generated by the personalization device. Table 14 shows the response to a successful INITIALIZE UPDATE command. Table 16 lists

status conditions that may occur, in addition to the general ones listed in ISO/IEC 7816-3.

Table 13 – INITIALIZE UPDATE Command Coding

Field	Content	Length
CLA	'80'	1
INS	'50'	1
P1	'00' – '7F' (See Section 3.2.5.3)	1
P2	'00'	1
Lc	'08'	1
Host challenge (R_{TERM})	Random number used in host and card cryptogram generation	8
Le	'00'	1

Table 14 – Response to INITIALIZE UPDATE command

Field	Length
KEYDATA (See Table 15)	10
Version number of the master key (KMC)	1
Identifier for Secure Channel Protocol (ALGSCP = '02')	1
Sequence Counter	2
Card challenge (R_{CARD})	6
Card cryptogram	8
SW1 SW2	2

Table 15 – Initial Contents of KEYDATA

Field	Length	Format
Identifier of the KMC (e.g. IIN right justified and left padded with 1111b per quartet)	6	BCD
Chip Serial Number (CSN)	4	Binary

Table 16 – Status Conditions for INITIALIZE UPDATE Command

SW1	SW2	Meaning
'6A'	'88'	Referenced data not found

3.2.5.3 The Key Version Number defines the key set Version Number to be used to initiate the Secure Channel Session. If this value is zero, the default key set for the selected application shall be used. While implementing this feature is required utilizing this feature is optional depending on the personalization context (e.g. if the entity personalizing the EMV

application is different from the entity personalizing the PSE application).

3.2.5.4 If the value indicates a Key Version Number that is not present or indicates a Key Version Number that is incomplete (i.e. the Key Version Number does not contain Key Identifiers 1, 2 and 3), a response of '6A88' shall be returned.

3.2.5.5 KEYDATA is a data element available to each IC card application. Its initial value should be coded as shown in Table 15**.**

3.2.5.6 The identifier of the KMC is part of the response data to the INITIALIZE UPDATE command and it facilitates locating the issuer's KMC.

3.2.5.7 The first 6 bytes of KEYDATA returned from the INITIALIZE UPDATE command are used to identify the master key for secure messaging (KMC). The six least significant bytes of KEYDATA are used as key diversification data. The personalization device must use the KMC and KEYDATA to generate the K_{ENC}, the K_{MAC} and the K_{DEK} for this IC card, as defined in section 4.1. These keys must have been placed in the IC card prior to the start of the personalization process.

3.2.5.8 Subsequent processing must use the identifier for Secure Channel Protocol (ALGSCP) in the response to the INITIALIZE UPDATE command to determine how to create MACs and when to create session keys.

The session keys must be calculated during processing of the INITIALIZE UPDATE response using data from the IC card. The session keys must be calculated as described in section 5.3.

A pseudo-random card challenge generation algorithm in the card provides the data preparation system with the ability to pre-compute the card challenge as opposed to being random. This allows an off-card entity, with knowledge of the relevant Secure Channel secret keys and the ability to track the Secure Channel Sequence Counter, to pre-compute an authentication sequence without first communicating with the card.

3.2.5.9 The card challenge is a pseudo-random number that shall be unique to a Secure Channel Session. A pseudo-random[3] card challenge shall be generated according to section E.4.2.3 of the GlobalPlatform Card Specification as follows:

- The AID of the currently selected Application is padded according to

[3] Implementation of the pseudo-random card challenge as defined in this requirement is mandatory unless issuer policy requires a random number generation in which case the card may implement a switch so at the initialization of the card it would be possible to choose a random or pseudo-random card challenge. Note that it is not possible to generate the pre-computed APDU command at the data preparation for a card implementing a random as card challenge.

DES padding (see bullet 15 of section 2.2);

- A MAC is calculated across the padded data using single DES plus final triple DES, the SKU_{MAC} session key and an ICV of binary zeroes;
- The six leftmost bytes of the resultant MAC constitute the card challenge.

3.2.5.10 The personalization device must verify the card cryptogram in the response to the INITIALIZE UPDATE command by generating a duplicate cryptogram and comparing it to the value returned in the response. The card cryptogram is a MAC created as described in section 5.4.1 using key SKU_{ENC} and the data to be MACed is = R_{TERM} (8 bytes) || Sequence Counter (2 bytes) || R_{CARD} (6 bytes). If the card cryptogram does not verify correctly, personalization processing must be terminated and a log of the process written, as described in section 3.4.

3.2.5.11 If the received host challenge is identical to the concatenation of the Secure Channel Sequence Counter of the identified Key Version Number and the card challenge (6 bytes generated as described previously), a response of '6982' shall be returned.

For pre-computing INITIALIZE UPDATE command during the data preparation process, the data preparation system needs to generate or to have access to the derived K_{ENC}, the K_{MAC} and the K_{DEK} for each given card to be personalized.

3.2.6 EXTERNAL AUTHENTICATE Command

The EXTERNAL AUTHENTICATE command follows the INITIALIZE UPDATE command and is used to authenticate the personalization device to the IC card application.

The EXTERNAL AUTHENTICATE command will be issued once for each secure channel initiation. It shall be issued at least once for each application to be personalized.

3.2.6.1 The EXTERNAL AUTHENTICATE command must be coded as shown in Table 17. The host cryptogram is calculated by the personalization device. The response to the EXTERNAL AUTHENTICATE commands consists only of SW1 SW2. Table 18 lists status conditions that may occur, in addition to the general ones listed in ISO/IEC 7816-3.

Table 17 – EXTERNAL AUTHENTICATE Command Coding

Field	Content	Length
CLA	'84'	1
INS	'82'	1
P1	Security Level - see Table 19	1
P2	'00'	1
Lc	'10'	1
	Host cryptogram	8
	C-MAC	8

Table 18 – Status Conditions for EXTERNAL AUTHENTICATE Command

SW1	SW2	Meaning
'69'	'82'	MAC failed verification
'69'	'85'	Conditions of use not satisfied
'63'	'00'	Authentication of host cryptogram failed
'68'	'00'	Class not supported

3.2.6.2 If an EXTERNAL AUTHENTICATE command is received and is not preceded immediately by an Initialize Update command that has been successfully processed, the SW1 SW2 '6985' shall be returned by the card.

3.2.6.3 If the secure messaging bit of the class byte (bit 3) is not set, a response of '6E00' shall be returned.

3.2.6.4 The security level is determined by the SECLEV field within the PDI.

3.2.6.5 Table 19 applies to all commands following the EXTERNAL AUTHENTICATE command. The security level does not apply to the EXTERNAL AUTHENTICATE command.

Table 19 – Security Level (P1)

b8	b7	b6	b5	b4	b3	b2	b1	Description
0	0	0	0	0	0	1	1	Encryption and MAC
0	0	0	0	0	0	0	1	MAC
0	0	0	0	0	0	0	0	No security

No security – All subsequent commands received by the IC card application will not include any security, i.e. no C-MAC and no encryption of the entire command data string by the SKU_{ENC}.

MAC – All subsequent commands received by the IC card application must contain a C-MAC.

Encryption and MAC - All subsequent commands received by the IC card application will include a C-MAC and the command data field will be encrypted by the SKU_{ENC}.

Note that the encryption specified in the EXTERNAL AUTHENTICATE command does not impact the security specified by the value of P1 in the STORE DATA command (see section 3.2.7). If both the EXTERNAL AUTHENTICATE command and the STORE DATA command specify encryption, the data is encrypted twice.

3.2.6.6 The host cryptogram must be created by generating a MAC as described in section 5.4.1 using SKU_{ENC}. The data to be MACed is = Sequence Counter (2 bytes)|| R_{CARD} (6 bytes)|| R_{TERM} (8 bytes). The IC card must verify the host cryptogram by generating a duplicate cryptogram and comparing it to the value received in the command data field.

3.2.6.7 The C-MAC must be calculated by the personalization device and verified by the IC card as described in section 5.4.2.

3.2.6.8 If the EXTERNAL AUTHENTICATE command is successful, the sequence counter shall be incremented by 1 and processing must continue with one or more STORE DATA commands.

3.2.7 STORE DATA Command

The STORE DATA command is used to personalize the EMV applications. There will be one STORE DATA command for each data grouping in the record from the data preparation process, although not necessarily one data grouping per single STORE DATA command – multiple DGIs may be sent in one STORE DATA command, as directed by a GROUP Personalization Device Instruction. This version of the STORE DATA command requires a secure channel to be established. A security level of '00' may be specified. The DGIs and data groupings used by the STORE DATA command are dependent on the data in the input record. Field ENC in the input record lists the identifiers of data groupings that must be encrypted.

3.2.7.1 The CLA byte of the STORE DATA command must be consistent with the security level of secure messaging set in EXTERNAL AUTHENTICATE command (CLA = '80' if security level = '00', otherwise CLA = '84').

3.2.7.2 The version of the STORE DATA command used to personalize the IC card applications must be coded as shown in Table 20. One or more triplets (DGI, Length, Data body) may be sent. The response to the STORE DATA consists usually of SW1 SW2. Table 22 lists the status conditions that may occur in addition to those specified in ISO/IEC 7816-3.

Table 20 – STORE DATA Command Coding for application personalization data

Field	Content	Length
CLA	'80' or '84'	1
INS	'E2'	1
P1	See Table 21	1
P2	Sequence Number	1
Lc	Length of command data	1 or 3
DGI_1	Identifier of first data to be stored	2
$Length_1$	Length of first data grouping	1 or 3
$Data_1$	First data to be stored	var.
DGI_n	Identifier of n'th data to be stored	2
$Length_n$	Length of n'th data grouping	1 or 3
$Data_n$	n'th data to be stored	var.
C-MAC	Present if CLA = '84'	0 or 8

Table 21 – Coding of P1 in STORE DATA Command

b8	b7	b6	b5-b1	Meaning
x				Last STORE DATA command indicator
1				Last STORE DATA command
0				Not the last STORE DATA command
	x	x		Encryption indicators:
	1	1		All DGIs encrypted under SKU_{DEK}
	0	0		No DGI is encrypted[4]
	0	1		Application dependent[5]
	1	0		RFU
			xxxxx	RFU[6]

Table 22 – Status conditions for STORE DATA command

SW1	SW2	Meaning
'6A'	'88'	Referenced data not found (Unrecognized DGI)
'6A'	'80'	Incorrect parameters in the data field

3.2.7.3 If the card implements extended APDU command data lengths as in ISO 7816-4 (indicated in the third software function of the card capabilities of the Answer To Reset historical bytes), then the DGI or grouped DGIs (if indicated by the GROUP instruction), must be sent to the IC application in one STORE DATA command.

3.2.7.4 If the card does NOT implement extended APDU command data length and the final length of an intended STORE DATA command data field (data grouping(s) and possible MAC) would be more that 255 bytes, then the DGI or grouped DGIs must be sent to the card in multiple STORE DATA commands as follows:

- The first APDU contains a STORE DATA command according to Table 20, truncated at the maximum allowable length (Lc equals 255 bytes including possible MAC).
- The subsequent APDU contains a STORE DATA command with any remaining data as command data, possibly again truncated at the maximum allowable length (Lc less than or equal to 255 bytes including possible MAC).

[4] The IC application may ignore or override this value to protect itself against intrusion. For example, the application must reject a clear text DGI if it expects to receive it always encrypted.

[5] For example, this bit can be set to indicate that some but not all of the DGI data is encrypted.

[6] RFU values are ignored by the IC application.

3.2.7.5 The application is responsible for managing any DGI data that spans more than one STORE DATA command. For the first STORE DATA command, the application will use the length of the last (or only) DGI, and the actual length of the DGI data, to determine whether a subsequent STORE DATA command is expected. For subsequent STORE DATA commands, the application concatenates the segments of data until the total length of the data equals the DGI length in the first STORE DATA command. Any inconsistency between the total length of the data segments in the STORE DATA commands, and the DGI length, shall cause an SW1SW2 of '6A80' to be returned by the card.

3.2.7.6 The personalization device must set P2 to '00' for the first STORE DATA command sent to the IC card application. The personalization device must then increment the value of P2 by 1 for each subsequent STORE DATA command[7].

3.2.7.7 If the $FORMAT_{TK}$ field in the input record is set to '00' and a DGI is listed in the ENC field in the input record, the TK identified in the input record must be used to decrypt the data created by the data preparation process. After the input data is decrypted as described in section 3.2.7.8, it must be re-encrypted prior to sending it to the IC card as described in section 3.2.7.12. Only the data portion of the data grouping is encrypted. The DGI and length field are not encrypted.

3.2.7.8 If the $FORMAT_{TK}$ field in the input record is set to '00' and the encryption type for the DGI listed in field ENC is '11', decryption of data by the personalization device must be done in ECB mode. This mode is illustrated in section 5.6.1. Triple DES (as presented in section 5.6.1.3) is used to decrypt each block.

3.2.7.9 If the $FORMAT_{TK}$ field in the input record is set to '01' and a DGI is listed in the "DGIs for TK" field (as shown in Table 10) in the input record, the TK identified in the input record must be used to decrypt the data created by the data preparation process as described in section 3.2.7.10. If the same DGI is listed in the ENC field in the input record, after the input data is decrypted, it must be re-encrypted prior to sending it to the IC card as described in section 3.2.7.12. Only the data portion of the data grouping is encrypted. The DGI and length field are not encrypted.

3.2.7.10 If the $FORMAT_{TK}$ field in the input record is set to '01' and the CMODE field (as shown in Table 10) is set to '11', decryption of data by the personalization device must be done in ECB mode. This mode is illustrated in section 5.6.1. Triple DES (as presented in section 5.6.1.3) is used to decrypt each block.

3.2.7.11 If a DGI is listed in the ENC field in the input record, after the input data is decrypted, it must be re-encrypted prior to sending it to the IC card as

[7] The ICC application may ignore the value of P2

described in section 3.2.7.12. Only the data portion of the data grouping is encrypted. The DGI and length field are not encrypted.

3.2.7.12 If the encryption type for the DGI listed in field ENC is '11', the personalization device uses the session key SKU_{DEK} to encrypt the data. Encryption must be done in ECB mode. This mode is illustrated in section 5.5.1. Triple DES (as presented in section 5.5.1.3) is used to encrypt each block.

3.2.7.13 If all DGIs within STORE DATA command are encrypted the personalization device must set b7 of P1 to 1, and b6 of P1 to 1. Based on this setting of P1, the IC card must use session key SKU_{DEK} to decrypt each individual DGI data in ECB mode. This mode is illustrated in section 5.6.1. Triple DES (as presented in section 5.6.1.3) is used to decrypt each block.

3.2.7.14 If some DGIs within STORE DATA command are encrypted the personalization device must set b7 of P1 to 0, and b6 of P1 to 1. Based on this setting of P1 the IC application must have the knowledge of which DGIs are encrypted. The IC card must use session key SKU_{DEK} to decrypt each individual encrypted DGI data in ECB mode. This mode is illustrated in section 5.6.1. Triple DES (as presented in section 5.6.1.3) is used to decrypt each block.

3.2.7.15 If the security level in the EXTERNAL AUTHENTICATE command specified MACing, the C-MAC must be calculated by the personalization device using SKU_{MAC} and verified by the IC card as described in section 5.4.2. The padding is not sent to the IC card.

3.2.7.16 If the security level in the EXTERNAL AUTHENTICATE command specified MACing and encryption, the C-MAC must be calculated by the personalization device using SKU_{MAC} and the command data field must be encrypted as described in section 5.5.2 using $SKU_{ENC.}$ Note that the padding added to the data field to ensure that encryption takes place over a data size which is a multiple of 8-bytes becomes part of the data field and must be reflected in the Lc. The IC card must decrypt the command data field as described in section 5.6.2 and verify the C-MAC as described in section 5.4.2.

3.2.7.17 If the SW1 SW2 that is returned by the IC card is '6A88', the input data record for the IC card application must be checked for the presence of the field VERCNTL. If the Data Grouping Identifier (DGI) that was rejected by the IC card is listed in field VERCNTL, normal processing must continue and the C-MAC must be saved to be used in the computation of the next C-MAC i.e. it is prepended to the next command data body, and it is this modified command data body that is MACed, using an IV of eight '00' bytes. If the data grouping DGI is not listed in field VERCNTL, personalization processing of the IC card application must be ended. The IC card must be rejected and an error log entry written as described in

section 3.4.

3.2.8 Last STORE DATA Command

3.2.8.1 Last STORE DATA command is indicated to the IC card application by the setting of bit 8 of P1 to 1b by the personalization device. If the conditions to transition the status of the application to "PERSONALIZED" are not satisfied as a result of missing DGIs or missing data element(s), the SW1 SW2 '6A86' may be returned by the application. Other status conditions may be used and are specific to the application.

3.2.8.2 Data grouping '7FFF', if present, must be retrieved from the input record and must be used as the data to be sent to the IC card application with the last STORE DATA command. The ORDER field within PDI may override this rule.

3.2.8.3 If the IC card application being personalized uses DGI '7FFF', there may be additional status conditions that are specific to the application.

3.2.8.4 If required by the application and after successful completion of the personalization, the acceptance of the Store Data command may be disabled by the application.

3.3 Command Responses

All responses to commands, whether successfully processed or not, include two status bytes, SW1 and SW2. SW1 and SW2 are one byte long each as defined in ISO/IEC 7816-3.

Beside specific behavior defined for each command in section 3.1.2 when a personalization device receives an SW1SW2 code different from '9000', '6A88', '61xx' or '67xx'; it shall abort the personalization process for the application if recovery is not possible.

3.4 Personalization Log Creation

At the end of the personalization process for an IC card application, a log of the personalization process for that IC card application must be created. At the end of the entire process an audit file containing the logs of the personalization processes for all IC card applications must be created. The format of the data in the log for each IC card is shown in Table 23. An example of the complete structure of the log file in XML format is provided in the GlobalPlatform Messaging Specification section 19.

Table 23 – Contents of Personalization Log

Field	Content	Length	Format
SEQNO	Sequence number of card personalized	3	Binary
DTHR	Date and time of personalization - YYMMDDHHMMSS	6	BCD
ID_{TERM}	Identifier of the personalization device	4	Binary
$LKMC_{ID}$	Length of KMC_{ID}	1	Binary
KMC_{ID}	Identifier of the personalization master key	var.	Binary
L_{CRN}	Length of CRN	1	Binary
CRN	CRN	var.	Binary
CSN	Chip Serial Number (IC Serial Number from KEYDATA returned by application #1)	4	Binary
L_{AID}	Length of the AID of the 1st application	1	Binary
AID	AID of the 1st application personalized	5-16	Binary
VER_{KEY}	Version Number of the master update key (KMC) returned in response to INITIALIZE UPDATE command for first application	1	Binary
SW1 SW2	The status condition returned from the last step of the personalization process for the first application.	2	Binary
STATUS	'00' personalization successful	1	Binary
$L_{LOGDATA}$	Length of the field LOGDATA for the first application	2	Binary
LOGDATA	Data from data preparation to be logged for the first application	var.	Binary
…			
L_{AID}	Length of the AID for the nth application	1	Binary
AID	AID of the nth application personalized	5-16	Binary
VER_{KEY}	Version Number of the master update key (KMC) returned in response to INITIALIZE UPDATE command for nth application	1	Binary
SW1 SW2	The status condition returned from the last step of the personalization process for the nth application.	2	Binary
STATUS	'00' personalization successful	1	Binary
$L_{LOGDATA}$	Length of the field LOGDATA for the nth application	2	Binary
LOGDATA	Data from data preparation to be logged for the nth application	var.	Binary

3.4.1.1 The personalization log must include the identifier of the personalization bureau in the header record.

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4 IC Card Personalization Processing

IC card personalization processing is preceded by a preparation or pre-personalization process. This preparation is described here in order to establish the data that is assumed to be present in the ICC prior to personalization.

4.1 Preparation for Personalization (Pre-Personalization)

Prior to personalization the ICC must be enabled/activated, the basic EMV application loaded, and the file and data structure established. In addition certain data must be placed onto the IC card. In some cases this data applies to the entire card (e.g. KMC_{ID}). In some cases, this data only applies to a single application (e.g. the AID).

4.1.1.1 Unless the card is capable of dynamically building files and records and initializing them to binary zeros, files must have been built with space allocated for the data described in the specifications for the IC card application and the space must be initialized to binary zeros.

4.1.1.2 Each application must be selectable by its AID.

4.1.1.3 If the File Control Information (FCI) for the application is not to be personalized, it must be created prior to personalization.

4.1.1.4 KEYDATA must be set as shown in Table 15**.** KEYDATA is composed of KMC_{ID} and Chip Serial Number (CSN). KMC_{ID} is the identifier of the master personalization key to be supplied by the card issuer or the personalizer. The length of KMC_{ID} is 6 bytes. The CSN is rightmost 4 bytes of the physical identifier of the card.

4.1.1.5 The version number of the personalization master key (KMC) used to generate the initial personalization keys (the K_{ENC}, the K_{MAC} and the K_{DEK}) for each application must be on the IC card.

4.1.1.6 A derived key (K_{ENC}) must be generated for each IC card and placed into the application. This key is used to generate the card cryptogram and to verify the host cryptogram. This key is also used to decrypt the STORE DATA command data field in CBC mode if the security level of secure messaging requires the command data field to be encrypted.

The K_{ENC} is a 16 byte (112 bits plus parity) DES key.

The K_{ENC} will be derived in the following way: K_{ENC} := DES3(KMC)[Six least significant bytes of the KEYDATA || 'F0' || '01'] || DES3(KMC)[Six least significant bytes of the KEYDATA || '0F' || '01'].

4.1.1.7 A derived key (K_{MAC}) must be generated for each IC card and placed into the card. This key is used to verify the C-MAC for the EXTERNAL AUTHENTICATE command and also to verify the C-MAC for the STORE DATA command(s) if the security level of secure messaging requires a MAC of the command data.

The K_{MAC} is a 16 byte (112 bits plus parity) DES key

The K_{MAC} will be derived in the following way: K_{MAC} := DES3(KMC)[Six least significant bytes of the KEYDATA || 'F0' || '02']|| DES3(KMC)[Six least significant bytes of the KEYDATA || '0F' || '02'].

4.1.1.8 A derived key (K_{DEK}) must be generated for each IC card and placed into the card. This key is used to decrypt in ECB mode secret data received in the STORE DATA command.

The K_{DEK} is a 16 byte (112 bits plus parity) DES key.

The K_{DEK} will be derived in the following way: K_{DEK} := DES3(KMC)[Six least significant bytes of the KEYDATA || 'F0' || '03']|| DES3(KMC)[Six least significant bytes of the KEYDATA || '0F' || '03'].

4.1.1.9 For each Secure Channel key set the sequence counter to be returned in the response to the INITIALIZE UPDATE command must be initialized to '0000'.

4.2 Load / Update of Secure Channel Key Set

To load or update the secure channel keys the new key set should be placed in the DGI '8F01' and encrypted under a TK shared between the data preparation system (or the entity that generates these keys) and the personalization system. The key related data should be placed in the DGI '7F01' and the KEYDATA in the DGI '00CF'. If the data preparation system (or the entity that generates these keys) has no knowledge of Chip Serial Number (CSN) this entity can generate a Card Image Number (CIN) unique across different batches of cards which will replace the CSN portion of the KEYDATA to be placed in DGI '00CF' (see Appendix A.4 for formatting these DGIs).

4.2.1.1 Each key set requires three static keys K_{ENC}, K_{MAC} and K_{DEK} and a sequence counter that must be initialized to '0000'.

4.3 File Structure for Records

During personalization, the application receives a series of STORE DATA commands corresponding to the record values then stores the record values. Depending on the card platform a file structure may need to be created or the application may simulate the files and records. In either case the application must have mutable persistent memory (e.g. EEPROM) available to store such records, using one of the following methods:

- The pre-allocation of the memory and file structure
- The allocation of the memory and file structure during personalization

Annex A.5 provides an optional mechanism to submit the file structure creation instructions within a DGI to the application using STORE DATA command.

4.4 Personalization Requirements

4.4.1 IC Card Requirements

4.4.1.1 The application to be personalized must be on a card conforming to EMV Version 4.1 Book 1 Part II and must use the Application Selection process specified in EMV Version 4.1 Book 1 Part III.

4.4.2 Command Support

4.4.2.1 Each IC card application that supports this specification must support the personalization commands described in section 3.1.2:
- SELECT
- INITIALIZE UPDATE
- EXTERNAL AUTHENTICATE
- STORE DATA

4.4.2.2 Each IC card must maintain a sequence counter for each secure channel key set version that can be returned in the response to the INITIALIZE UPDATE command. This counter must be incremented by 1 after each successful EXTERNAL AUTHENTICATE command. Every time a key set version is updated with new set of keys its sequence counter must be initialized to '0000'.

4.4.2.3 If the IC card application does not recognize the DGI in the STORE DATA command, it must respond with an SW1 SW2 of '6A88'.

4.4.3 Secure Messaging

Secure messaging shall be required by all applications for the following personalization commands:

- EXTERNAL AUTHENTICATE command (see section 3.2.6)
- STORE DATA command if indicated by the security level of the EXTERNAL AUTHENTICATE command (see section 3.2.7)

4.4.3.1 Commands requiring a MAC shall include an 8 byte C-MAC that must be verified by the IC card prior to accepting the command. If the C-MAC fails to verify successfully, the IC card must reject the command with SW1 SW2 = '6982' and the secure channel session is terminated.

4.4.3.2 To verify a C-MAC, the IC card must generate a duplicate C-MAC and compare it with the C-MAC included in the command data. The C-MAC must be calculated as described in section 5.4.2.

4.4.3.3 If the C-MAC is verified, the IC card application must retain the C-MAC from each command to be concatenated to the beginning of the next APDU for the computation of the next C-MAC. The C-MAC must be retained for a command even if the response to the command is not '9000'.

4.4.3.4 The IC card application must be able to decrypt data as specified in section 5.6.

4.4.3.5 The secure channel described in this document is compliant with Secure Channel Protocol '02' - implementation option '55'[8] as defined in Appendix E of the GlobalPlatform Card Specification.

[8] Implementation of pseudo-random generation as defined in the section 3.2.5.9 unless issuer policy requires a random number generation as opposed to pseudo-random number generation in which case the secure channel shall be compliant with Secure Channel Protocol '02' – implementation option '15' as defined in Appendix E of the GlobalPlatform Card Specification.

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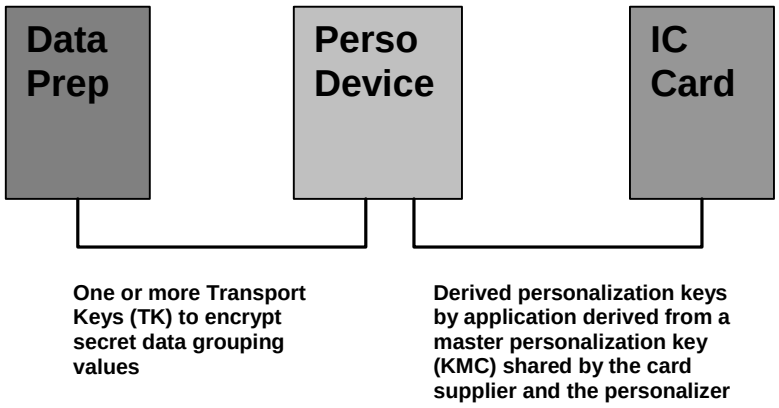
5 Cryptography for Personalization

5.1 Two Key Zones

Two key zones exist in the personalization process in Indirect method. There is a key zone between the data preparation processes and the personalization device. There is also a key zone between the personalization device and the IC card. These two key zones are shown in Figure 8.

Figure 8 –Personalization Two Key Zones

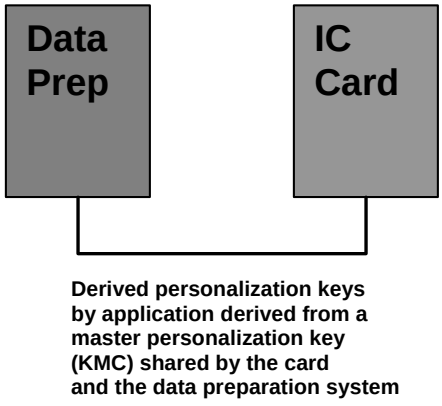


The purpose of having two key zones is to enable the data preparation process to be independent of the IC card type, as far as possible.

5.2 One Key Zone

One key zone exists in the personalization process in Direct method between the data preparation processes and the IC card. This key zone is shown in Figure 9.

Figure 9 –Personalization One Key Zone



5.3 Session Keys

DES session keys are generated every time a secure channel is initiated. These session keys may be used for subsequent commands if secure messaging is required. Up to three session keys may be generated, namely SKU_{ENC}, SKU_{MAC}, and SKU_{DEK}.

5.3.1.1 All encryption, decryption and MACing in commands that are sent to the IC card must be performed using session keys (SKU_{ENC}, SKU_{MAC}, and SKU_{DEK}).

5.3.1.2 Session keys must be calculated using the triple DES algorithm presented in section 5.5.2.3 and the base keys K_{ENC}, K_{MAC}, and K_{DEK} to produce SKU_{ENC}, SKU_{MAC}, and SKU_{DEK} respectively.

The session keys must be calculated in CBC mode as specified in section 5.5.2 and the data in Table 24. Padding is not added prior to encryption. The 16 bytes of derivation data, when encrypted, will result in a 16-byte double length key.

Table 24 – Derivation Data for Session Keys

Session Key	IC Card Key	Derivation Data
SKU_{ENC}	K_{ENC}	'0182' || sequence counter || '00000000000000000000000'
SKU_{MAC}	K_{MAC}	'0101' || sequence counter || '00000000000000000000000'
SKU_{DEK}	K_{DEK}	'0181' || sequence counter || '00000000000000000000000'

The session keys must be calculated for each IC card secure channel key set used during processing of the INITIALIZE UPDATE command using a sequence counter of the key set version provided by the IC card. See section 3.2.5 for specifications for the INITIALIZE UPDATE command.

These session keys are used for all cryptography for personalizing the IC card application until the completion of the last STORE DATA command. See section 3.2.8 for specifications for the last STORE DATA command.

5.4 MACs

The personalization process creates MACs for three purposes:

1. During the IC personalization process (INITIALIZE UPDATE command and EXTERNAL AUTHENTICATE command) the IC card returns a MAC (the card cryptogram) and the personalization device sends a MAC (the host

cryptogram) to the IC card. The IC card and the personalization device authenticate each other using these cryptograms. The process of creating the MACs listed in 1 is described in section 5.4.1.

2. The EXTERNAL AUTHENTICATE command requires a C-MAC to be sent from the personalization device to the IC card. Based on the security level set in the EXTERNAL AUTHENTICATE command, each STORE DATA command may require a C-MAC. The C-MACs ensure the integrity of the personalization data. Because each C-MAC incorporates the C-MAC from the previous command (including the C-MAC from the EXTERNAL AUTHENTICATE command) as the first block to compute the next MAC (there is no preceding MAC value to be used as the first block for computing the C-MAC of the EXTERNAL AUTHENTICATE command), they also ensure that all the personalization data is sent to the IC card and in the correct order. The process of creating the MACs listed in 2 is described in section 5.4.2.
3. All data sent from the data preparation process to the personalization device must be MACed to ensure the integrity of the personalization data file. The process of creating the MACs listed in 3 is described in section 5.4.3

5.4.1 MACs for Personalization Cryptograms

5.4.1.1 Input to the MAC is first padded to the right with '80'. The result is padded to the right with up to 7 bytes of '00' to make the result 8 bytes long. This is defined in ISO/IEC 9797-1, as padding method 2.

5.4.1.2 The full triple DES MAC is as defined in ISO 9797-1 as MAC Algorithm 1 with output transformation 1, without truncation, and with triple DES taking the place of the block cipher.

5.4.1.3 All 64 bits of the final output block are used as the MAC created for personalization cryptograms.

5.4.1.4 Verification of a cryptogram must be performed by computing a MAC based on the same parameters (and key) and then comparing the result with the cryptogram received.

5.4.2 C-MAC for Secure Messaging

Secure messaging is required for the following personalization command:

- EXTERNAL AUTHENTICATE (see section 3.2.6)

Based on the security level set in the EXTERNAL AUTHENTICATE command, secure messaging may also be required for the following personalization command:

- STORE DATA (see section 3.2.7)

5.4.2.1 Commands using secure messaging must include an 8 byte C-MAC created by the personalization device and verified by the IC card prior to accepting the command. If the command C-MAC fails to verify successfully, the IC card must reject the command with SW1 SW2 = '6982' and close the secure channel.

Note: To avoid confusion with the MAC function defined in 5.4.1, C-MAC is used as the name of the function to generate a secure message MAC and as the name of the secure message MAC.

5.4.2.2 The C-MAC must be calculated as follows:

1. Concatenate the command header (CLA INS P1 P2 Lc) with the command data (excluding the C-MAC itself).

   The command header must be modified as follows:

   - The value of Lc in the data to compute the C-MAC must reflect the presence of the C-MAC in the command data, i.e. Lc = Lc + 8.
   - The class byte shall be modified to indicate that this APDU includes secure messaging. This is achieved by setting bit 3 of the class byte. A STORE DATA command that contain C-MAC will have a class byte of '84'.
     If both the STORE DATA command and the security level of the EXTERNAL AUTHENTICATE command specify encryption, the encryption required by the STORE DATA command will be done before the C-MAC is computed and the EXTERNAL AUTHENTICATE encryption will be done after the C-MAC is computed.
     The specific rules are:
     - Data groupings that are sent to the IC card with a P1 setting in the STORE DATA command indicate that the data is encrypted under the SKU_{DEK} before the C-MAC is computed.
     - If the security level in the EXTERNAL AUTHENTICATE command indicates that both encryption and MACing are used, the C-MAC must be created on the original command data (includes data encrypted under SKU_{DEK}) then the APDU command data field is encrypted under SKU_{ENC}.
2. Prepend the C-MAC computed for the previous command and validated by the card to the left of the data requiring the MAC. If the IC card rejects a STORE DATA command with a DGI that is listed in field VERCNTL (see section 2.4.2), processing must continue. The personalization device and the IC card must keep any C-MAC that has been validated by the IC card to use as the first block of data for a subsequent C-MAC generation.
3. Append a byte of '80' to the right of the data.
4. If the resultant data block length is a multiple of 8, no further padding is required. Otherwise, append up to 7 bytes of '00' until the length is a multiple of 8. Divide the block into 8-byte blocks with the leftmost 8 bytes (8 leftmost bytes of the EXTERNAL AUTHENTICATE command or C-MAC from previous command for the subsequent STORE DATA commands) being block one.
5. An Initialization Vector (IV) of all zeros is always used.
6. The C-MAC is computed as defined in section 5.4.2.3, using SKU_{MAC} as the key.

5.4.2.3 The process of generating a C-MAC is performed with single DES plus final triple DES MAC according to ISO 9797-1 as MAC Algorithm 3 with output transformation 3, without truncation, and with DES taking the place of the block cipher. This is also known as the "Retail MAC" and is shown in Figure 10.

Both the personalization device and the IC card must create the C-MAC. The IC card verifies the C-MAC by comparing the C-MAC it creates to the C-MAC in the command. Both the personalization device and the IC card must also save the verified C-MAC to be used as the first block in the next C-MAC creation or verification.

5.4.3 MAC for integrity of the personalization data file

Integrity and authenticity are required for all data sent from the data preparation process to the personalizer to ensure the integrity of the personalization data file.

5.4.3.1 For each application the input to the MAC is the data within section 3 of the Table 8 excluding the fields MACkey and MAC_{INP} (L_{APPL} includes the length for fields MACkey and MAC_{INP}).

5.4.3.2 Input to the MAC is first appended (to the right) with '80'. The result is padded to the right with up to 7 bytes of '00' (possibly none) to make the input data a multiple of 8-byte blocks.

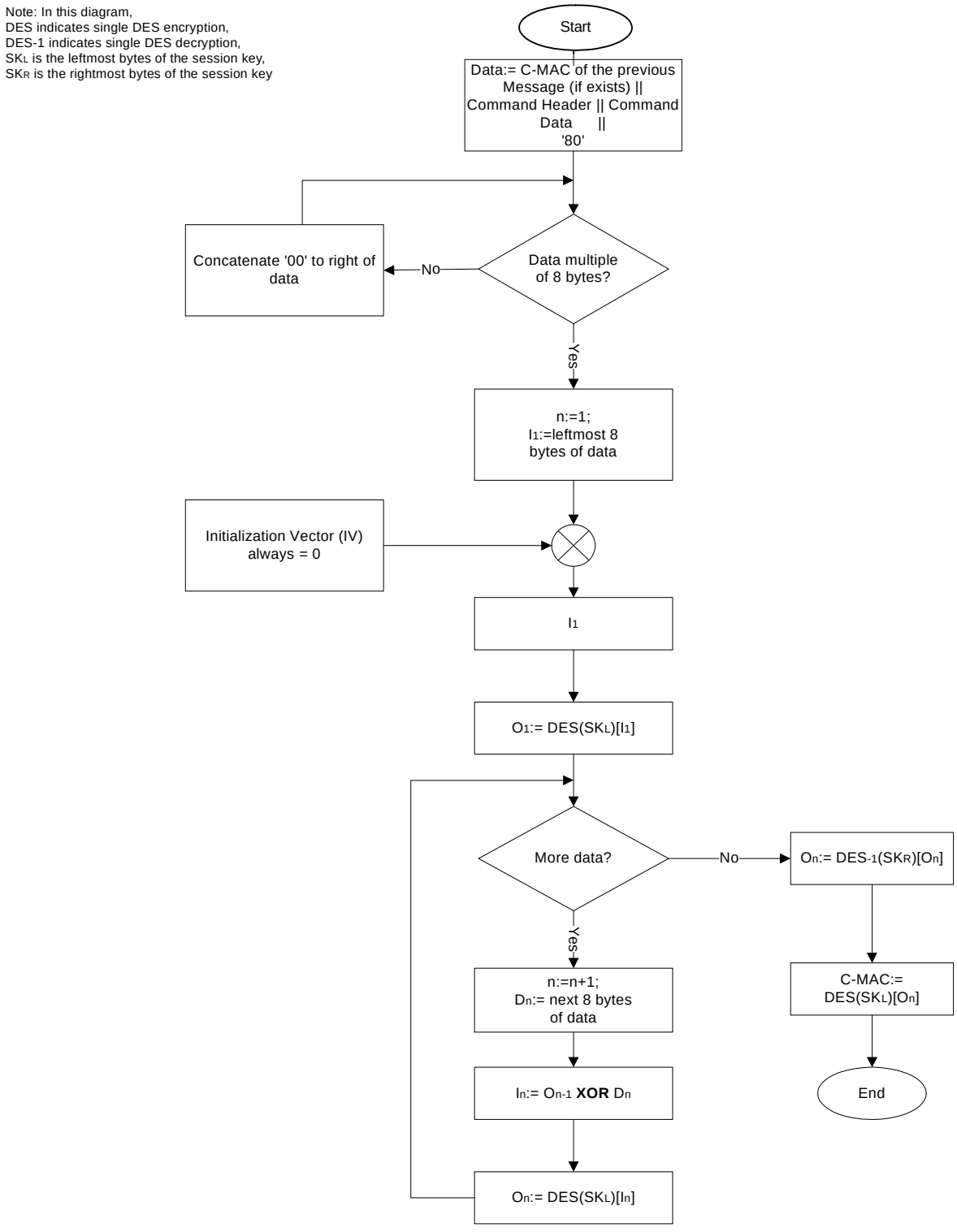
5.4.3.3 The process of generating a MAC using MACkey must be performed in single DES plus final triple DES MAC according to ISO 9797-1 as MAC Algorithm 3 with output transformation 3, without truncation, and with DES taking the place of the block cipher. This is also known as the Retail MAC and presented in Figure 10 (with no MAC from previous message).

5.4.3.4 The leftmost 32 bits of the final output block are used as the MAC created during data preparation process.

Both the data preparation system and the personalization system must create the MAC. The personalization system must compare the MAC it creates to the MAC in the field MAC_{INP} within the personalization data file to verify it.

5.4.3.5 Once the input to an application has been verified, subsequent processing must ensure that the same input is delivered to the application without alteration or addition.

Figure 10 – C-MAC and MAC Computation



5.5 Encryption

This section describes the encryption of secret data during personalization.

After personalization, confidential or secret data may be exchanged between a terminal and an IC card application. For example, a PIN may be changed between a terminal and an IC card during an online transaction. This section does not apply to encryption of secret data after personalization. Post personalization encryption is covered in application specific documents.

5.5.1 Encryption Using ECB mode

5.5.1.1 The data preparation function must encrypt DES and RSA keys and secret data e.g. PIN Block, with Triple DES in ECB mode using a Transport Key.

5.5.1.2 The personalization device must encrypt keys and secret data with Triple DES in ECB mode using the session key SKU_{DEK}.

5.5.1.3 Triple DES in ECB mode, as defined in ISO 10116, is used.

5.5.2 Encryption Using CBC Mode

5.5.2.1 If the security level set in EXTERNAL AUTHENTICATE command requires MAC and encryption, the personalization device must encrypt the APDU command data field in CBC mode using the session key SKU_{ENC} after the MAC has been computed.

5.5.2.2 Input to the encryption process is first padded to the right with '80'. The result is padded to the right with up to 7 bytes of '00' (possibly none) to make the input data a multiple of 8-byte blocks.

5.5.2.3 Encryption of data must be done in Triple DES in CBC mode, as defined in ISO 10116 with an Initial Vector equal to '00 00 00 00 00 00 00 00'.

5.6 Decryption

The personalization device must decrypt secret data encrypted by the data preparation process. This secret data will then be re-encrypted prior to sending to the IC card. The IC card should decrypt the secret data prior to storing it for future use. This section describes the decryption of secret data during personalization.

5.6.1 Decryption Using ECB Mode

5.6.1.1 The personalization device must use the TK identified in the input record for the decryption of secret data (prior to re-encryption under SKU_{DEK} by the personalization device).

5.6.1.2 The IC card must use SKU_{DEK} for decryption of encrypted data grouping values.

5.6.1.3 Triple DES in ECB mode, as defined in ISO 10116, is used.

5.6.2 Decryption Using CBC Mode

5.6.2.1 The SKU_{ENC} must be used for decryption done by the IC card.

5.6.2.2 Decryption of data must be done with Triple DES in CBC mode, as defined in ISO 10116 with an Initial Vector equal to '00 00 00 00 00 00 00 00'.

Padding should be removed after decryption by the IC card. The IC card determines the length of the padding by searching the decrypted data stream from the rightmost byte. The first ‘80’ found is the start of the padding.

5.7 Triple DES Calculations

5.7.1.1 Triple DES uses a compound operation of DES encryption and decryption. DES and triple DES are defined in ISO/IEC 18033-3. Triple DES, as used in this specification, uses keying option 2 as defined in ISO/IEC 18033-3.

6 Personalization Data Elements

The data elements are presented in alphabetical sequence of abbreviated name.

6.1 ACT (Action to be Performed)

Purpose: Identifier for the action to be performed in a Processing Step.
Format: 1 byte binary
Content: A value of '0F' is used for the personalization step in conjunction with DGIs. A value of '0B' is used for the personalization step in conjunction with pre-computed APDU commands. See the appropriate platform reference for other values.

6.2 AID (Application Identifier)

Reference: ISO/IEC 7816-5
Purpose: Identifier for the application. Used during Application Selection as defined in EMV Version 4.1 Book 1.
Format: 5-16 bytes
Content: RID || PIX where the RID is the five-byte global registered identifier as specified in ISO/IEC 7816–5 and the PIX (0–11 bytes) is at the discretion of the owner of the RID.

6.3 ALGSCP (Algorithm for Secure Channel Protocol)

Purpose: Identifies the Secure Channel Protocol that is implemented on the IC card
Format: 1 byte, binary
Content: '02' – session keys are generated and MACs are generated and validated as described in this specification.

6.4 C-MAC

A C-MAC is generated by an off-card entity and applied across the full APDU command being transmitted to the card including the C-MAC from previous command (if exists) prepended to header and the data field in the command message. It does not include Le.

Purpose: To protect the integrity of a command individually and within an ordered sequence of commands sent to the card during a secure channel session
Format: 8 bytes, binary
Content: var.

6.5 CMODE (Chaining Mode)

Purpose: Identifies the chaining mode to use to decrypt the related DGI
Format: 1 byte, binary
Content: '11' – ECB mode as described in section 5.6.1.

6.6 CSN (Chip Serial Number)

Purpose: To uniquely identify each chip from a specific chip/card manufacturer.
Format: Binary, variable.

6.7 DTHR (Date and Time)

Purpose: The date and time in YYMMDDHHMMSS format
Format: BCD, 6 bytes.

6.8 ENC (Encryption Personalization Instructions)

Purpose: To specify the data groupings that must be encrypted. See section 2.4.3
Format: Binary, variable.

6.9 ID_{TK} (Identifier of the Transport Key)

Purpose: Identifier of the key used to encrypt secret data sent from the data preparation process to the personalization device.
Format: Binary, 12 bytes
Content: See Table 8

6.10 ID_{OWNER} (Identifier of the Application Specification Owner)

Purpose: Used to identify the owner of the specifications for this application.
Format: Binary, variable
Content: It is recommended that the RID of the owner of the specifications for the application be used in the coding of this field.

6.11 ID_{TERM} (Identifier of the Personalization Device)

Purpose: Identifies the device used to personalize an IC card.
Format: Binary, 4 bytes.

6.12 K_{ENC} (DES Key for Creating Personalization Session Key for Confidentiality and Authentication Cryptogram)

Purpose: This DES key is created prior to the start of the personalization process and is used by the personalization process to create the session key SKU_{ENC}.
Format: Binary, 16 bytes
Notes: Must be generated with odd parity.

6.13 K_{DEK} (DES Key for Creating Personalization Session Key for Key and PIN Encryption)

Purpose: This DES key is created prior to the start of the personalization process and is used by the personalization process to create the session key SKU_{DEK}.
Format: Binary, 16 bytes
Notes: Must be generated with odd parity.

6.14 K_{MAC} (DES Key for Creating Personalization Session Key for MACs)

Purpose: This DES key is created prior to the start of the personalization process and is used by the personalization process to create the session key SKU_{MAC}.
Format: Binary, 16 bytes
Notes: Must be generated with odd parity.

6.15 Key Check Value

Purpose: The data is used to prove that a card/processor has access to a specific DES key value.
Format: Binary, 3 bytes
Contents: The three leftmost bytes of the result of encrypting eight bytes of zeros by the DES key concerned.

6.16 KEYDATA (Derivation Data for Secure Channel Keys)

Purpose: The data used to derive the K_{DEK}, K_{MAC} and the K_{ENC} from the KMC.
Format: Binary, 10 bytes
Contents: See Table 15

6.17 KMC (DES Master Key for Personalization Session Keys)

Purpose: This DES key is used for generating derived keys to generate MACs and encrypt and decrypt DES keys and secret data during personalization (K_{ENC}, K_{MAC} and K_{DEK}).
Format: Binary, 16 bytes
Notes: Must be generated with odd parity.

6.18 KMC_{ID} (Identifier of the Master Key for Personalization)

Purpose: Data required by the personalization device for identification of the Master Key for personalization. This field is used to determine which KMC is to be used to derive the keys for secure channel. This data must be placed in the IC card prior to personalization, and must be retrievable from the KEYDATA returned from the INITIALIZE UPDATE command prior to the explicit selection of an application. This field will normally contain the card issuer BIN/IIN (e.g. IIN right justified and left padded with 1111b per quartet). However, if the personalization device is at a personalization bureau that uses an identifier for card issuers other than a BIN/IIN, that identifier may be used in this field.
If a card issuer has multiple card suppliers and uses different KMCs for each card supplier, this field may contain an identifier of the card supplier as well as the identifier of the card issuer.
The KMC_{ID} is used as input data to derive the card static keys (K_{ENC}, K_{MAC}, K_{DEK}).

Format: Binary, 6 bytes

6.19 L (Length of Data)

Purpose: The length of data that follows.
Format: Binary, variable
Remarks: Length and content depend upon usage

6.20 LCCA (Length of IC Card Application Data)

Purpose: The length of the data for IC card application(s).
Format: ASCII decimal digits, padded at the most significant end by ASCII zeros (“30”), 7 bytes

6.21 LOGDATA (Data Logging Personalization Instructions)

Purpose: To specify the data that must be logged by the personalization process. See section 2.5.
Format: Binary, variable.

6.22 MAC_{INP} (MAC of All Data for an Application)

Purpose: A MAC created over all of the data for an IC card application as described in section 5.4.3. MAC_{INP} is the 4 leftmost bytes of the created MAC.
Format: Binary, 4 bytes

6.23 MACkey (MAC Key)

Purpose: The DES key used to create MAC_{INP}. This key should be uniquely created for the data for each application on each IC card.
Format: Binary, 16 bytes

6.24 MIC (Module Identifier Code)

Purpose: An identifier that specifies that this is data for IC card application(s). The length and values of this field are established when the personalization device is configured.
Format: ASCII, variable, 1 to 7 bytes

6.25 ORDER (Data Grouping Order Personalization Instructions)

Purpose: To specify the order in which data groupings must be sent to the IC card. See section 2.4.1.
Format: Binary, variable.

6.26 POINTER (Additional Pointer to Personalization Data or Instructions)

Purpose: A pointer to additional data or instructions for the personalization process. A separate pointer is available for each Processing Step. The usage of this field is outside the scope of this specification. It is envisioned that is will be set based on agreements between data preparation systems and personalization systems.
Format: Binary, variable

6.27 R_{CARD} (Pseudo-Random Number from the IC Card)

Purpose: A pseudo-random number (see 3.2.5.9) generated by the IC card or the IC card application. Used in the creation of the host and card cryptograms.
Format: Binary, 6 bytes

6.28 R_{TERM} (Random Number from the Personalization Device)

Purpose: A random number generated by the personalization device. Used in the creation of the host and card cryptograms.
Format: Binary, 8 bytes

6.29 RANDOM (Random Number)

Purpose: May be used during encryption and decryption of secret data encrypted with a TK
Format: Binary, variable – 8 bytes recommended
Content: A random number to be used during personalization processing

6.30 REQ (Required or Optional Action)

Purpose: Indicates whether the action to be performed in a Processing Step is required or optional. If a Processing Step is required, it must be done, even if it has been done before. If a Processing Step is optional, it must not be re-done if it has been done before.
Format: 1 byte binary
Content: '00' is optional, '01' is required

6.31 SEQNO (Sequence Number)

Purpose: The sequence number of a personalized IC card in a run of IC cards personalized. The first card has sequence number 1, the second, number 2, etc.
Format: Binary, 3 bytes

6.32 SKU_{ENC} (Personalization Session Key for confidentiality and authentication cryptogram)

Purpose: This DES key is created during the personalization process and is used to create cryptograms and may be used to encrypt and decrypt secret data in CBC mode.
Format: Binary, 16 bytes
Content: Derived as described in section 5.3.
Remarks: Parity convention not required

6.33 SKU_{DEK} (Personalization Session Key for Key and PIN Encryption)

Purpose: This DES key is created during the personalization process and is used to encrypt and decrypt secret data in ECB mode.
Format: Binary, 16 bytes
Content: Derived as described in section 5.3.
Remarks: Parity convention not required

6.34 SKU_{MAC} (Personalization Session Key for MACing)

Purpose: This DES key is created during the personalization process and is used when secure MACing is required to create C-MACs.
Format: Binary, 16 bytes
Content: Derived as described in section 5.3.
Remarks: Parity convention not required

6.35 TAG (Identifier of Data for a Processing Step)

Purpose: Identifier for the data in ICC Data in the input record to be used in a Processing Step.
Format: Binary, variable
Content: A BER TLV encoded tag. A value of 'EF' is used for the personalization Processing Step '0F'. A value of 'EE' is used for the personalization Processing Step '0B'. See the appropriate platform reference for other values.

6.36 TK (Transport Key)

Purpose: A DES key used to encrypt other key values for transmission between the data preparation system and the personalization device.
Format: Binary, 16 bytes
Remarks: This key is not related to the K_{DEK} and the SKU_{DEK} used to encrypt secret data sent to an IC card.

6.37 $TYPE_{TK}$ (Indicator of Use(s) of Transport Key)

Purpose: To identify the uses of a Transport Key
Format: Binary, 1 byte
Content: Provides information on what the TK encrypts and the encryption algorithm used. See Table 25.
If a TK is a general purpose TK with an encryption algorithm (b7 and b6) = 01b, then the TK encrypts secret data as described in section 5.5.
If a TK is indicated by an encryption method (b7 and b6) of 10b, then the secret data is XORed with the RANDOM number for this application before encryption (by the data preparation system) and after decryption (by the personalization system).

Table 25 – Coding of $TYPE_{TK}$

b8	b7	b6	b5	b4	b3	b2	b1	Meaning
x								TK for MACkey encryption
0								TK not used for MACkey encryption
1								TK used for MACkey encryption
	x	x						Encryption algorithm
	0	1						General purpose TK
	1	0						TK using RANDOM field and XOR operation
	0	0						RFU
	1	1						RFU
			x	x	x			RFU
						x	x	RFU for Proprietary Implementations

6.38 VERCNTL (Version Control Personalization Instructions)

Purpose: To specify the data groupings that may be rejected by the IC card without interrupting the personalization process. See section 2.4.2.
Format: Binary, variable.

6.39 VNL (Version Number of Layout)

Purpose: The version number of the layout of the file from the data preparation process to the personalization device.
Format: Binary or ASCII, 4 bytes
Content: ”02.2” (ASCII) is defined for this specification

Annex A. Common EMV Data Groupings

A.1 Introduction

This Annex defines DGIs for use in the personalization of EMV card applications that are common between payment systems. The first group of common DGIs is linked to the main EMV payment application. The second group of DGIs is linked to the Payment System Environment (PSE) application.

A.2 Common DGIs for EMV Payment Applications

The recommended common data groupings for EMV payment applications are defined below.

Table A-1 – Data Grouping Identifiers for Payment Applications

DGI	Data Content	Function	Encrypt	External Access
8000	DES keys – Table A-2	CAM* / Issuer Auth/ Issuer Script	Yes	None
9000	DES Key Check Values – Table A-3		No	None
8010	Offline PIN Block - Table A-4	Offline PIN	Yes	PIN CHANGE / UNBLOCK
801n**	Duplicate Offline PIN Block - Table A-5	Offline PIN	Yes	Same as above
9010	PIN Related Data - Table A-6	PIN Try Limit/Counter	No	GET DATA
901n**	Duplicate PIN Related Data - Table A-7	PIN Try Limit/Counter	No	Same as above
8101	ICC Private Key (DDA/PIN Encipherment)- Table A-8	DDA/PIN Encipher	Yes	None
8102	ICC PIN Encipherment Private Key - Table A-9	PIN Encipher	Yes	None
8103	ICC Modulus (DDA/PIN Encipherment) - Table A-10	DDA/PIN Encipher	Yes	None
8104	ICC Modulus PIN Encipherment – Table A-11	PIN Encipher	Yes	None
8201	CRT constant DDA/PIN Encipherment - Tables A-12 and A-12b	DDA/PIN Encipher	Yes	None
8202	CRT constant DDA/PIN Encipherment - Tables A-12 and A-12b	DDA/PIN Encipher	Yes	None

DGI	Data Content	Function	Encrypt	External Access
8203	CRT constant DDA/PIN Encipherment - Tables A-12 and A-12b	DDA/PIN Encipher	Yes	None
8204	CRT constant DDA/PIN Encipherment - Tables A-12 and A-12b	DDA/PIN Encipher	Yes	None
8205	CRT constant DDA/PIN Encipherment - Tables A-12 and A-12b	DDA/PIN Encipher	Yes	None
8301	CRT constant PIN Encipherment - Tables A-13 and A-13b	PIN Encipher	Yes	None
8302	CRT constant PIN Encipherment - Tables A-13 and A-13b	PIN Encipher	Yes	None
8303	CRT constant PIN Encipherment - Tables A-13 and A-13b	PIN Encipher	Yes	None
8304	CRT constant PIN Encipherment - Tables A-13 and A-13b	PIN Encipher	Yes	None
8305	CRT constant PIN Encipherment - Tables A-13 and A-13b	PIN Encipher	Yes	None
9102	SELECT Response Data - Table A-14	-	No	SELECT
9104	GPO Response Data - Table A-15	-	No	GET PROCESSING OPTIONS
91nn**	Duplicate GPO Response Data - Table A-16	-	No	GET PROCESSING OPTIONS
3000	Application Common Internal data – Table A-17	-	No	Data dependent
3001	Application Internal data – Table A-18	-	No	Data dependent

NOTE: * Card Authentication Method

** Indicates store in last record(s) in the file, because it is a duplicate data element

The requirement column titled "Req.", in the following tables of data elements for each DGI, lists the requirements for each data element:

M (Mandatory) indicates that the data element must be present.

C (Conditional) indicates that the data element is necessary under certain conditions.

O (Optional) indicates that the data element is optional

Table A-2 – Data Content for DGI '8000'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	Unique Derivation Key (UDK) Message Authentication (MAC UDK) DEA Key Data Encipherment (ENC UDK) DEA Key	16 16 16	SKU_{DEK}

Table A-3 – Data Content for DGI '9000'

Req.	Tag	Data Element	Length	Encrypt
O	N/A	Key Check Values for card keys UDK, MAC UDK and ENC UDK	3-9	N/A

Table A-4 – Data Content for DGI '8010'

Req.	Tag	Data Element	Length	Encrypt
C	—	Reference PIN Block (see section 2.4.4)	8	SKU_{DEK}

Table A-5 – Data Content for DGI '801n'

Req.	Tag	Data Element	Length	Encrypt
C	—	Duplicate Reference PIN Block (see section 2.4.4)	8	SKU_{DEK}

Table A-6 – Data Content for DGI '9010'

Req.	Tag	Data Element	Length	Encrypt
C	—	PIN Try Counter (Tag '9F17')	1	N/A
C	—	PIN Try Limit	1	N/A

Table A-7 – Data Content for DGI '901n'

Req.	Tag	Data Element	Length	Encrypt
C	—	Duplicate PIN Try Counter (Tag '9F17')	1	N/A
C	—	Duplicate PIN Try Limit	1	N/A

To support DDA (and also PIN Encipherment using the same key), personalize either DGIs '8101' ICC Private Key and '8103' Modulus, or '8201' to '8205' CRT (Chinese Remainder Theorem) constants.
Additionally, to support a separate key for PIN Encipherment, personalize either DGIs '8102' and '8104', or '8301' to '8305'.

Table A-8 – Data Content for DGI '8101'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	ICC Private Key (DDA / PIN Encipherment) Exponent	var.	SKU_{DEK}

Table A-9 – Data Content for DGI '8102'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	ICC Private Key (PIN Encipherment) Exponent	var.	SKU_{DEK}

Table A-10 – Data Content for DGI '8103'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	ICC Key (DDA / PIN Encipherment) Modulus	var.	SKU_{DEK}

Table A-11 – Data Content for DGI '8104'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	ICC Key (PIN Encipherment) Modulus	var.	SKU_{DEK}

Table A-12 – Data Content for DGI '8201' through '8205' for p^{-1} mod q convention

Req.	Tag	Data Element	Length	Encrypt
C	N/A	CRT constant p^{-1} mod q	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(p - 1)$	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(q - 1)$	var.	SKU_{DEK}
C	N/A	CRT constant prime factor p	var.	SKU_{DEK}
C	N/A	CRT constant prime factor q	var.	SKU_{DEK}

Table A-12b – Data Content for DGI '8201' through '8205' for q^{-1} mod p convention

Req.	Tag	Data Element	Length	Encrypt
C	N/A	CRT constant q^{-1} mod p	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(q - 1)$	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(p - 1)$	var.	SKU_{DEK}
C	N/A	CRT constant prime factor q	var.	SKU_{DEK}
C	N/A	CRT constant prime factor p	var.	SKU_{DEK}

Table A-13 – Data Content for DGI '8301' through '8305' for p^{-1} *mod q* convention

Req.	Tag	Data Element	Length	Encrypt
C	N/A	CRT constant p^{-1} mod q	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(p-1)$	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(q-1)$	var.	SKU_{DEK}
C	N/A	CRT constant the prime factor p	var.	SKU_{DEK}
C	N/A	CRT constant the prime factor q	var.	SKU_{DEK}

Table A-13b – Data Content for DGI '8301' through '8305' for q^{-1} *mod p* convention

Req.	Tag	Data Element	Length	Encrypt
C	N/A	CRT constant q^{-1} mod p	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(q-1)$	var.	SKU_{DEK}
C	N/A	CRT constant d mod $(p-1)$	var.	SKU_{DEK}
C	N/A	CRT constant the prime factor q	var.	SKU_{DEK}
C	N/A	CRT constant the prime factor p	var.	SKU_{DEK}

Table A-14 – Data Content for DGI '9102'

Req.	Tag	Data Element	Length	Encrypt
M	A5	FCI Proprietary Template	var.	
M	50	Application Label	1-16	N/A
C	87	Application Priority Indicator	1	N/A
C	9F38	Processing Option Data Object List (PDOL)	var.	N/A
O	5F2D	Language Preference	2-8	N/A
C	9F11	Issuer Code Table Index	1	N/A
O	9F12	Application Preferred Name	1-16	N/A
O	BF0C	FCI Issuer Discretionary Data	var.	N/A

Table A-15 – Data Content for DGI '9104'

Req.	Tag	Data Element	Length	Encrypt
C	82	Application Interchange Profile (AIP)	2	N/A
C	94	Application File Locator (AFL)	var.	N/A

Table A-16 – Data Content for DGI '91nn'

Req.	Tag	Data Element	Length	Encrypt
C	82	Duplicate Application Interchange Profile (AIP)	2	N/A
C	94	Duplicate Application File Locator (AFL)	var.	N/A

Table A–17 – Application Common Internal Data Content for DGI '3000'

Req.	Tag	Data Element	Length	Encrypt
C	9F36	ATC	2	N/A
C	9F4F	Log Format	Var.	N/A

Table A–18 – Application Internal Data Content for DGI '3001'*

Req.	Tag	Data Element	Length	Encrypt
	Non-common Tags	Application Internal Data Elements		

*If necessary multiple DGI '3001' can be submitted to the application.

A.3 Common DGIs for EMV PSE

The recommended data groupings for the EMV Payment System Environment (PSE) application are defined below.

Table A-19 - Data Grouping Identifiers for PSE

DGI	Data Content	Function	Encrypt	External Access
0101	First Record Data - Table A-19	-	No	READ RECORD
01nn	Subsequent Record Data - Table A-19	-	No	READ RECORD
9102	Select PSE Response Data - Table A-20	-	No	SELECT

Table A-20 - Data Content for DGI '0101' and '01nn'

Req.	Tag	Data Element	Length	Encrypt
M	70	Record Template	var.	N/A
M	61	Directory Entry Template	Var.	N/A
M	4F	Dedicated File Name (AID)	5-16	N/A
O	50	Application Label	1-16	N/A
O	9F12	Application Preferred Name	1-16	N/A
C	87	Application Priority Indicator (used when there is more than one payment application on the card)	1	N/A
O	73	Directory Discretionary Template	Var.	N/A

Table A-21 - Data Content for DGI '9102'

Req.	Tag	Data Element	Length	Encrypt
M	A5	FCI Proprietary Template	var.	N/A
M	88	SFI of the directory elementary file	1	N/A
O	5F2D	Language Preference	2-8	N/A
O	9F11	Issuer Code Table Index	1	N/A
O	BF0C	FCI Issuer Discretionary Data	var.	N/A

A.4 Common DGIs to Load/Update Secure Channel Static Keys

The Data Grouping Identifiers '7F01', '8F01' and '00CF' are recommended for use to load or update the secure channel static keys i.e. K_{ENC}, K_{MAC} and K_{DEK}. The condition of use is that the application allows load or update of the secure channel static keys after initialization of the card.

These DGIs are defined to standardize any secure channel static keys update after initialization of the card.

Table A-22 – Data Grouping Identifiers for Secure Channel Static Keys

DGI	Data Content	Function	Encrypt	External Access
7F01	Secure Channel DES keys related data – Table A-23	Related data for Load/Update personalization static keys K_{ENC}, K_{MAC} and K_{DEK}	No	None
8F01	Secure Channel DES Keys – Table A-24	Load/Update personalization static keys K_{ENC}, K_{MAC} and K_{DEK}	Yes	None
00CF	Secure Channel DES Key derivation data - Table A-25	Derivation data for Load/Update personalization static keys K_{ENC}, K_{MAC} and K_{DEK}	No	INITIALIZE UPDATE GET DATA (Tag 'CF')

Table A-23 – Data Content for DGI '7F01'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	Current Key Version Number ('00' or '01' to '6F')	1	N/A
		New Key Version Number ('01' to '6F')	1	
		Key type ('80')	1	
		Check value for new Key Identifier 1	3	
		Check value for new Key Identifier 2	3	
		Check value for new Key Identifier 3	3	

Table A-24 – Data Content for DGI '8F01'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	New Key Identifier 1 (encryption)	16	SKU_{DEK}
		New Key Identifier 2 (MAC)	16	
		New Key Identifier 3 (DEK)	16	

Table A-25 – Data Content for DGI '00CF'

Req.	Tag	Data Element	Length	Encrypt
C	N/A	New Key derivation data	10	N/A

A.5 Common DGIs to Create File Structure for EMV Records

This provides a recommended way to create EF under the EMV application in order to create, update, and read EMV, payment system, and issuer records.

The creation of EF used as internal files (including files to store PIN and application keys) for EMV application is outside of scope of this document.

The Data Grouping Identifier '0062' is recommended for use to create EFs under the EMV CPS compliant application. One or more DGI '0062' may be used to create EFs.

Table A-26 – Data Grouping Identifiers for Secure Channel Static Keys

DGI	Data Content	Function	Encrypt	External Access
0062	Concatenation of (one FCP per EF) File Control Parameter – Table A-27	Create EF to store/retrieve EMV, payment system and issuer records	No	READ RECORD STORE DATA UPDATE RECORD

Table A-27 - Data Content for DGI '0062'

Req.	Tag	Data Element	Length	Encrypt
M	62	FCP	13 or 16	N/A
M	80	Number of data bytes in the file, excluding structural information (see ISO/IEC 7816-4 Table 12)	2	N/A
M M O O	82	File descriptor byte (see ISO/IEC 7816-4 Table 14), Data coding byte (see ISO/IEC 7816-4 Table 87), Maximum record size on two bytes ('00 01' to '00 FE') Number of records on one byte ('01' to 'FF')	2 or 5	N/A
M	88	Short EF identifier ('01' to '1E')	1	N/A
C	8C	Security attribute in compact format – Table A-28	4	N/A

The access rules for the EF are:

- Write (through STORE DATA command) after external authentication at the EMV application level (initiation of a secure channel as defined in this specification)
- Rewrite (through UPDATE RECORD command) after validation of the secure messaging of issuer scripting as defined in EMV Version 4.1 - Book 3
- Read (through READ RECORD command) with no conditions (free access)

If the access rules are implicitly known by the EMV application (at the DF level) then the presence of TLV tagged '8C' is not required or if present it shall be ignored by the EMV application.

If the access rules are to be communicated to the EMV application (at the DF level) then they shall be coded as defined in Table A-28.

Table A-28 – Security attribute (tag '8C')

Req.	Data Element	Length	Value	External Access
M	Access mode byte for EFs - Write record - Update record - Read record	1	'07'	
M	Write record allowed after initiation of a secure channel with DF (SE 1)	1	'A1'	STORE DATA
M	Update record allowed after validation of secure messaging of issuer scripting (SE 2)	1	'C2'	UPDATE RECORD
M	Read record allowed with no conditions	1	'00'	READ RECORD

For an explanation on the value of the access mode byte for EFs see ISO/IEC 7816-4 Table 17.

For an explanation on the value of the security condition byte see ISO/IEC 7816-4 Table 20.

The security environment 1 (SE 1) shall indicate after external authentication at the EMV application level (initiation of a secure channel as defined in this specification) and shall be implicitly known by the EMV application (at the DF level).

The security environment 2 (SE 2) shall indicate validation of the secure messaging of issuer scripting as defined in EMV Version 4.1 - Book 3 and shall be implicitly known by the EMV application (at the DF level).

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Annex B. Overview of EMV Card Personalization Indirect Method