

Supplementary CI Plus Specification

for

Service / Network Operators

Version 1.3



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1 References

1.1 Normative references

- [1] CI Plus Specification, v.1.3
<http://www.ci-plus.com>
- [2] ETSI EN301 192, V1.4.1 (2004-11): Digital Video Broadcasting (DVB); DVB specification for data broadcasting.
- [3] ISO/IEC 13818-6:1998(E). Information technology - Generic coding of moving pictures and associated audio information, Extensions for DSM-CC.
- [4] ETSI EN 300 486, V 1.8.1 (2008-07), Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems.
- [5] ETSI TR 101 162, Digital Video Broadcasting (DVB); Allocation of Service Information (SI) and Data Broadcasting Codes codes for Digital Video Broadcasting (DVB) systems.
- [6] IETF RFC 1950 (1996): ZLIB Compressed Data Format Specification version 3.3.

2 Definitions, symbols and abbreviations

2.1 Definitions

CICAM: Common Interface Conditional Access Module

2.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

BCD	Binary Coded Decimal
CA	Conditional Access
CICAM	Common Interface Conditional Access Module
CIP	Common Interface Plus
ECM	Entitlement Control Message
EIT	Event Information Table
EMM	Entitlement Management Message
LSB	Least Significant Bit
MJD	Modified Julian Date
PID	Packet Identifier
PMT	Program Management Table
RSA	Rivest Shamir Adleman public key cryptographic algorithm
RSD	Revocation Signalling Data
SDT	Service Description Table
SOCRL	Service Operator Certificate Revocation List
SOCWL	Service Operator Certificate White-List
SOPKC	Service Operator Public Key Certificate
SOP	Service Operator Public Key
SOQ	Service Operator Private Key

3 Technical mechanisms

3.1 Requirements for Host revocation

This section details the revocation mechanism as described in section 5.5 of the CI Plus Specification [1]. The host service revocation mechanism is linked to a specific Service Operator. Host service revocation comprises black listing and white listing. The black list is called Service Operator Certificate Revocation List (SOCRL) and supports all revocation granularities listed in section 5.5.2 [1]. The white list is called the Service Operator Certificate White List (SOCWL) and contains identifiers for single host devices for which revocation should be removed but are still listed in the latest SOCRL. The SOCWL shall overrule the SOCRL. The SOCWL shall always refer to the latest version of the SOCRL. The scope of revocation is limited to the network of the Service Operator.

3.1.1 RSD signalling

The CICAM shall receive information from the Service Operator that enables it to download new and updated SOPKC, SOCWL and SOCRL files. This information is conveyed as Revocation Signalling Data (RSD) and its definition is based on the following requirements.

Table 3-1: Signalling requirements

	Requirements
RS.1	The RSD detection shall be switched on or off by the CA system.
RS.2	When RSD detection is switched on, the CICAM shall download the RSD. To assure RSD detection, the RSD shall be present on the network at all times when RSD detection is switched on.
RS.3	The RSD shall be protected against replay, tampering and blocking.
RS.4	The CICAM shall verify the digital signature on the RSD with the public key in the Service Operator Certificate before it is used.
RS.5	The RSD transmission time-out shall be 60 minutes and the RSD shall cycle at least 4 times per transmission timeout. The timeout shall be persistent and shall not be reset due to a power-cycle or reset.
RS.6	The RSD shall identify the Service Operator.
RS.7	The RSD shall identify the services that require CI Plus protection.
RS.8	The RSD shall identify the correct CI Plus Data Carousel.
RS.9	The RSD shall indicate where the latest SOPKC file is located in the CI Plus Data Carousel.
RS.10	The RSD shall indicate where the latest SOCWL file is located in the CI Plus Data Carousel.
RS.11	The RSD shall indicate where the latest SOCRL file is located in the CI Plus Data Carousel.
RS.12	The RSD shall indicate the transmission time-out for the SOCRL.
RS.13	The SOCRL and SOCWL shall be protected against replay, tampering and blocking.
Note:	requirements RS.7 to RS.13 are defined in the context of the Service Operator as indicated by RS.6.

The RSD shall be transmitted to the CICAM in a secure way such that it shall be protected against replay, tampering and blocking. This may be achieved by transmitting the RSD directly under the control of the CA system. Alternatively, the RSD may be delivered on a data carousel and the CA system shall minimally deliver the service_operator_identity, RSD version_number and RSD on/off state directly to the CICAM.

3.1.2 Data carousel signalling

The RSD, SOPKC, SOCRL and SOCWL may all be regarded as files. The CICAM shall download the SOPKC, SOCRL, SOCWL and optionally the RSD file, using the broadcast channel, where the files are repeatedly transmitted using a dedicated carousel: the CI Plus data carousel. The RSD is optional to carry in the data carousel and if it is transmitted via the CAS then it is not transmitted in the data carousel.

The CI Plus Data Carousel shall conform to the One-layer Data Carousel as specified in [2], Clause 10. The CI Plus Data Carousel shall contain at most four files per Service Operator: the RSD, SOPKC, SOCRL and SOCWL.

The CI Plus Data Carousel is located by parsing the PMT table for the 'data_broadcast_id_descriptor' and optionally the SDT or EIT tables for the 'data_broadcast_descriptor' with a 'data_broadcast_id' value of 0x0122 ([2], Clause

10.3.1). Each file in the CI Plus Data Carousel is identified by a combination of a ‘module_id’ and a ‘moduleVersion’ field. Both are part of the ‘moduleInfo’ list of the DownloadInfoIndication (DII) message ([2], Clause 10.1.3). The advised maximum ‘moduleSize’ is 500Kbytes. The CI Plus Data Carousel is broadcast on a single PID.

The CICAM receives the RSD (or information about the RSD when the RSD is delivered on the CI Plus Data Carousel) from the CA System which contains data that is required to locate the correct files in the CI Plus Data Carousel. To achieve correct and uniform end-to-end behaviour a minimal set of RSD is defined:

- ‘transaction_id’ field (specified in [2], Clause 10.3.1)
- ‘moduleInfo’ list (specified in [3], Clause 5.5.2.1.1)

The CICAM shall use the ‘data_broadcast_id_descriptor’ to locate the CI Plus Data carousel and shall use the ‘transaction_id’ field to determine versioning. The correct version of the CI Plus Data Carousel shall be determined by comparing the ‘transaction_id’ in the RSD with the ‘transaction_id’ stored by the CICAM as a result of a previous file download. Where the ‘transaction_ids’ are not equal an updated CI Plus Data Carousel is available.

When the CICAM establishes that there is revocation data to download it shall use the ‘moduleInfo’ list to determine which files are updated and available for download. The CICAM shall compare the ‘moduleInfo’ list in the RSD with the ‘moduleInfo’ list stored by the CICAM as a result of a previous file download. If for a certain ‘module_id’ the ‘moduleVersion’ fields are not equal then the file identified by ‘module_id’ must be downloaded. The ‘moduleID’ field is specified according to Table 3-2. The ‘moduleVersion’ fields are equal to the version numbers contained in the SOPKC, SOCRL and SOCWL files, which are authentic because of the digital signature.

Table 3-2: Module ID

module_id	File
1	SOPKC
2	SOCRL
3	reserved
4	SOCWL
5	RSD

A virgin CICAM has no history and therefore cannot use the SOPKC to validate the RSD that is received from the CA system. In this situation it is permitted to use the RSD to obtain the SOPKC directly. After reception of the SOPKC the CICAM shall first verify the SOPKC using the root certificate and thereafter shall use the SOPKC to validate the RSD. If the RSD and SOPKC are valid then the CICAM shall download the remaining files that are indicated by the ‘moduleInfo’ list irrespective of the ‘moduleVersion’. After a successful download of the SOCRL or SOCWL files, the authenticity of the data shall be tested by verifying the digital signatures using the RSA public key from the SOPKC.

Digital signatures shall comply with RSASSA-PSS as specified in [1], Annex I.

As a last step, the ‘moduleVersions’ as found in the RSD, shall be verified against the version numbers contained in the downloaded files. The version numbers that are contained in the files are authentic because they are protected by the digital signature and provide protection against replay.

If a file’s signature cannot be verified, it is discarded. A transmission time-out shall not be reset in this case. If a transmission time-out for a file expires, the CICAM becomes limited operational, it does not remove CA scrambling of CI Plus protected services.

Where the RSD file is delivered in the CI Plus data carousel then the RSD shall first be checked for validity using the service_operator_identity and RSD version_number delivered using the CA. If revocation is enabled (on) and the RSD files does not exactly match the RSD file information delivered by the CA system then the CICAM becomes limited operational.

3.1.2.1 Data broadcast descriptors

The data_broadcast_id_descriptor identifies the type of the data component and is placed in the component loop of the PSI PMT table. Its exact use and meaning is dependent upon the value of the data_broadcast_id field. The selector_bytes of the data_broadcast_id_descriptor and data_broadcast_descriptor shall be zero length for a CI Plus LLP data carousel.

There shall be at most one instance of the data_broadcast_id_descriptor with the CI Plus LLP registered value of data_broadcast_id [5] in the PMT. i.e. Only one elementary stream may carry the CI Plus Data Carousel.

data_broadcast_id = 0x0122 (CI Plus LLP)

3.1.3 File Formats

The file formats for the RSD, SOCRL, SOCWL and SOPKC are based on a Tag-Length-Value (TLV) structure indicating the file_tag and the file_len. The ROT shall supply these files to the Service or Network Operator for delivery on the Data Carousel.

The value of 'file_tag' field is specified according Table 3-3.

Table 3-3: file_tag values

file_tag value	file
0xDx	Reserved – compressed file format
0xE1	SOPKC
0xE2	SOCRL
0xE3	reserved
0xE4	SOCWL
0xE5	RSD

3.1.3.1 Compressed File Format

The use of the compressed file format is optional, when it is used, the compressed variants of the RSD, SOCRL, SOCWL and SOPKC are packaged in a generic wrapper that identifies the compression method as shown in Table 3-4.

Table 3-4: compressed_file Syntax

Syntax	No. of bits	Mnemonic
compressed_file() {		
compression_tag	16	uimsbf
compressed_data_len	24	uimsbf
uncompressed_data_len	24	uimsbf
compressed_data	N	bslbf
}		

compression_tag. The 8 most significant bits of the compression_tag identify the compression algorithm according to Table 3-5. The 8 least significant bits are copied from the file_tag associated with the compressed_data and identify the compressed file according Table 3-3.

Table 3-5: compression_tag most significant byte values

Value	Description
0xD0	zlib compression structure of RFC 1950 [6]
0xD1-0xD7	CI Plus LLP reserved for future use
0xD8-0xDF	User defined

compressed_data_len. The compressed_data_len field specifies the length of the compressed_data field in bytes.

uncompressed_data_len. The length in bytes of the compressed_data field once it has been decompressed using the compression method specified by the compression_tag.

compressed_data. This field contains either a compressed RSD_file, SOCRL_file, SOCWL_file or SOPKC_file. The number of bits N are calculated as follows $N = (\text{compressed_data_len} * 8)$.

3.1.4 RSD file format

The RSD file is defined in Table 3-6, this is provided for information only as the ROT creates this file.

Table 3-6: RSD_file Syntax

Syntax	No. of bits	Mnemonic
RSD_file() {		
file_tag	8	uimsbf
file_len	24	uimsbf
version_number	16	uimsbf
valid_until_timestamp	32	bslbf
service_operator_identity	64	bslbf
encryption_method_identity	8	bslbf
transaction_id	32	uimsbf
reserved_for_future_use	8	bslbf
number_of_file_entries	8	uimsbf
for (i = 0; i < N; i++) {		
module_id	16	bslbf
module_version	8	bslbf
transmission_timeout	24	uimsbf
reserved_for_future_use	8	bslbf
}		
number_of_service_entries	16	uimsbf
for (i = 0; i < N; i++) {		
service_id	16	bslbf
}		
RSD_file_signature	2048	bslbf
}		

file_tag. The file_tag field is specified as 0xE5.

file_len. The file_len field specifies the length of the RSD_file starting from the version_number, excluding the file_tag and file_len fields. The size of the RSD is expressed in bytes and shall not exceed the maximum file length of 2 Kbytes.

version_number. The version_number field specifies the version number of the RSD. The RSD version_number must strictly increase. The RSD version_number is also used to prevent replay of previous RSDs by comparing it with the latest RSD version number that was detected by the CICAM (see section 5.5 of [1]).

valid_until_timestamp. The valid_until_timestamp field represents a point in time after which the RSD_file is considered as invalid. The valid_until_timestamp field consists of 16-bits giving the 16 LSB of the Modified Julian Date (MJD) and 4 digits in 4-bit Binary Coded Decimal (BCD).

Example: 1993/10/13 12:45 is coded as "0xC0791245".

The valid_until_timestamp shall be set such that expiration occurs before the version_number wraps, there are 2^{15} different versions. A reasonable validity period might be 2 years.

service_operator_identity. The service_operator_identity field identifies the Service Operator Certificate of the Service Operator that has signed the RSD. The service_operator_identity is issued by the Root-of-Trust on request of a Service Operator. The service_operator_identity appears in the CN of the Service Operator certificates' subject field (see section 9.3.6 of [1]). When the CICAM verifies the integrity of the RSD file, it shall ensure that the service_operator_identity in the RSD file matches the CN in the Service Operator Certificate.

encryption_method_identity. The encryption_method_identity field is used to identify the encryption method used for the fields transaction_id, module_info, module_version and service_id. The encryption_method_identity '0x00' is mandatory for implementation.

Table 3-7: Encryption Method Identity

encryption_method_identity	Method
0x00	No encryption
0x01 – 0xFF	Reserved for future use
Note: when an encryption cipher is used the length of the encrypted fields shall be padded if required by a 1 (i.e. one) and then 0s (i.e. zeros).	

transaction_id. The transaction_id field specifies the correct CI Plus data carousel as specified by the data broadcast descriptor.

number_of_file_entries. This 8-bit field specifies the number of file entries that appear in the loop following this field. Each entry corresponds to a single file that appears in the data carousel, represented by a module_id. The loop shall minimally include a SOPKC and SOCRL file. The loop may optionally include a SOCWL file.

module_id. The module_id field is used to identify the correct file for download. Refer to section 3.1.2 for details.

module_version. The module_version field is used to identify the correct version of a file for download. Refer to section 3.1.2 for details.

transmission_timeout. The transmission_timeout field is used to specify the transmission timeout for the file. This transmission_timeout is specified as the RSD transmission timeout (i.e. RS.5) divided by at least 4. The time is expressed in milliseconds. The transmission_timeout is not applicable for the SOCWL file, it shall be set to 0xffff and ignored.

number_of_service_entries. The number_of_service_entries field specifies the number of services that are protected by CI Plus. Each entry corresponds to a single service represented by the program number. If the number of service entries is zero (0) then none of the CA services of the service operator are CI Plus protected.

service_id. The service_id field identifies a service that is to be protected with CI Plus. This is a 16-bit field which serves as a label to identify this service from any other service. The service_id is the same as the program_number in the corresponding PMT (or SDT or EIT), as specified in [4]. A service_id value of 0x0000 may be used to indicate that all CA services of a transport stream are CI Plus protected. A service_id value of 0xffff may be used to indicate that the CI Plus protection is determined using a CA system specific method (e.g. EMI).

When a service_id value of 0x0000 or 0xffff is used then this shall be the only service entry present in the loop and the number_of_service_entries field shall be specified as 1.

The service entries contained within the RSD_file may be locally scoped (on a per transport stream basis) or globally scoped (on a per network basis). The service_id implicitly inherits the original network identity and transport stream identity of the current transport stream in which it is contained and service_ids may exist in the service loop that are not included in the current transport stream. For a global network configuration then it is the service operators responsibility to ensure that service_ids are unique across the network such that any DVB CI service is not incorrectly enforced as CI Plus.

RSD_file_signature. The RSD_file_signature field is calculated over all preceding fields. It protects the file's integrity and provides single source authenticity with respect to its creator, the Service Operator. The signature is created according to the method indicated by signature_method_identity and uses the Service Operator Private Key (SOQ) to calculate the signature and Service Operator Public Key (SOP) to verify the signature

If revocation is activated by the CA System then RSD data shall be present in each MPEG-2 Transport Stream that carries services designated as CI Plus controlled content.

3.1.5 Additional requirements

The RSD detection is by default disabled in the CICAM. Switching the RSD detection on or off is performed via a protected CA message. There are many existing mechanisms to deliver such a message securely to the CICAM; examples are per EMM, decoder data EMM, private data, ECM, or something else. A representative Simulcrypt system is shown in Annex A.

The exact message format is out of scope. Such a message shall be confidential and authentic and shall be preserved against replay.

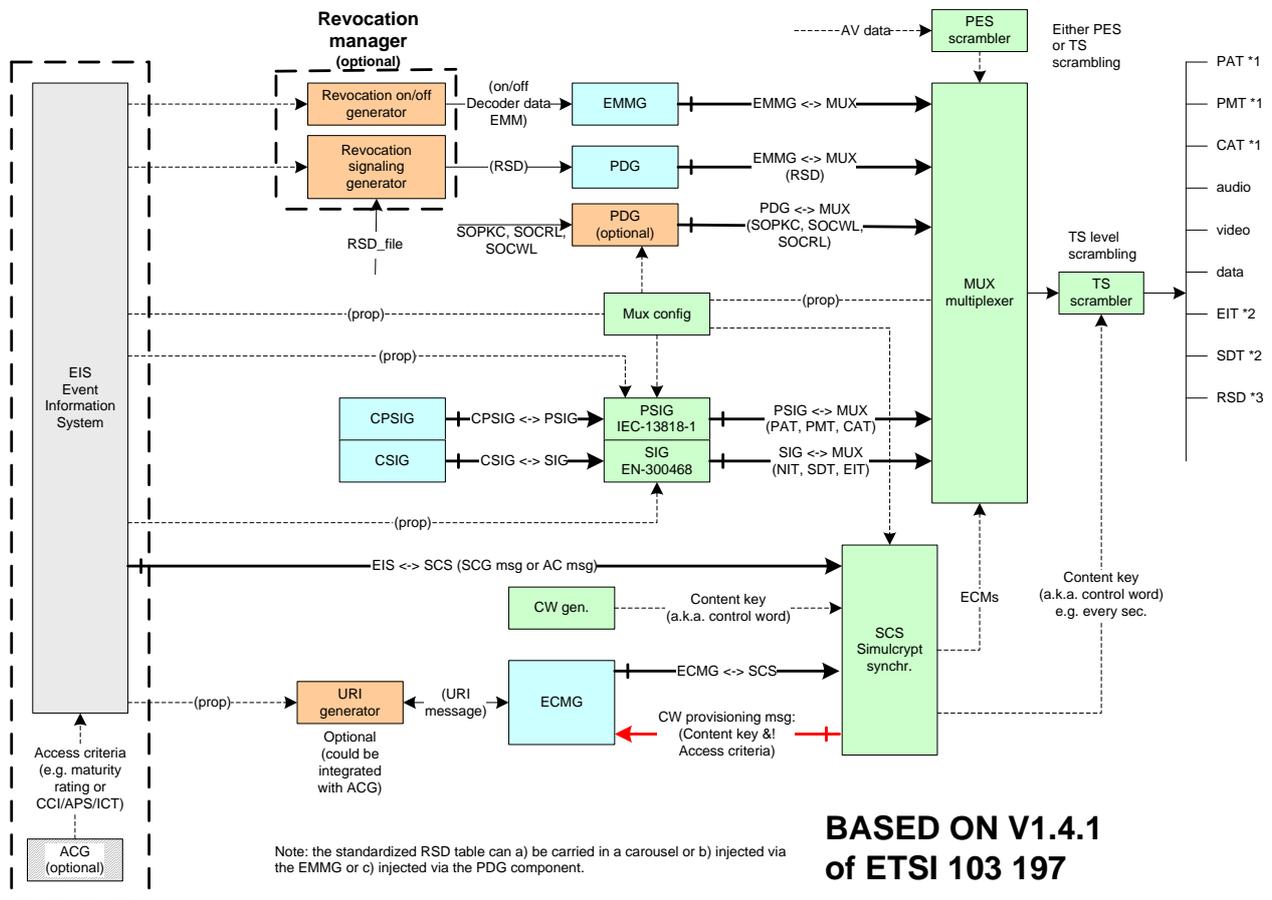
The CICAM shall preserve the RSD detection state over resets and reboots.

3.2 Requirements for Host shunning

The CI Plus specification [1] defines the CI Plus LLP private descriptor 'ci_protection_descriptor' which is specified using the 'private_data_specifier_descriptor' [4], in section 10.1.1 for the host shunning function but does not define a 'private_data_specifier' value. A registered private data specifier value [5] is used and the value is defined as follows:

private_data_specifier = 0x00000040 (CI Plus LLP)

Annex A- RSD signalling in Simulcrypt (informative)



- (*1) PSI - Program Specific Information acc. IEC-13818-1, i.e. PAT, PMT, CAT.
- (*2) SI - Service Information acc. EN-300468, i.e. SDT, EIT.
- (*3) PD - Private Data acc. to this CI specification, i.e. RSD.

- Key:
- ACG - Access Criteria Generator
 - CPSIG - Custom Program Specific Information Generator
 - CSIG - Custom Service Information Generator
 - ECMG - Entitlement Control Message Generator
 - EIS - Event Information System
 - EMMG - Entitlement Management Message Generator
 - PDG - Private Data Generator
 - PSIG - Program Specific Information Generator (acc. EN-300468)
 - MUX - Multiplexer
 - SCS - Simulcrypt Synchronizer
 - SIG - Service Information Generator (acc IEC-13818-1)

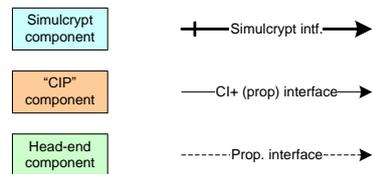


Figure A-1: Example RSD integration in an Simulcrypt environment