symbian

Symbian OS v9.X SIS File Format Specification

Version 1.1
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Contents

1 Introduction

1.1 Purpose and Scope

This document describes the newly restructured and redesigned SIS file format, which is introduced to complement the Symbian OS v9.1 release of Software Install. SIS files are used as the primary means of packaging files for deployment to a device, and are interpreted accordingly by the native software installer. As well as simply containing files, the SIS file can contain conditional statements which influence the installation e.g. device specific installations, language-specific installations, and user-selectable optional components.

Symbian OS v9.1 delivers new security features to the device, so operations which were previously possible via software install may now no-longer be possible. In addition, the device-side native installer is now policing the installation to ensure that the package meets certain security criteria before installation can succeed.

2 SIS File Format

2.1 Overview

The information in the SIS file is split up into two separate parts. The first part is the meta-data, describing the files that need to be installed. The second part of the SIS file contains all the actual file data. This enables software installation to be split into two phases, a decision and an installation phase. During the decision phase, the SIS file is examined and security checks are carried out in order to verify the install. The installation phase is only carried out if the verification is successful and is the process of copying the files to the device.

2.1.1 Note on Reservation of SIS Field Values

Please note that Symbian reserves the right to extend the set of applicable values relating to defined SIS fields, for example, fields employing bit-indicators such as `TInstallFlags.`

The generation of unspecified values – outside the context of the supported MakeSIS and/or SignSIS tools is therefore likely to cause compatibility problems with later versions of Symbian OS. This may mean, therefore, that packages will fail to install.

2.2 Integrity

The SIS file format supports signatures and certificates to enable a package to be signed. These signatures are verified during installation, and can also be re-verified after the package is installed on the device.

In order to support the processing of the SIS file in two phases, only the meta-data of the SIS file is signed. The metadata contains hashes for each file in the package, in order to ensure the integrity of the file data, and therefore the integrity of the entire SIS file is protected by the signed meta-data. This means that during the installation phase software install can verify the hash against the one included in the signed meta-data for each file being installed, whilst using an untrusted component to perform any necessary decompression.

Separate checksums for each of the meta-data and the file data are present in the SIS file to enable corrupt SIS files to be detected at the beginning of the installation process. These checksums are *optional*.

2.3 Extensibility

Due to the effort and potential disruption involved in changing file formats, the SIS format is designed to be extensible, and uses a *type-length-value* (TLV) format. Since each `SISField` has a specified length, when parsing a SIS file the installer will ignore fields with unknown types.

2.4 Compression

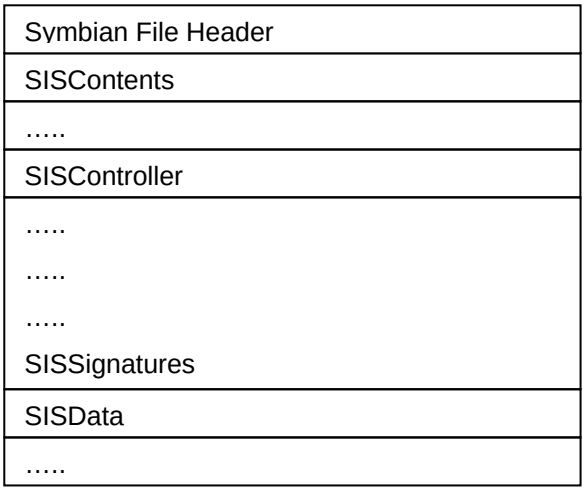
The new SIS file format supports the compression of each of the files in the SIS file individually, and the `SISController` can also be compressed. This reduces the extra space needed to carry out installation. Compression is supported by using a `SISCompressed SISField` which can contain another compressed `SISField` inside.

2.5 Nesting

In order to limit the amount of resource required to install a SIS file package, the installer will now only processes the nesting of SIS files down to a depth of 8. SIS files containing embedding to a greater depth than this will be rejected.

2.6 Supporting the re-signing of a SIS file

Since the SIS file format has no offsets which need to be changed it is easy to add a new signature and certificate chains to the end of the meta-data of the SIS file, even though they are in the middle of the file.



The `SISSignatures SISField` will be lengthened by the addition of additional signatures and certificate chains, and the SISFields following will be moved to a position further on in the file.

2.7 Programming Considerations

2.7.1 File Format

The SIS file format is designed so that each type of `SISField` is represented by one class. This makes it easy to construct a C++ class instance from a `SISField`. Since there are no offsets used in the file format it is possible to construct a C++ class with just the data from the `SISField`.

2.7.2 Memory usage

Since a SIS file may be large it is not possible to load everything into memory at once. Due to the structure of the file format, the meta-data information of each `SISField` can be read without reading all of the data in the contained `SISFields`.

2.8 Supporting the embedding of a SIS file

The SIS supports the embedding of one SIS file into another. MakeSIS is able to take an already generated SIS file and embed it into a SIS file that it is creating. The existing SIS file will be loaded, and the `SISController` decompressed if necessary and inserted into the Embedded SIS Files field of the `SISInstallBlock`. The `SISDataUnit` which contains the files needed for installation are added onto the end of the Data Units array of the `SISData SISField`. Since the `SISControllers` have a Data Index field, which indicates the index of the `SISDataUnit` which contains the files they need, MakeSIS must iterate through the added `SISControllers` and change these to the correct values.

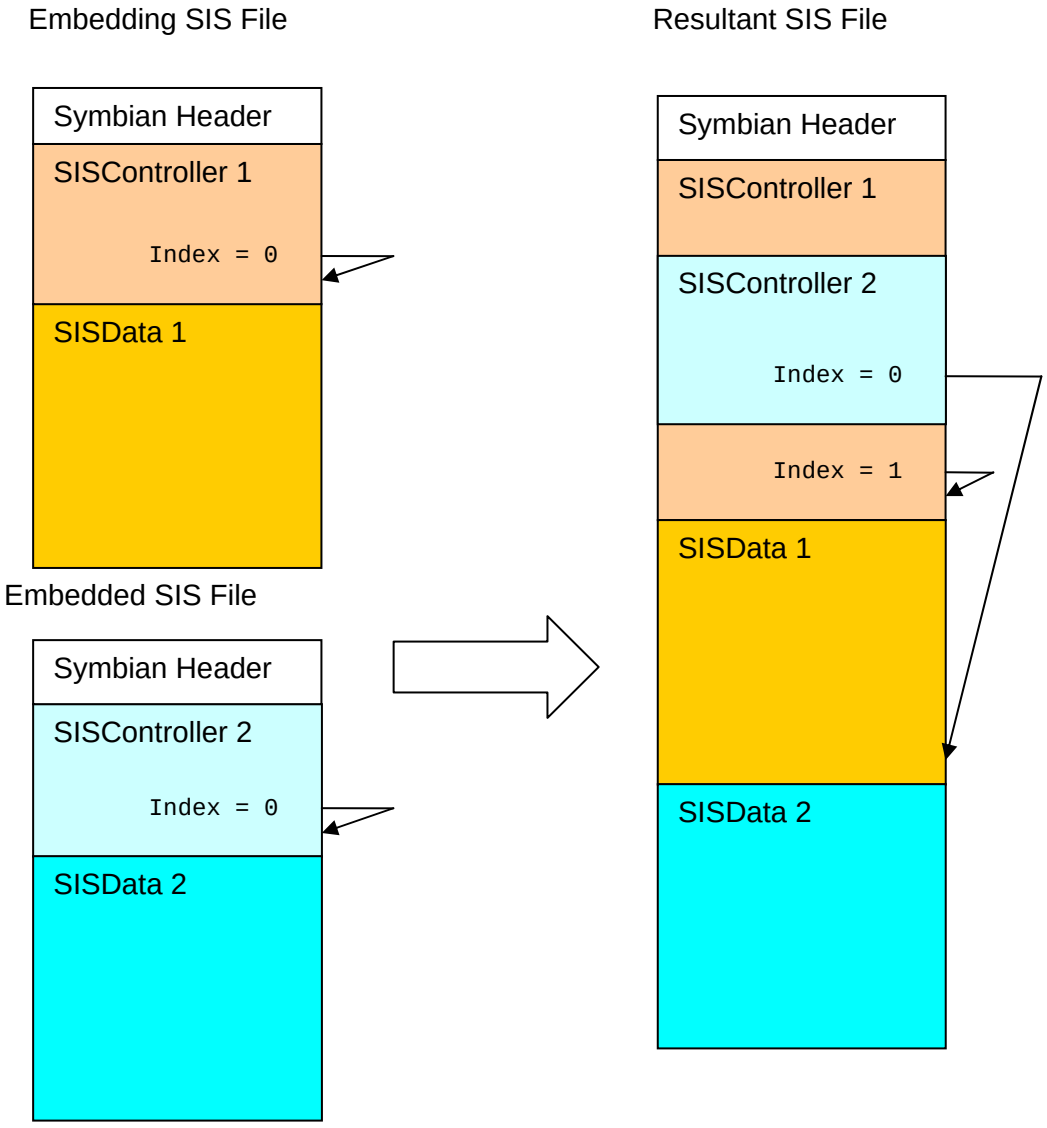


Figure 1 – Embedding a SIS file

In the resultant SIS file, to find the absolute index of the `SISFileData` in the `SISDataUnit`, the data indices of each of the chain of `SISControllers`, from the outermost `SISController` to the

SISController currently being considered, are summed. From *Figure 1 – Embedding a SIS file*, both of the SISControllers have a Data Index equal to zero. When calculating the index of the SISFileData in the SISDataUnit for Controller 2, the data indices of Controller 1 and Controller 2 are summed to get the absolute index of one.

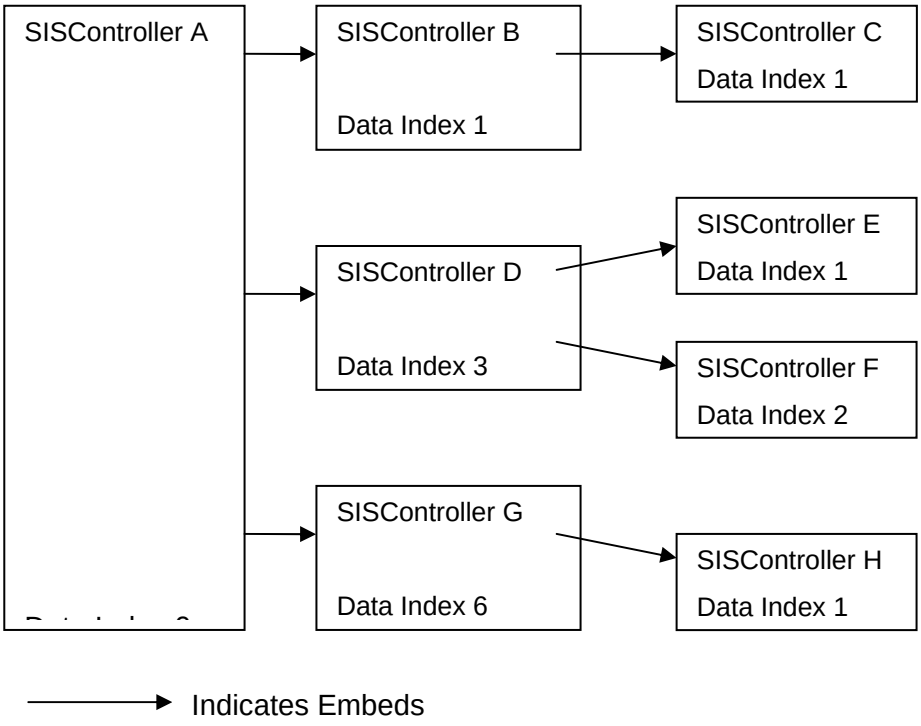


Figure 2 – Data indices with multiple embedded controllers

The following table indicates the absolute index of the SISDataUnit in SISFileData, for the corresponding controller in the previous diagram.

SISController	Absolute Index of SISDataUnit in SISFileData
A	A (0) = 0
B	A (0) + B (1) = 1
C	A (0) + B (1) + C (1) =2
D	A (0) + D (3) = 3
E	A (0) + D (3) + E (1) = 4
F	A (0) + D (3) + F (2) = 5
G	A (0) + G (6) = 6
H	A (0) + G (6) + H (1) = 7

2.9 Byte ordering

All meta-data are stored in little-endian format.

2.10 Text Character Set

The new SIS file format only supports Unicode UCS-2 encoded strings.

2.11 File Limitations

The number of levels of embedding of SIS controllers/files is limited to eight, as previously covered.

Various installation types have been removed. The supported types are now:

```
EInstInstallation       // standard type
EInstAugmentation       // removable addition to a package
EInstPartialUpgrade     // adds files to a package (patch) without any removals
EInstPreinstalledApp    // for use with pre-installed media
EInstPreInstalledPatch  // for use with pre-installed media
```

The unsupported types are `EInstSISSystem`, `EInstSISOption`, `EInstSISConfig`, `EInstSISPatch`, `EInstSISMIDlet` and `EInstSISMIDletSuite`.

2.12 SIS File Structure Overview

The SIS file format is composed of `SISFields` encoded using a type-length-value format. All `SISFields` are stored in this format, with the exception of any `SISField` which is stored inside a `SISArray`. This is since an array stores `SISFields` of the same type, it would be inefficient to store the type value for each entry in the array, and so only the Length and Values are stored.

Type	Length
Value	

2.12.1.1 Type

This field indicates the type of the `SISField`. Each type of `SISField` has a unique ID, details of which can be found in Appendix A.

The type field is 4 bytes in length.

2.12.1.2 Length

This is the length of the Value field only, and does not include the sizes of the other fields contained in the `SISField`.

The Length field is stored in either 4 or 8 bytes, depending on its value. This is because for some fields we need to support a 64 bit length but for most we don't, so storing the length in 64 bits for all fields would use unnecessary space. The Length is always represented by an unsigned value.

If Length is smaller than 2^{31} then the value is stored using 32 bits. If Length is greater than or equal to 2^{31} then the value is stored using 64 bits. The most significant bit is set to one, meaning the greatest possible Data Length which can be presented is $2^{63} – 1$.

To read in the value of Data Length we first read in the first 32 bits. If the most significant bit is zero, then the lower 31 bits represent the value of Length. If the most significant bit is one, then we read the next 32 bits, and construct the 63 bit data value from both parts.

2.12.1.3 Value

This field contains the data of the `SISField`. Its format depends on the Field ID.

2.12.1.4 Rationale

The reason for this format is that it makes it makes it very easy to construct a C++ class instance from a `SISField`. It is also possible to construct this instance by giving only the SISField data and no other part of the SIS file.

2.12.2 Alignment

The SIS file is padded with zero bytes (at the end of each `SISField`) where necessary so each `SISField` begins on a 32 bit word boundary. This is to enable efficient parsing of the format from memory, on processors which only allow 32-bit aligned access.

2.12.3 Notation

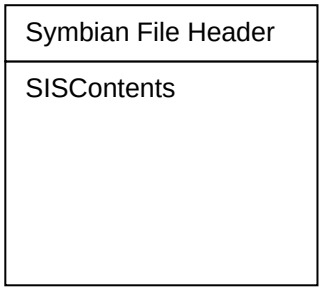
The following notation is used to describe the data-structures used by the SIS file format:

Structure Name		
Name of Field 1	Type of Field	Size of Field
…	…	…
Name of Field N	Type of Field	Size of Field

The Structure name is the name of the structure, which determines the ID stored in the type field. The length is determined by the length of all the fields specified. The fields 1 to N, specify the data which should appear in the value part of the structure.

3 SIS File Structure

All of the actual data of the SIS file is contained in the SISContents `SISField`. However Symbian OS uses a header, to associate files with applications. This header is a flat data structure consisting of three 32-bit UIDs and a 32-bit checksum.



3.1 File Header Structure

Field Name	Field Size
UID 1	4 Bytes
UID 2	4 Bytes
UID 3	4 Bytes
UID Checksum	4 Bytes

3.1.1 UID 1

This is the UID of the application associated with SIS files. This is always 0x10201A7A.

3.1.2 UID 2

This UID is reserved for possible future use.

3.1.3 UID 3

This package UID identifies the SIS file. This UID will uniquely identify the SIS file, except for the case of upgrades, where both SIS files will share the same UID3 This UID should be the same as the UID present in the `SISUid SISField` in the top level `SISController`.

Note that this UID (UID3) is generally referred-to in other documentation as the package-UID, or pUID for short.

3.1.4 UID Checksum

This field provides a checksum of the UID structure in its entirety.

4 SIS Fields

4.1 General SISFields

4.1.1 SISString

This `SISField` contains a UCS-2 encoded Unicode string.

SISString		Length
String		

4.1.1.1 String

This field contains the Unicode UCS-2 encoded string. Its length in bytes is specified by the Length field, and since each character is encoded using 16 bits there will be half as many characters in the string, as specified by this length.

4.1.2 SISArray

The `SISArray SISField` holds an array of one `SISField` type. The type of the contained `SISFields` will be checked on creation from data, and addition of each new `SISField`. The notation `SISArray<SISString>` will be used to indicate an array of `SISStrings`. All of the `SISFields` in the array are stored without their type as an optimisation, so just the length and value parts of the TLV are stored.

SISArray		Length
SISField Type	TUint32	4 bytes
SISField 1	SISField	
…	…	
SISField N	SISField	

4.1.2.1 SISField Type

This field indicates the type of the `SISFields` in the array. All of the fields are of the same type and this will be checked on creation of the `SISField` from data, and addition of each new `SISField`.

4.1.2.2 SISFields

This is a sequence of `SISFields`, whose type is equal to the value of the `SISField` type field. The `SISField` is only partially stored, the type being left out, as an optimisation since it can be determined from the SISField Type field of the `SISArray`. The number of fields can be determined by reading in all the fields until we have read all the data specified by the Length of the `SISArray` `SISField`.

4.1.2.3 Rationale

In several places in the SIS file format an array of `SISFields` is needed, so in order to reduce code duplication a `SISArray` type is provided.

4.1.3 SISCompressed

This `SISField` is a wrapper around raw data, where the wrapped data can be optionally compressed. This data can be a `SISField` which allows easy integration of compression into the SIS file format. The notation `SISCompressed<SISString>` will be used to indicate a compressed `SISString`, and `SISCompressed<Raw Data>` for compressed raw data.

SISCompressed		Length
Compression Algorithm	TUint32	4 bytes
Uncompressed Data Size	TUint64	8 bytes
Compressed Data		

4.1.3.1 Compression Algorithm

This field contains the algorithm used to compress the data for this file.

```
enum TCompressionAlgorithm
{
      ECompressNone = 0,      //The data is uncompressed
      ECompressDeflate        //The data is compressed according to RFC 1951
};
```

4.1.3.2 Uncompressed Data Size

This field contains the size of the data, when it is uncompressed.

4.1.3.3 Compressed Data

This field contains the raw compressed data.

4.1.4 SISVersion

This `SISField` provides a data structure for the storage of a version number, with major, minor and build components.

SISVersion		Length
Major	TInt32	4 bytes
Minor	TInt32	4 bytes
Build	TInt32	4 bytes

Only positive values or zero can be used to indicate a specific version. However, where applicable, the Major, Minor, or Build components of the `SISVersion` can be set to –1 in order to indicate any version.

4.1.5 SISVersionRange

This `SISField` specifies a range of versions. It is used to indicate which versions can satisfy a certain dependency. If the range is only a specific version then both the 'From Version' and 'To Version' fields should be set to the same specific value. If the upgrade is applicable to any version then both the 'From version' and the 'To Version' should have the Major, Minor and Build components set to –1. The 'To Version' field may be omitted, meaning the version range applies to the 'From Version' and all subsequent versions.

SISVersionRange		Length
From Version	SISVersion	
To Version	SISVersion	

4.1.5.1 Version Checking

When checking a dependency, we check the installed version of the package against the 'From Version' and the 'To Version' separately.

To check the 'From Version' we first check that the major version, of the package being installed, against the major version of the installed version. If the installed major version is less then this dependency check fails. If the installed major version is greater than this dependency check passes. If they are equal then we check the minor version in the same way. If all the components of the versions are equal then the dependency check passes. In this way we carry out a lexicographical compare of the versions. The value of -1 in any of the major, minor or build versions is treated as a special case. If we reach a compare with a field where the 'From Version' is -1, then the whole of the from part of the dependency check passes.

The 'To Version' is checked in a similar way.

Examples:

	Major	Minor	Build
From Version	3	-1	-1
To version	4	5	-1
This will upgrade any version from 3.x.x to 4.5.x where x is any value			

	Major	Minor	Build
From Version	1	3	4
To version	1	3	5
This will upgrade either 1.3.4 or 1.3.5			

4.1.6 SISDate

This `SISField` contains a date. The date is stored according to the Gregorian calendar, with the year part being stored in full, and must be a valid date.

SISDate		Length
Year	TUint16	2 bytes

Month	TUint8	1 byte
Day	TUint8	1 byte

4.1.6.1 Year

The year is stored as an absolute number, i.e. the year 2004 is represented by storing 2004 in this field.

4.1.6.2 Month

Months are stored using 0 for January up to 11 for December.

4.1.6.3 Day

Days are stored beginning from one.

4.1.7 SISTime

This `SISField` contains a time. The time must be expressed in UTC, and be a valid time.

SISTime		Length
Hours	TUint8	1 byte
Minutes	TUint8	1 byte
Seconds	TUint8	1 byte

4.1.8 SISDateTime

This `SISField` contains both date and time `SISFields`.

SISDateTime		Length
Date	SISDate	
Time	SISTime	

4.1.9 SISUid

This `SISField` contains the UID of the SIS file.

SISUid		Length
UID 1	TInt32	4 bytes

4.1.10 SISLanguage

This `SISField` identifies a language.

SISLanguage		Length
Language	TUint32	4 bytes

4.1.10.1 Language

The value of this field corresponds to the `TLanguage` enumeration, but is stored as a TUint32 in the SIS file.

4.1.11 SISBlob

This `SISField` encapsulates some raw data which is interpreted depending on the context.

SISBlob		Length
Data		

4.1.11.1 Data

This field contains the data. Its length is determined by the Length of the `SISField`.

4.1.12 SISDataIndex

This `SISField` is used as a relative index into the array of Data Units field of the `SISData SISField`. To get the absolute index of the `SISDataUnit` in the `SISFileData SISField`, all the data indices from the outermost embedding `SISController` down to the `SISController` currently being considered are summed. See *Supporting the embedding of a SIS file* for more information.

SISDataIndex		Length
Data Index	TUint32	4 bytes

4.1.12.1 Data Index

This `field` is used to find the index into the array of Data Units field of the `SISData SISField`. There is one `SISDataUnit` for each `SISController`.

4.2 SIS File Meta-data SISFields

4.2.1 SISContents

This `SISField` contains the whole of the contents of the SIS file. The contents are split up into the `SISController`, which contains the meta-data, and the `SISData`, which contains the actual file data.

SISContents		Length
Controller Checksum	SISControllerChecksum	
Data Checksum	SISDataChecksum	
Controller	SISCompressed <SISController>	
Data	SISData	

4.2.1.1 Controller Checksum

The checksum is a CRC-16 checksum over the contents of the Controller field. The checksum is over the whole of the SISCompressed<SISController>, so if the SISController is compressed, it does not have to be decompressed to verify this checksum. This enables the checking of the integrity of the controller without checking the whole file. This field is optional, and may not be present.

4.2.1.2 Data Checksum

The checksum is a CRC-16 checksum over the contents of the Data field. This enables the checking of the integrity of the data without checking the whole file. This field is optional, and may not be present.

4.2.1.3 Controller

The controller contains all the meta-data for the SIS file.

4.2.1.4 Data

The data field contains the actual files in the SIS file. These are processed differently depending on the meta-data present in the controller field.

4.2.2 SISControllerChecksum

This `SISField` contains the checksum for the possibly compressed `SISController`.

SISControllerChecksum		Length
Checksum	TUint16	

4.2.2.1 Checksum

This field contains the CRC-16 checksum, which is calculated over the whole of the `SISCompressed<SISController>` `SISField`.

4.2.3 SISDataChecksum

This `SISField` contains the checksum for the `SISData` section of the SIS File.

SISDataChecksum		Length
Checksum	TUint16	

4.2.3.1 Checksum

This field contains the CRC-16 checksum, which is calculated over the whole of the `SISData` `SISField`.

4.2.4 SISController

This `SISField` contains the meta-data for the SIS file.

SISController		Length
Info	SISInfo	
Options	SISSupportedOptions	
Languages	SISSupportedLanguages	
Prerequisites	SISPrerequisites	
Properties	SISProperties	
Logo	SISLogo	
Install Block	SISInstallBlock	
Signature 0..N 0	SISSignatureCertificateChain	
Signature 0..N …	SISSignatureCertificateChain	
Signature 0..N N	SISSignatureCertificateChain	
Data Index	SISDataIndex	

4.2.4.1 Info

This field contains information about the SIS file.

4.2.4.2 Options

This field contains the options that the user is asked to choose from when installing the file. These options are used to determine which files to install.

4.2.4.3 Languages

This field contains the languages supported by the SIS file.

4.2.4.4 Prerequisites

This field contains the prerequisites needed in order to install the SIS file.

4.2.4.5 Properties

This field contains properties, which are key, value pairs of integers.

4.2.4.6 Logo

This field is optional, and if present contains a logo which will be displayed at the start of installation.

4.2.4.7 Signature 0..N

These `SISFields` contain signatures, which sign the data contained in the SISController, excluding the Data Index SISField. Each `SISSignatureCertificateChain` signs the data from the beginning of the `SISInfo SISField` in the `SISController` to the end of the `SISField` immediately preceding the `SISSignatureCertificateChain SISField`. Thus, each signature signs all the previous signatures as well as the SISController data.

There may be any number of `SISSignatureCertificateChain SISFields`, including zero, meaning the SISController is unsigned.

4.2.4.8 Data Index

This `SISField` is an index into the array of Data Units field of the `SISData SISField`. There is one `SISDataUnit` for each `SISController`.

4.2.5 SISInfo

This `SISField` contains information about the SIS file.

SISInfo		Length
UID	SISUid	
Vendor Unique Name	SISString	
Names	SISArray<SISString>	
Vendor Names	SISArray<SISString>	
Version	SISVersion	
Creation Time	SISDateTime	
Install Type	TUint8	1 byte
Install Flags	TUint8	1 byte

4.2.5.1 UID

This field contains the UID of the SIS file. The UID should be unique to a SIS file packaging a certain application, but there may be multiple different versions of this package, with the same UID.

4.2.5.2 Vendor ID

This field contains the ID of the vendor which created the package.

4.2.5.3 Vendor Unique Name

This field contains a non-localised vendor name. It is used to check whether a package is a valid upgrade, during installation.

4.2.5.4 Names

This field contains an array of names of the SIS file. There must be exactly one name for each of the languages supported, and each name is matched to the corresponding language identified in the `SISSupportedLanguages` field of the `SISController`, at the same position in that array.

4.2.5.5 Vendor Names

This field contains an array of names of the SIS file vendor. There must be exactly one name for each of the languages supported, and each name is matched to the corresponding language identified in the `SISSupportedLanguages` field of the `SISController`, at the same position in that array.

4.2.5.6 Version

This field contains the version of the SIS file.

4.2.5.7 Creation Time

This field contains the creation time and date of the SIS file. However, this is not a secure timestamp and can easily be altered by the user changing their PC clock before creating the SIS file.

4.2.5.8 Install Type

This field contains the type of installation of the SIS file. Depending on the value, Software Install will install the package using different behaviours. The value is stored as a TUint8 but corresponds to the following enumeration:

```
enum TInstallType
      {
      EInstInstallation,
      EInstAugmentation,
      EInstPartialUpgrade,
      EInstPreInstalledApp,
      EInstPreInstalledPatch
      };
```

4.2.5.8.1 EInstApplication [SA]

The SIS file contains an application that can be installed on the device. Once it has been installed, it appears in the list of installed SIS files so that the user can remove it.

If the user wants to install a SIS Installation File that has the same UID and type `EInstApplication` on a device where there is already a SIS file installed with that UID and type `EInstApplication` then this is considered as an upgrade. The current version will be removed from the device and the new one will be installed.

4.2.5.8.2 EInstAugmentation [SP]

The SIS file contains an augmentation of an existing package. These files can be removed at a later date, separately from the augmented application. This allows, for example, game levels which augment an already installed application.

4.2.5.8.3 EInstPartialUpgrade [PU]

The SIS file contains a partial upgrade to an application. A partial upgrade to an application differs from a normal application upgrade, in that the original package is not removed from the device, before the files which are contained in the upgrade are installed. This allows, for example, a very small upgrade SIS to replace just the parts of a package which require replacement, and not require re-delivery of the whole package again.

4.2.5.8.4 EInstPreInstalledApp [PA]

This is a special indicator for use with applications which are pre-installed, in-place, on media cards.

4.2.5.8.5 EInstPreInstalledPatch [PP]

This is a special indicator for use with applications which are pre-installed, and augment another application on the device (e.g. provide extra game levels).

4.2.5.9 Install Flags

This field contains flags which affect the installation. The value is stored as a TUint8 but corresponds to the following enumeration:

```
enum TInstallFlags
   {
   EInstFlagShutdownApps = 1  // Shutdown all applications before uninstalling files
   }
```

4.2.6 SISSupportedLanguages

This `SISField` contains an array of languages that the SIS file supports.

SISSupportedLanguages		Length
Languages	SISArray<SISLanguage>	

4.2.7 SISSupportedOptions

This `SISField` contains options that the SIS file supports. The user is asked to select from these options during install.

SISSupportedOptions		Length
Options	SISArray <SISSupportedOption>	

4.2.7.1 Options

This field is an array of options supported by the SIS file. There is one entry in the array for each option supported by the SIS file, and its size may be zero or greater.

4.2.8 SISSupportedOption

This `SISField` contains names for a supported option of the SIS file. There is a name in the array for each supported language in the SIS file, in the same order as specified in the `SISSupportedLanguages SISField`.

SISSupportedOption		Length
Names	SISArray<SISString>	

4.2.9 SISPrerequisites

This `SISField` indicates the prerequisites that have to be met before Software Install will install the SIS file. The supported types of prerequisites are:

SIS packages already installed on the device, and their version.

The device must be one of a list of devices, identified by SIS files pre-installed on the device.

SISPrerequisites		Length
Target Devices	SISArray <SISDependency>	
Dependencies	SISArray <SISDependency>	

4.2.9.1 Target Devices

This field is an array of `SISDependency SISFields` indicating on which devices this SIS file can be installed. Each device has a SIS file pre-installed, specific to that device. If the Target Devices `SISArray` contains any `SISDependencies` then at least one of these dependencies must be present in order to install the SIS file on the device. If the Target Devices `SISArray` has no entries then the SIS file can be installed on any type of device.

4.2.9.2 Dependencies

This field is an array of `SISDependencies` indicating which SIS packages need to be installed in order for this one to be installable. There maybe zero or more dependencies. For installation to continue, all the SIS files present in this `SISArray` must exist on the device.

4.2.10 SISDependency

This `SISField` specifies a SIS package that must be installed on the device.

SISDependency		Length
UID	SISUid	
Version Range	SISVersionRange	
Dependency Names	SISArray<SISString>	

4.2.10.1 UID

This field indicates the UID of the SIS package which needs to be installed on the device, in order to satisfy this dependency.

4.2.10.2 Version Range

This field indicates the range of versions of the SIS package that needs to be installed on the device. This SISField is optional; if it is not present then any version of the SIS package installed on the device will meet this dependency.

4.2.10.3 Dependency Names

This array contains the list of names of the dependency in each of the languages supported by the SIS file. There must be exactly one `SISString` per language supported by the SIS file.

4.2.11 SISProperties

The `SISProperties` block contains properties for the SIS package. These used to be called capabilities in the old format, but have been renamed to avoid confusion with platform security capabilities.

SISProperties		Length
Properties	SISArray<SISProperty>	

4.2.12 SISProperty

This `SISField` contains a property, which is a key, value pair associated with a SIS package.

SISProperty		Length
Key	TInt32	4 bytes
Value	TInt32	4 bytes

4.2.13 SISLogo

This `SISField` possibly contains a logo that is displayed during the installation progress.

SISLogo		Length
Logo file	SISFileDescription	

4.2.13.1 Logo file

This field contains the `SISFileDescription` for a logo file which is displayed at the start of installation. The MIME type field of the `SISFileDescription` is used to determine what format the logo is in. If the target field of the `SISFileDescription` is not an empty string, then the logo is also installed on the device.

4.2.14 SISFileDescription

This `SISField` gives information about a file stored in the `SISData` section.

SISFileDescription		Length
Target	SISString	
MIME Type	SISString	
Capabilities	SISCapabilities	

Hash	SISHash	
Operation	TUint32	4 bytes
Operation Options	TUint32	4 bytes
Length	TUint64	8 bytes
Uncompressed Length	TUint64	8 bytes
File Index	TUint32	4 bytes

4.2.14.1 Target

This field is the location to install the file to. This is only used for the instructions that are actually going to copy the file somewhere on the device; it may be an empty string indicating the file will not be installed, for example when you want to run a file, or display it as a logo, without installing it on the device.

4.2.14.2 MIME Type

This field is the MIME type of the file described. This is used when running a file by MIME type and also when displaying an image file during install in order to choose the type of image decoder to use.

4.2.14.3 Capabilities

This is an optional `SISField`, and is only present if the file this `SISFileDescription` refers to is an executable file. The `SISCapabilities SISField` contains information about the capabilities the executable being described has been allocated.

4.2.14.4 Hash

This field contains the hash of the uncompressed file data.

4.2.14.5 Operation

This field is used to indicate how to process this file during installation.

```
enum TSISFileOperation
      {
      EOpInstall  = 1,  // Install File
      EOpRun      = 2,  // Run File
      EOpText     = 4,  // Display File as Text
      EOpNull     = 8   // File is not present but will be removed on uninstall
      };
```

4.2.14.6 Operation Options

This field indicates which options are applicable to the processing of this file during installation. The operation being carried out determines which options are valid.

4.2.14.6.1 Options valid for EOpInstall

```
enum TSISFileOperationOption
      {
      EInstVerifyOnRestore    = 1<<15     // Verify on Restore
      };
```

EInstVerifyOnRestore

This option is used for secure backup and restore, to indicate that this file is not written-to after install, and so its contents should remain identical as to when it was installed. This allows verification, by checking the hash, upon restoration of the file from a backup.

4.2.14.6.2 Options valid for EOpRun

```
enum TInstFileRunOption
      {
      EInstFileRunOptionInstall      = 1<<1,   // Run at installation
      EInstFileRunOptionUninstall    = 1<<2,   // Run at uninstallation
      EInstFileRunOptionByMimeType   = 1<<3,   // Run using MIME type
      EInstFileRunOptionWaitEnd      = 1<<4,   // Wait for end before continuing
      EInstFileRunOptionSendEnd      = 1<<5,   // Terminate after (un)install ends
      };
```

EInstFileRunOptionInstall

This option indicates that the file specified will be run at installation time. If the target field is valid, then this file is installed to that location, otherwise this file is not copied to the device.

EInstFileRunOptionUninstall

This option indicates that the file specified will be run at uninstallation time. The target field must be valid, as Software Install will copy this file to the device so that it can be run at the time when the package is uninstalled.

EInstFileRunOptionByMimeType

This option indicates that the file is to be run, either at installation or uninstallation time, by MIME type. If this option is not set then the file specified will be run as an executable.

EInstFileRunOptionWaitEnd

If this option is set Software Install waits until the application being run finishes before continuing. Software Install should implement a sensible timeout however otherwise a malicious or malformed application could run forever and prevent any other access to Software Install without rebooting the device.

If this option is not set Software Install does not wait for the application being run to finish before continuing.

This option must not be set if `EInstFileRunOptionSendEnd` is set.

EInstFileRunOptionSendEnd

If this option is set then Software Install terminates this application, if it is still running, after the installation has finished.

This option must not be set if `EInstFileRunOptionWaitEnd` is set.

4.2.14.6.3 Options valid for EOpText

```
enum TInstTextOption
      {
      EInstFileTextOptionContinue   = 1<<9,     // Continue button
      EInstFileTextOptionSkipIfNo   = 1<<10,    // Yes/No - skip next file if user
                                                // selects no
      EInstFileTextOptionAbortIfNo  = 1<<11,    // Yes/No - abort install if
                                                // user selects no
      EInstFileTextOptionExitIfNo   = 1<<12,    // Yes/No - uninstall if user
                                                // selects no
      };
```

EInstFileTextOptionContinue

This indicates that the installer should display the text, with a button to continue the install. After the dialog has been dismissed the installation will continue.

EInstFileTextOptionSkipIfNo

This indicates that the installer should display the text, with two buttons, one labelled yes and one labelled no. If the no button is pressed then the installer shall skip the file currently being processed, otherwise installation will continue as normal.

EInstFileTextOptionAbortIfNo

This indicates that the installer should display the text, with two buttons, one labelled yes and one labelled no. If the no button is pressed then the installer shall abort the installation, otherwise installation will continue as normal. The installer will display a dialog indicating that the installation has been aborted.

EInstFileTextOptionExitIfNo

This indicates that the installer should display the text, with two buttons, one labelled yes and one labelled no. If the no button is pressed then the installer shall abort the installation, otherwise installation will continue as normal. The only difference between this option and `EInstFileTextOptionAbortIfNo` is that the installer will not display a dialog indicating that the installation has been aborted.

4.2.14.7 Length

This field contains the length of the compressed file data the `SISFileDescription` is referring too in the SIS file itself.

4.2.14.8 Uncompressed Length

The length of the compressed file data the `SISFileDescription` is referring to, after it has been decompressed.

4.2.14.9 File Index

This is index of the `SISFileData SISField`, which contains the actual file data, in the Data Units field of the `SISDataUnit`.

4.2.15 SISCapabilities

This `SISField` represents the capabilities an executable within the SIS file has.

SISHash		Length
Capabilities		Variable length

4.2.15.1 Capabilities

This is a bit-field containing all the capabilities the executable has been allocated. The field has variable length, but the length will always be a multiple of 4 bytes. It will be the only field in this `SISField`, and thus will have a length equal to the length of the `SISField`, given in the header. The lowest order bit will indicate whether the executable has been allocated capability 0 in the `TCapability` enumeration, the second lowest bit, capability 1, and so on.

4.2.16 SISHash

This `SISField` represents a hash.

SISHash		Length
Hash Algorithm	TUint32	4 bytes
Hash Data	SISBlob	

4.2.16.1 Hash Algorithm

This field indicates the algorithm used to generate the hash. The following hash algorithms are currently supported:

```
enum TSISHashAlgorithm
{
      ESISHashAlgSHA1   = 1         // SHA-1 hash algorithm
}
```

4.2.16.2 Hash Data

This field contains the data of the hash contained in a `SISBlob SISField`. The length of this data depends upon the hashing algorithm used.

4.3 Signatures

The new SIS file format has been designed to support signing using multiple certificate chains. Multiple signatures are also supported for each chain, enabling different algorithms to be used for each of the signatures. Only one of these signatures needs to be validated for Software Install to consider the Certificate Chain as valid.

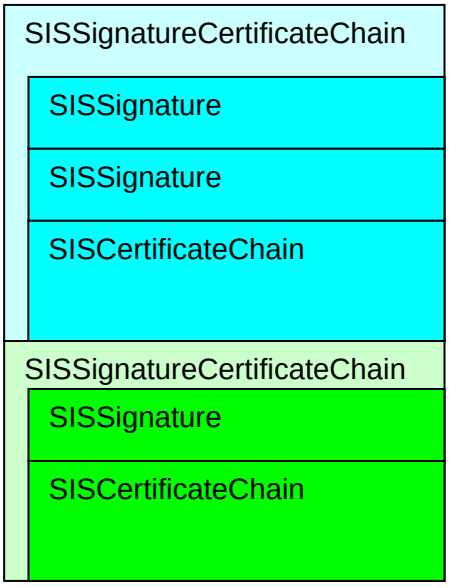


Figure 3 – Diagram of signature and certificate chain layout in SIS file

4.3.1 SISSignatureCertificateChain

This `SISField` contains the signatures used to sign the SIS file and the certificate chain needed to validate the signatures.

SISSignatureCertificateChain		Length
Signatures	SISArray<SISSignature>	
Certificate Chain	SISCertificateChain	

4.3.1.1 Signatures

This field contains an array of signatures.

4.3.1.2 Certificate Chain

This field contains the certificate chain needed to verify the signatures.

4.3.2 SISCertificateChain

This `SISField` contains the certificate data as an ASN.1 encoded X509 certificate chain.

SISCertificateChain		Length
Certificate Data	SISBlob	

4.3.2.1 Certificate Data

This field contains the certificate data as an ASN.1 encoded X509 certificate chain.

4.3.3 SISSignature

This `SISField` contains the signature and an identifier of the signing and hashing algorithms used to generate it.

SISSignature		Length
Signature Algorithm	SISSignatureAlgorithm	
Signature Data	SISBlob	

4.3.3.1 Signature Algorithm

This contains the algorithm used for signing, and the algorithm used for hashing the data, to enable the signature to be validated.

4.3.3.2 Signature Data

This field contains a `SISBlob SISField` containing the signature data.

4.3.4 SISSignatureAlgorithm

This SISField contains details about the signature and hash algorithms used to create a signature.

SISSignatureAlgorithm		Length
Algorithm Identifier	SISString	

4.3.4.1 Algorithm Identifier

This is a string delimited by '.' characters which represents the Object Identifier of the algorithms used. Currently supported algorithms are:

- “1.2.840.113549.1.1.5” - SHA-1 with RSA signature
- “1.2.840.10040.4.3” - SHA-1 with DSA signature

4.4 Expressions

The SIS file is generated from a textual package description. This description supports a simple format of deciding which files to install, at installation time, using if, then, and else constructs. This is encoded into the SIS package using the following `SISFields`.

4.4.1 SISIf

This `SISField` represents an if statement and condition in the package file used to generate the SIS file.

SISIf		Length
Expression	SISExpression	
Install Block	SISInstallBlock	
Else ifs	SISArray<SISElseIf>	

4.4.1.1 Expression

This field contains the expression which is evaluated during the processing of this `SISField` during install.

4.4.1.2 Install Block

This field contains the `SISInstallBlock` that is processed recursively if the expression evaluates to true.

4.4.1.3 Else ifs

If the expression evaluates to false then each of these `SISElseIf SISFields` are evaluated in sequence. If one of the expressions evaluates to true then the `SISInstallBlock` *belonging to the expression* is processed recursively and no further `SISElseIf` blocks in the array are checked. There may be zero or greater `SISElseIf SISFields` in this array.

MakeSIS can simulate an else statement in the package, by adding a `SISElseIf SISField`, with a condition which always evaluates to true.

4.4.2 SISElseIf

This `SISField` represents the ‘else if’ part of an ‘if’ statement in the package file.

SISElseIf		Length
Expression	SISExpression	
Install Block	SISInstallBlock	

4.4.2.1 Expression

This `SISExpression` is evaluated by Software Install while processing the `SISElseIf SISField`.

4.4.2.2 Install Block

If Expression evaluates to true then this `SISInstallBlock SISField` is processed recursively by Software install.

4.4.3 SISInstallBlock

This `SISField` contains a list of files in the package which need to be installed, a list of embedded SIS files, and a list of `SISIf` blocks inside this install block. Each of these arrays may have zero or more entries.

SISInstallBlock		Length
Files	SISArray<SISFileDescription>	
Embedded SIS Files	SISArray<SISController>	
If blocks	SISArray<SISIf>	

4.4.3.1 Files

This field contains a list of files, which need to be processed with the `SISInstallBlock`. The most common operation to perform will be to install these files, but depending on the options they may be displayed to the user or run, see `SISFileDescription` for more information. There may be zero or greater `SISFileDescription SISFields` in this array.

4.4.3.2 Embedded SIS Files

This field contains a list of embedded SIS files, which are represented by `SISControllers` stored in the meta-data of the SIS file and need to be processed with the `SISInstallBlock`. There may be zero or greater `SISController SISFields` in this array.

4.4.3.3 If blocks

This field contains a list of `SISIf` fields, which need to be processed with the `SISInstallBlock`. Software Install will check the condition of each of these `SISIf` blocks and if it is true, process that `SISIf` block recursively. There may be zero or greater `SISIf SISFields` in this array.

4.4.4 SISExpression

This `SISField` represents an expression. Expressions are broken down into parts, and the whole expression is represented as a tree of `SISExpression SISFields`.

SISExpression		Length
Operator	TUint32	4 bytes
Integer Value	TInt32	4 bytes
String Value	SISString	
Left Expression	SISExpression	
Right Expression	SISExpression	

4.4.4.1 Operator

The Operator field indicates what the operator is for this expression and thus determines which of the other fields are valid.

```
enum TOperator
      {
      // Binary Operators
      EBinOpEqual = 1,        // equal to
      EBinOpNotEqual,         // not equal to
      EBinOpGreaterThan,      // greater than
```

```
EBinOpLessThan,         // less than
EBinOpGreaterOrEqual,   // greater than or equal to
EBinOpLessOrEqual,      // less than or equal to

// Logical Operators
ELogOpAnd,              // logical AND
ELogOpOr,               // logical OR

// Unary Operators
EUnaryOpNot,            // NOT() - logical NOT

// Functions
EFuncExists,            // EXISTS() – Checks if the file exists
EFuncAppProperties,     // APPPROP() – Queries application properties
EFuncDevProperties,     // PACKAGE() – Queries for an installed package

// Primitives
EPrimTypeString,        // This expression holds a string value
EPrimTypeOption,        // This expression is an option, identified by integer
EPrimTypeVariable,      // This expression is a variable,identified by integer
EPrimTypeNumber         // This expression holds a number value
};
```

4.4.4.1.1 Function Descriptions

EXISTS(string1) (EFuncExists)

This function takes a string value, indicating a file name. During install if the file is present on the device then this function returns `ETrue`, otherwise it returns `EFalse`.

If the operator is `EFuncExists`, then this `SISExpression` will contain a `SISString SISField` containing the name of the file to check for at installation time.

APPPROP(expression1, expression2) (EFuncAppProperties)

This function queries properties for an installed SIS file. A property is a key, value pair. The first parameter is the UID of the installed SIS file, or the SIS file currently being installed. The second parameter is the key of the key, value pair. This function returns the value integer corresponding to the key or 0 if the key was not found, or if either of the expressions does not evaluate to an integer value. The keys must be unique in a particular SIS file so multiple values will never be found.

If the operator is `EFuncAppProperties`, then this `SISExpression` will contain Left, and Right `SISExpressions`. The Left field corresponds to the first parameter and the Right field gives the second parameter.

PACKAGE(expression1) (EFuncDevProperties)

This function queries for the existence of a package installed on the device. The integer parameter given is the pUID to search for. It returns ‘1’ if the package was found, and zero otherwise.

If the operator is `EFuncDevProperties`, then this the Left Expression will be present containing `SISExpression`.

4.4.4.1.2 Variables

The SIS file format supports the use of variables when creating expressions. Most of these variables correspond to device properties, which can be queried by using the `HAL::Get()` function on the device. The other variable which is supported is ‘Language’, which takes on the value of the language selected

by the user, at install time, and 'RemoteInstall'. For more information about these variables, see Appendix B. Variables are stored using an integer corresponding to the following enumeration:

```
enum TVariableIndex
  {
  // 0–0x1000 are reserved for HALData values, see Appendix B for the allowed values
  EVarLanguage = 0x1001,
  EVarRemoteInstall = 0x1002
  }
```

4.4.4.2 Integer Value

This part of the expression can contain an integer value. It will be valid if the type of the expression is `EPrimTypeNumber`, `EPrimTypeVariable`, or `EPrimTypeOption`.

4.4.4.3 String Value

This part of the expression can contain a string. This field is optional; it will be present only if the type of the expression is `EPrimTypeString`, or `EFuncExists`.

4.4.4.4 Left Expression

This is the left sub-part of the expression. This field is optional; it will be present when the operator of this `SISExpression` is any binary operators `EBinOpEqual`, `EBinOpNotEqual`, `EBinOpGreaterThan`, `EBinOpLessThan`, `EBinOpLessOrEqual`, `EBinOpGreaterOrEqual`, or the logical operators `ELogOpAnd` and `ELogOpOr`, or the function operators `EFuncAppProperties` and `EFuncDevProperties`.

4.4.4.5 Right Expression

This is the right sub-part of the expression. This field is optional; it will be present when the operator of this `SISExpression` is not any of the primitives `EPrimTypeString`, `EPrimTypeOption`, `EPrimTypeVariable`, or `EPrimTypeNumber`, or the function `EFuncExists`.

4.5 SIS File Data

This section of the SIS file contains the actual file data that is used during the install process. It consists of an array of data units, each of which contains the files from one `SISController`. There may be more than one data unit if there are embedded SIS files. Each `SISController` has a field containing the index into the Data Units array in the SISData `SISField`. This contains the files which are installed by that `SISController`. This makes it easy to add and remove embedded SIS files.

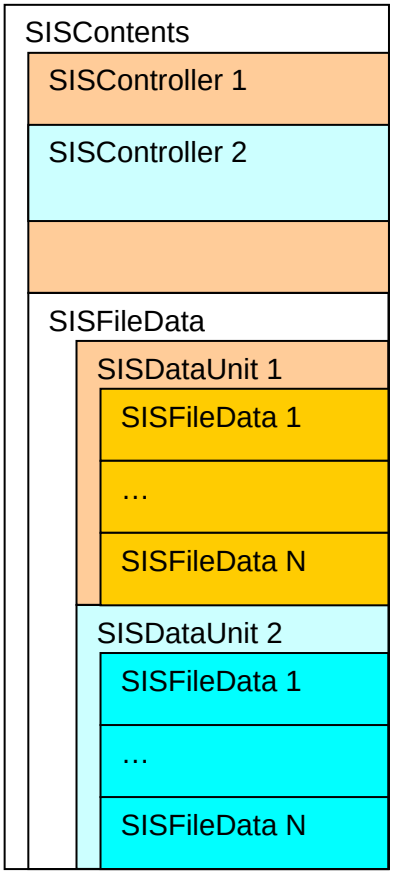


Figure 4 – Diagram of SIS file format with embedded SIS file

4.5.1 SISData

The `SISData SISField` contains all of the file data for a SIS file.

SISData		Length
Data Units	SISArray<SISDataUnit>	

4.5.1.1 Data Units

There is one data unit present for each `SISController` in the meta-data of the SIS file. There may be more than one `SISController`, and thus data unit, if there are embedded SIS files.

4.5.2 SISDataUnit

The `SISDataUnit` contains all the file data for a `SISController`.

SISDataUnit		Length
File Data	SISArray<SISFileData>	

4.5.2.1 File Data

This field is an array of possibly compressed `SISFileData SISFields`. There is an entry in this array for every file which it is possible for this `SISController` to install.

4.5.3 SISFileData

The `SISFileData SISField` contains the actual data for a file, which may be compressed.

SISFileData		Length
File Data	SISCompressed<Raw File Data>	

4.5.3.1 File Data

This field contains the possibly compressed file data. The raw file data is stored in the Compressed Data field of the `SISCompressed SISField`.

Appendix A - ESISFieldType Values

Invalid SISField	0
SISString	1
SISArray	2
SISCompressed	3
SISVersion	4
SISVersionRange	5
SISDate	6
SISTime	7
SISDateTime	8
SISUid	9
Unused	10
SISLanguage	11
SISContents	12
SISController	13
SISInfo	14
SISSupportedLanguages	15
SISSupportedOptions	16
SISPrerequisites	17
SISDependency	18
SISProperties	19
SISProperty	20
SISSignatures	21
SISCertificateChain	22
SISLogo	23
SISFileDescription	24
SISHash	25
SISIf	26
SISElseIf	27
SISInstallBlock	28
SISExpression	29
SISData	30
SISDataUnit	31
SISFileData	32
SISSupportedOption	33
SISControllerChecksum	34
SISDataChecksum	35
SISSignature	36
SISBlob	37
SISSignatureAlgorithm	38
SISSignatureCertificateChain	39
SISDataIndex	40
SISCapabilities	41

Appendix B - Variable Names

The SIS and package file formats allow complex expressions to be built up, which determine at install time, whether files are copied to the device. Software Install will assign values to these variables at installation time.

The following variables are provided, which can be used to get information about the device. Each of these corresponds to the value returned by `HALData::Get()` with different attributes.

Variable Name (Keyword specified in .pkg File)	Attribute used by HALData::Get (In C++)
Manufacturer	`HALData::EManufacturer`
ManufacturerHardwareRev	`HALData::EManufacturerHardwareRev`
ManufacturerSoftwareRev	`HALData::EManufacturerSoftwareRev`
ManufacturerSoftwareBuild	`HALData::EManufacturerSoftwareBuild`
Model	`HALData::EModel`
MachineUid	`HALData::EMachineUid`
DeviceFamily	`HALData::EDeviceFamily`
DeviceFamilyRev	`HALData::EDeviceFamilyRev`
CPU	`HALData::ECPU`
CPUArch	`HALData::ECPUArch`
CPUABI	`HALData::ECPUABI`
CPUSpeed	`HALData::ECPUSpeed`
SystemTickPeriod	`HALData::ESystemTickPeriod`
MemoryRAM	`HALData::EMemoryRAM`
MemoryRAMFree	`HALData::EMemoryRAMFree`
MemoryROM	`HALData::EMemoryROM`
MemoryPageSize	`HALData::EMemoryPageSize`
PowerBackup	`HALData::EPowerBackup`
Keyboard	`HALData::EKeyboard`
KeyboardDeviceKeys	`HALData::EKeyboardDeviceKeys`
KeyboardAppKeys	`HALData::EKeyboardAppKeys`
KeyboardClick	`HALData::EKeyboardClick`
KeyboardClickVolumeMax	`HALData::EKeyboardClickVolumeMax`
DisplayXPixels	`HALData::EDisplayXPixels`
DisplayYPixels	`HALData::EDisplayYPixels`
DisplayXTwips	`HALData::EDisplayXTwips`
DisplayYTwips	`HALData::EDisplayYTwips`
DisplayColors	`HALData::EDisplayColors`
DisplayContrastMax	`HALData::EDisplayContrastMax`

Backlight	`HALData::EBacklight`
Pen	`HALData::EPen`
PenX	`HALData::EPenX`
PenY	`HALData::EPenY`
PenDisplayOn	`HALData::EPenDisplayOn`
PenClick	`HALData::EPenClick`
PenClickVolumeMax	`HALData::EPenClickVolumeMax`
Mouse	`HALData::EMouse`
MouseX	`HALData::EMouseX`
MouseY	`HALData::EMouseY`
MouseButtons	`HALData::EMouseButtons`
CaseSwitch	`HALData::ECaseSwitch`
LEDs	`HALData::ELEDs`
IntegratedPhone	`HALData::EIntegratedPhone`
DisplayBrightness	`HALData::EDisplayBrightness`
DisplayBrightnessMax	`HALData::EDisplayBrightnessMax`
KeyboardBacklightState	`HALData::EKeyboardBacklightState`
AccessoryPower	`HALData::EAccessoryPower`
NumHalAttributes	`HALData::ENumHalAttributes`
FPHardware	`HALData::EHardwareFloatingPoint`

The following additional variables provide information about the choices of the user during installation.

Variable Name	Description
Language	This variable will be set to the language the user chooses. The integer value will correspond to the `TLanguage` enumeration.
option**N** (where **N** is a number from 1 to the number of options in the SIS file).	There is a variable for each of the different options in the SIS file. The value of each of these variables will be 1 if the option was selected and 0 otherwise.

Back to Developer Library