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**SUIT CBOR manifest serialisation format
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Abstract

This specification describes the format of a manifest. A manifest is a bundle of metadata about the firmware for an IoT device, where to find the firmware, the devices to which it applies, and cryptographic information protecting the manifest.

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Table of Contents

1.	Introduction	3
2.	Conventions and Terminology	4
3.	Distributing firmware	5
4.	Workflow of a device applying a firmware update	5
5.	SUIT manifest goals	6
6.	SUIT manifest design overview	7
6.1.	Manifest Design Evaluation	8
6.2.	Severable Elements	9
6.3.	Conventions	9
6.4.	Payloads	9
7.	Manifest Structure	10
7.1.	Outer wrapper	11
7.2.	Manifest	13
7.3.	SUIT_Dependency	16
7.4.	SUIT_Component_Reference	17
7.5.	Manifest Parameters	17
7.5.1.	SUIT_Parameter_Strict_Order	19
7.5.2.	SUIT_Parameter_Coerce_Condition_Failure	20
7.6.	SUIT_Parameter_Encryption_Info	20
7.7.	SUIT_Parameter_Compression_Info	20
7.8.	SUIT_Parameter_Unpack_Info	20
7.9.	SUIT_Parameters CDDL	21
7.10.	SUIT_Command_Sequence	22
7.11.	SUIT_Condition	24
7.11.1.	Identifier Conditions	25
7.11.2.	suit-condition-image-match	25
7.11.3.	suit-condition-image-not-match	25
7.11.4.	suit-condition-use-before	25
7.11.5.	suit-condition-minimum-battery	25
7.11.6.	suit-condition-update-authorised	26
7.11.7.	suit-condition-version	26

7.11.8.	SUIT_Condition_Custom	27
7.11.9.	Identifiers	27
7.11.10.	SUIT_Condition CDDL	29
7.12.	SUIT_Directive	29
7.12.1.	suit-directive-set-component-index	30
7.12.2.	suit-directive-set-dependency-index	31
7.12.3.	suit-directive-abort	31
7.12.4.	suit-directive-run-sequence	31
7.12.5.	suit-directive-try-each	32
7.12.6.	suit-directive-process-dependency	32
7.12.7.	suit-directive-set-parameters	33
7.12.8.	suit-directive-override-parameters	33
7.12.9.	suit-directive-fetch	34
7.12.10.	suit-directive-copy	34
7.12.11.	suit-directive-swap	35
7.12.12.	suit-directive-run	35
7.12.13.	suit-directive-wait	36
7.12.14.	SUIT_Directive CDDL	37
8.	Dependency processing	39
9.	Access Control Lists	40
10.	SUIT digest container	40
11.	Creating conditional sequences	41
12.	Full CDDL	43
13.	Examples	49
13.1.	Example 0:	50
13.2.	Example 1:	52
13.3.	Example 2:	54
13.4.	Example 3:	57
13.5.	Example 4:	61
13.6.	Example 5:	65
13.7.	Example 6:	69
14.	IANA Considerations	73
15.	Security Considerations	73
16.	Mailing List Information	74
17.	Acknowledgements	74
18.	References	74
18.1.	Normative References	74
18.2.	Informative References	75
18.3.	URIs	75
	Authors' Addresses	76

1. Introduction

A firmware update mechanism is an essential security feature for IoT devices to deal with vulnerabilities. While the transport of firmware images to the devices themselves is important there are already various techniques available, such as the Lightweight Machine-to-Machine (LwM2M) protocol offering device management of IoT

devices. Equally important is the inclusion of meta-data about the conveyed firmware image (in the form of a manifest) and the use of end-to-end security protection to detect modifications and (optionally) to make reverse engineering more difficult. End-to-end security allows the author, who builds the firmware image, to be sure that no other party (including potential adversaries) can install firmware updates on IoT devices without adequate privileges. This authorization process is ensured by the use of dedicated symmetric or asymmetric keys installed on the IoT device: for use cases where only integrity protection is required it is sufficient to install a trust anchor on the IoT device. For confidentiality protected firmware images it is additionally required to install either one or multiple symmetric or asymmetric keys on the IoT device. Starting security protection at the author is a risk mitigation technique so firmware images and manifests can be stored on untrusted repositories; it also reduces the scope of a compromise of any repository or intermediate system to be no worse than a denial of service.

It is assumed that the reader is familiar with the high-level firmware update architecture [[Architecture](#)].

The SUIF manifest is heavily optimised for consumption by constrained devices. This means that it is not constructed as a conventional descriptive document. Instead, of describing what an update IS, it describes what a recipient should DO.

While the SUIF manifest is informed by and optimised for firmware update use cases, there is nothing in the [[Information](#)] that restricts its use to only firmware use cases. Software update and delivery of arbitrary data can equally be managed by SUIF-based metadata.

2. Conventions and Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

- SUIF: Software Update for the Internet of Things, the IETF working group for this standard.
- Payload: A piece of information to be delivered. Typically Firmware for the purposes of SUIF.
- Resource: A piece of information that is used to construct a payload.

- Manifest: A piece of information that describes one or more payloads, one or more resources, and the processors needed to transform resources into payloads.
- Update: One or more manifests that describe one or more payloads.
- Update Authority: The owner of a cryptographic key used to sign updates, trusted by recipient devices.
- Recipient: The system, typically an IoT device, that receives a manifest.
- Condition: A test for a property of the Recipient or its components.
- Directive: An action for the Recipient to perform.
- Command: A Condition or a Directive.
- Trusted Execution: A process by which a system ensures that only trusted code is executed, for example secure boot.

3. Distributing firmware

Distributing firmware in a multi-party environment is a difficult operation. Each party requires a different subset of data. Some data may not be accessible to all parties. Multiple signatures may be required from parties with different authorities. This topic is covered in more depth in [[Architecture](#)].

4. Workflow of a device applying a firmware update

The manifest is designed to work with a pull parser, where each section of the manifest is used in sequence. The expected workflow for a device installing an update can be broken down into 5 steps:

1. Verify the signature of the manifest
2. Verify the applicability of the manifest
3. Resolve dependencies
4. Fetch payload(s)
5. Install payload(s)

When installation is complete, similar information can be used for validating and running images in a further three steps:

1. Verify image(s)
2. Load image(s)
3. Run image(s)

When multiple manifests are used for an update, each manifest's steps occur in a lockstep fashion; all manifests have dependency resolution performed before any manifest performs a payload fetch, etc.

5. SUIT manifest goals

The manifest described in this document is intended to meet several goals, as described below.

1. Meet the requirements defined in [[Information](#)].
2. Simple to parse on a constrained node
3. Simple to process on a constrained node
4. Compact encoding
5. Comprehensible by an intermediate system
6. Expressive enough to enable advanced use cases on advanced nodes
7. Extensible

The SUIT manifest can be used for a variety of purposes throughout its lifecycle. The manifest allows:

1. the Firmware Author to reason about releasing a firmware.
2. the Network Operator to reason about compatibility of a firmware.
3. the Device Operator to reason about the impact of a firmware.
4. the Device Operator to manage distribution of firmware to devices.
5. the Plant Manager to reason about timing and acceptance of firmware updates.
6. the device to reason about the authority & authenticity of a firmware prior to installation.
7. the device to reason about the applicability of a firmware.

8. the device to reason about the installation of a firmware.
9. the device to reason about the authenticity & encoding of a firmware at boot.

Each of these uses happens at a different stage of the manifest lifecycle, so each has different requirements.

6. SUIT manifest design overview

In order to provide flexible behaviour to constrained devices, while still allowing more powerful devices to use their full capabilities, the SUIT manifest encodes the required behaviour of a Recipient device. Behaviour is encoded as a specialised byte code, contained in a CBOR list. This promotes a flat encoding, which simplifies the parser. The information encoded by this byte code closely matches the operations that a device will perform, which promotes ease of processing. The core operations used by most update and trusted execution operations are represented in the byte code. The byte code can be extended by registering new operations.

The specialised byte code approach gives benefits equivalent to those provided by a scripting language or conventional byte code, with two substantial differences. First, the language is extremely high level, consisting of only the operations that a device may perform during update and trusted execution of a firmware image. Second, the language specifies behaviours in a linearised form, without reverse branches. Conditional processing is supported, and parallel and out-of-order processing may be performed by sufficiently capable devices.

By structuring the data in this way, the manifest processor becomes a very simple engine that uses a pull parser to interpret the manifest. This pull parser invokes a series of command handlers that evaluate a Condition or execute a Directive. Most data is structured in a highly regular pattern, which simplifies the parser.

The results of this allow a Recipient to implement a very small parser for constrained applications. If needed, such a parser also allows the Recipient to perform complex updates with reduced overhead. Conditional execution of commands allows a simple device to perform important decisions at validation-time.

Dependency handling is vastly simplified as well. Dependencies function like subroutines of the language. When a manifest has a dependency, it can invoke that dependency's commands and modify their behaviour by setting parameters. Because some parameters come with security implications, the dependencies also have a mechanism to reject modifications to parameters on a fine-grained level.

Developing a robust permissions system works in this model too. The Recipient can use a simple ACL that is a table of Identities and Component Identifier permissions to ensure that only manifests authenticated by the appropriate identity have access to operate on a component.

Capability reporting is similarly simplified. A Recipient can report the Commands, Parameters, Algorithms, and Component Identifiers that it supports. This is sufficiently precise for a manifest author to create a manifest that the Recipient can accept.

The simplicity of design in the Recipient due to all of these benefits allows even a highly constrained platform to use advanced update capabilities.

6.1. Manifest Design Evaluation

To evaluate this design, it is compared to the goals stated above.

Goal evaluation:

1. Each command and condition is anchored to a manifest information element in [[Information](#)]
2. The use of a byte code encourages flat encoding and reduces nesting depth. This promotes a simple encoding.
3. The encoded information closely matches the operations that a device will perform, making the format easy to process.
4. Encoding efficiency exceeds 50% when compared to raw data.
5. Tooling will be required to reason about the manifest.
6. The core operations used by most update and trusted execution operations are represented in the byte code. The use cases listed in [[Information](#)] are enabled.
7. Registration of new standard byte code identifiers enables extension in a comprehensible way.

The manifest described by this document meets the stated goals. Meeting goal 5-comprehensible by intermediate systems-will require additional tooling or a division of metadata.

6.2. Severable Elements

Because the manifest can be used by different actors at different times, some parts of the manifest can be removed without affecting later stages of the lifecycle. This is called "Severing." Severing of information is achieved by separating that information from the signed container so that removing it does not affect the signature. This means that ensuring authenticity of severable parts of the manifest is a requirement for the signed portion of the manifest. Severing some parts makes it possible to discard parts of the manifest that are no longer necessary. This is important because it allows the storage used by the manifest to be greatly reduced. For example, no text size limits are needed if text is removed from the manifest prior to delivery to a constrained device.

Elements are made severable by removing them from the manifest, encoding them in a bstr, and placing a SUI_T_Digest of the bstr in the manifest so that they can still be authenticated. The SUI_T_Digest typically consumes 4 bytes more than the size of the raw digest, therefore elements smaller than $(\text{Digest Bits})/8 + 4$ SHOULD never be severable. Elements larger than $(\text{Digest Bits})/8 + 4$ MAY be severable, while elements that are much larger than $(\text{Digest Bits})/8 + 4$ SHOULD be severable.

6.3. Conventions

The map indices in this encoding are reset to 1 for each map within the structure. This is to keep the indices as small as possible. The goal is to keep the index objects to single bytes (CBOR positive integers 1-23).

Wherever enumerations are used, they are started at 1. This allows detection of several common software errors that are caused by uninitialised variables. Positive numbers in enumerations are reserved for IANA registration. Negative numbers are used to identify application-specific implementations.

CDDL names are hyphenated and CDDL structures follow the convention adopted in COSE [[RFC8152](#)]: SUI_T_Structure_Name.

6.4. Payloads

Payloads can take many forms, for example, binary, hex, s-record, elf, binary diff, PEM certificate, CBOR Web Token, serialised configuration. These payloads fall into two broad categories: those that require installation-time unpacking and those that do not. Binary, PEM certificate, and CBOR Web Token do not require installation-time unpacking. Hex, s-record, and serialised

configuration require installation-time unpacking. Elf may or may not require unpacking depending on the target.

Some payloads cannot be directly converted to a writable binary stream. Hex, s-record, and elf may contain gaps and they have no guarantee of monotonic increase of address, which makes pre-processing them into a binary stream difficult on constrained platforms. Serialised configuration may be unpacked into a configuration database, which makes it impossible to preprocess into a binary stream, suitable for direct writing.

Where a specialised unpacking algorithm is needed, a digest is not always calculable over an installed payload. For example, an elf, s-record or hex file may contain gaps that can contain any data, while not changing whether or not an installed payload is valid. Serialised configuration may update only some device data rather than all of it. This means that the digest cannot always be calculated over an installed payload when a specialised installer is used.

This presents two problems for the manifest: first, it must indicate that a specialised installer is needed and, second, it cannot provide a hash of the payload that is checkable after installation. These two problems are resolved in two ways:

1. Payloads that need a specialised installer must indicate this in `suit-payload-info-unpack`.
2. Payloads that need specialised verification must indicate this in the `SUIT_Parameter_Image_Digest` by indicating a `SUIT_Digest` algorithm that correctly validates their information.

7. Manifest Structure

The manifest is divided into several sections in a hierarchy as follows:

1. The outer wrapper
 1. The authentication wrapper
 2. The manifest
 1. Critical Information
 2. Information shared by all command sequences
 1. List of dependencies

2. List of payloads
3. List of payloads in dependencies
4. Common list of conditions, directives
3. Dependency resolution Reference or list of conditions, directives
4. Payload fetch Reference or list of conditions, directives
5. Installation Reference or list of conditions, directives
6. Verification conditions/directives
7. Load conditions/directives
8. Run conditions/directives
9. Text / Reference
10. COSWID / Reference
3. Dependency resolution conditions/directives
4. Payload fetch conditions/directives
5. Installation conditions/directives
6. Text
7. COSWID / Reference
8. Intermediate Certificate(s) / CWTs
9. Inline Payload(s)

7.1. Outer wrapper

This object is a container for the other pieces of the manifest to provide a common mechanism to find each of the parts. All elements of the outer wrapper are contained in bstr objects. Wherever the manifest references an object in the outer wrapper, the bstr is included in the digest calculation.

The CDDL that describes the wrapper is below


```

SUIT_Outer_Wrapper = {
    suit-authentication-wrapper => bstr .cbor
                                SUIT_Authentication_Wrapper / nil,
    $SUIT_Manifest_Wrapped,
    ? suit-dependency-resolution => bstr .cbor SUIT_Command_Sequence,
    ? suit-payload-fetch         => bstr .cbor SUIT_Command_Sequence,
    ? suit-install               => bstr .cbor SUIT_Command_Sequence,
    ? suit-text-external         => bstr .cbor SUIT_Text_Info,
    ? suit-coswid-external       => bstr .cbor COSWID
}

SUIT_Authentication_Wrapper = [ + (COSE_Mac_Tagged / COSE_Sign_Tagged /
                                COSE_Mac0_Tagged / COSE_Sign1_Tagged)]
SUIT_Encryption_Wrapper = COSE_Encrypt_Tagged / COSE_Encrypt0_Tagged

SUIT_Manifest_Wrapped //= (suit-manifest => bstr .cbor SUIT_Manifest)
SUIT_Manifest_Wrapped //= (
    suit-manifest-encryption-info => bstr .cbor SUIT_Encryption_Wrapper,
    suit-manifest-encrypted       => bstr
)

```

All elements of the outer wrapper must be wrapped in a bstr to minimize the complexity of the code that evaluates the cryptographic integrity of the element and to ensure correct serialisation for integrity and authenticity checks.

The suit-authentication-wrapper contains a list of 1 or more cryptographic authentication wrappers for the core part of the manifest. These are implemented as COSE_Mac_Tagged or COSE_Sign_Tagged blocks. The Manifest is authenticated by these blocks in "detached payload" mode. The COSE_Mac_Tagged and COSE_Sign_Tagged blocks are described in [RFC 8152](#) [[RFC8152](#)] and are beyond the scope of this document. The suit-authentication-wrapper MUST come first in the SUIT_Outer_Wrapper, regardless of canonical encoding of CBOR. All validators MUST reject any SUIT_Outer_Wrapper that begins with any element other than a suit-authentication-wrapper.

A manifest that has not had authentication information added MUST still contain the suit-authentication-wrapper element, but the content MUST be nil.

The outer wrapper MUST contain only one of

- a plaintext manifest: SUIT_Manifest
- an encrypted manifest: both a SUIT_Encryption_Wrapper and the ciphertext of a manifest.

When the outer wrapper contains `SUIT_Encryption_Wrapper`, the `suit-authentication-wrapper` MUST authenticate the plaintext of `suit-manifest-encrypted`.

`suit-manifest` contains a `SUIT_Manifest` structure, which describes the payload(s) to be installed and any dependencies on other manifests.

`suit-manifest-encryption-info` contains a `SUIT_Encryption_Wrapper`, a COSE object that describes the information required to decrypt a ciphertext manifest.

`suit-manifest-encrypted` contains a ciphertext manifest.

Each of `suit-dependency-resolution`, `suit-payload-fetch`, and `suit-payload-installation` contain the severable contents of the identically named portions of the manifest, described in [Section 7.2](#).

`suit-text` contains all the human-readable information that describes any and all parts of the manifest, its payload(s) and its resource(s).

`suit-coswid` contains a Concise Software Identifier. This may be discarded by the recipient if not needed.

[7.2](#). Manifest

The manifest describes the critical metadata for the referenced payload(s). In addition, it contains:

1. a version number for the manifest structure itself
2. a sequence number
3. a list of dependencies
4. a list of components affected
5. a list of components affected by dependencies
6. a reference for each of the severable blocks.
7. a list of actions that the recipient should perform.

The following CDDL fragment defines the manifest.


```

SUIT_Manifest = {
    suit-manifest-version          => 1,
    suit-manifest-sequence-number => uint,
    suit-common                    => bstr .cbor SUIT_Common,
    ? suit-dependency-resolution  => Digest / bstr .cbor SUIT_Command_Sequence,
    ? suit-payload-fetch          => Digest / bstr .cbor SUIT_Command_Sequence,
    ? suit-install                => Digest / bstr .cbor SUIT_Command_Sequence
    ? suit-validate               => bstr .cbor SUIT_Command_Sequence
    ? suit-load                   => bstr .cbor SUIT_Command_Sequence
    ? suit-run                    => bstr .cbor SUIT_Command_Sequence
    ? suit-text-info              => Digest / bstr .cbor SUIT_Text_Map
    ? suit-coswid                 => Digest / bstr .cbor COSWID
}

SUIT_Common = {
    ? suit-dependencies           => bstr .cbor [ + SUIT_Dependency ],
    ? suit-components             => bstr .cbor [ +
SUIT_Component_Identifier ],
    ? suit-dependency-components => bstr .cbor [ + SUIT_Component_Reference ],
    ? suit-common-sequence        => bstr .cbor SUIT_Command_Sequence,
}

```

Several fields in the Manifest can be either a CBOR structure or a `SUIT_Digest`. In each of these cases, the `SUIT_Digest` provides for a severable field. Severable fields are RECOMMENDED to implement. In particular, text SHOULD be severable, since most useful text elements occupy more space than a `SUIT_Digest`, but are not needed by recipient devices. Because `SUIT_Digest` is a CBOR Array and each severable element is a CBOR bstr, it is straight-forward for a recipient to determine whether an element is been severable. The key used for a severable element is the same in the `SUIT_Manifest` and in the `SUIT_Outer_Wrapper` so that a recipient can easily identify the correct data in the outer wrapper.

The `suit-manifest-version` indicates the version of serialisation used to encode the manifest. Version 1 is the version described in this document. `suit-manifest-version` is REQUIRED.

The `suit-manifest-sequence-number` is a monotonically increasing anti-rollback counter. It also helps devices to determine which in a set of manifests is the "root" manifest in a given update. Each manifest MUST have a sequence number higher than each of its dependencies. Each recipient MUST reject any manifest that has a sequence number lower than its current sequence number. It MAY be convenient to use a UTC timestamp in seconds as the sequence number. `suit-manifest-sequence-number` is REQUIRED.

`suit-common` encodes all the information that is shared between each

of the command sequences, including: suit-dependencies, suit-

components, suit-dependency-components, and suit-common-sequence. suit-common is REQUIRED to implement.

suit-dependencies is a list of SUI_T_Dependency blocks that specify manifests that must be present before the current manifest can be processed. suit-dependencies is OPTIONAL to implement.

In order to distinguish between components that are affected by the current manifest and components that are affected by a dependency, they are kept in separate lists. Components affected by the current manifest only list the component identifier. Components affected by a dependency include the component identifier and the index of the dependency that defines the component.

suit-components is a list of SUI_T_Component blocks that specify the component identifiers that will be affected by the content of the current manifest. suit-components is OPTIONAL, but at least one manifest MUST contain a suit-components block.

suit-dependency-components is a list of SUI_T_Component_Reference blocks that specify component identifiers that will be affected by the content of a dependency of the current manifest. suit-dependency-components is OPTIONAL.

suit-common-sequence is a SUI_T_Command_Sequence to execute prior to executing any other command sequence. Typical actions in suit-common-sequence include setting expected device identity and image digests when they are conditional (see [Section 11](#) for more information on conditional sequences). suit-common-sequence is RECOMMENDED.

suit-dependency-resolution is a SUI_T_Command_Sequence to execute in order to perform dependency resolution. Typical actions include configuring URIs of dependency manifests, fetching dependency manifests, and validating dependency manifests' contents. suit-dependency-resolution is REQUIRED when suit-dependencies is present.

suit-payload-fetch is a SUI_T_Command_Sequence to execute in order to obtain a payload. Some manifests may include these actions in the suit-install section instead if they operate in a streaming installation mode. This is particularly relevant for constrained devices without any temporary storage for staging the update. suit-payload-fetch is OPTIONAL.

suit-install is a SUI_T_Command_Sequence to execute in order to install a payload. Typical actions include verifying a payload stored in temporary storage, copying a staged payload from temporary storage, and unpacking a payload. suit-install is OPTIONAL.

suit-validate is a SUIT_Command_Sequence to execute in order to validate that the result of applying the update is correct. Typical actions involve image validation and manifest validation. suit-validate is REQUIRED. If the manifest contains dependencies, one process-dependency invocation per dependency or one process-dependency invocation targeting all dependencies SHOULD be present in validate.

suit-load is a SUIT_Command_Sequence to execute in order to prepare a payload for execution. Typical actions include copying an image from permanent storage into RAM, optionally including actions such as decryption or decompression. suit-load is OPTIONAL.

suit-run is a SUIT_Command_Sequence to execute in order to run an image. suit-run typically contains a single instruction: either the "run" directive for the bootable manifest or the "process dependencies" directive for any dependents of the bootable manifest. suit-run is OPTIONAL. Only one manifest in an update may contain the "run" directive.

suit-text-info is a digest that uniquely identifies the content of the Text that is packaged in the OuterWrapper. text is OPTIONAL.

suit-coswid is a digest that uniquely identifies the content of the concise-software-identifier that is packaged in the OuterWrapper. coswid is OPTIONAL.

7.3. SUIT_Dependency

SUIT_Dependency specifies a manifest that describes a dependency of the current manifest.

The following CDDL describes the SUIT_Dependency structure.

```
SUIT_Dependency = {  
    suit-dependency-digest => SUIT_Digest,  
    ? suit-dependency-prefix => SUIT_Component_Identifier,  
}
```

The suit-dependency-digest specifies the dependency manifest uniquely by identifying a particular Manifest structure. The digest is calculated over the Manifest structure instead of the COSE Sig_structure or Mac_structure. This means that a digest may need to be calculated more than once, however this is necessary to ensure that removing a signature from a manifest does not break dependencies due to missing signature elements. This is also necessary to support the trusted intermediary use case, where an intermediary re-signs the

Manifest, removing the original signature, potentially with a different algorithm, or trading COSE_Sign for COSE_Mac.

The suit-dependency-prefix element contains a `SUIT_Component_Identifier`. This specifies the scope at which the dependency operates. This allows the dependency to be forwarded on to a component that is capable of parsing its own manifests. It also allows one manifest to be deployed to multiple dependent devices without those devices needing consistent component hierarchy. This element is OPTIONAL.

7.4. SUIT_Component_Reference

The `SUIT_Component_Reference` describes an image that is defined by another manifest. This is useful for overriding the behaviour of another manifest, for example by directing the recipient to look at a different URI for the image or by changing the expected format, such as when a gateway performs decryption on behalf of a constrained device. The following CDDL describes the `SUIT_Component_Reference`.

```
SUIT_Component_Reference = {
  suit-component-identifier => SUIT_Component_Identifier,
  suit-component-dependency-index => uint
}
```

7.5. Manifest Parameters

Many conditions and directives require additional information. That information is contained within parameters that can be set in a consistent way. Parameters MUST only be:

1. Integers
2. Byte strings
3. Booleans

This allows reduction of manifest size and replacement of parameters from one manifest to the next. Byte strings MAY contain CBOR-encoded objects.

The defined manifest parameters are described below.

Parameter Code	CBOR Type	Default	Scope	Name	Description
1	boolean	True	Global	Strict Order	Requires that the manifest

						is processed in a strictly linear fashion. Set to 0 to enable parallel handling of manifest directives.
2	boolean	False	Command Segment	Coerce Condition Failure		Coerces the success code of a command segment to success even when aborted due to a condition failure.
3	bstr	nil	Component/Global	Vendor ID		A RFC4122 UUID representing the vendor of the device or component
4	bstr	nil	Component/Global	Class ID		A RFC4122 UUID representing the class of the device or component
5	bstr	nil	Component/Global	Device ID		A RFC4122 UUID representing the device or component
6	bstr	nil	Component/Dependency	URI		A URI from which to fetch a resource
7	bstr	nil	Component/Dependency	Encryption Info		A COSE object defining the encryption mode of a resource
8	bstr	nil	Component	Compress		A SUIT_Compress

				ion Info	sion_Info
					object
9	bstr	nil	Component	Unpack Info	A SUI_Unpack_
					Info object
10	uint	nil	Component	Source C	A Component
				omponent	Index
11	bstr	nil	Component/Dep	Image	A SUI_Digest
			endency	Digest	
12	bstr	nil	Component/Dep	Image	Integer size
			endency	Size	
24	bstr	nil	Component/Dep	URI List	A CBOR encoded
			endency		list of ranked
					URIs
25	boole	Fals	Component/Dep	URI List	A CBOR encoded
	an	e	endency	Append	list of ranked
					URIs
nint	int/b	nil	Custom	Custom P	Application-
	str			arameter	defined
					parameter
+-----+-----+-----+-----+-----+-----+					

CBOR-encoded object parameters are still wrapped in a bstr. This is because it allows a parser that is aggregating parameters to reference the object with a single pointer and traverse it without understanding the contents. This is important for modularisation and division of responsibility within a pull parser. The same consideration does not apply to Conditions and Directives because those elements are invoked with their arguments immediately

[7.5.1.](#) SUI_Parameter_Strict_Order

The Strict Order Parameter allows a manifest to govern when directives can be executed out-of-order. This allows for systems that have a sensitivity to order of updates to choose the order in which they are executed. It also allows for more advanced systems to parallelise their handling of updates. Strict Order defaults to True. It MAY be set to False when the order of operations does not matter. When arriving at the end of a command sequence, ALL commands MUST have completed, regardless of the state of SUI_Parameter_Strict_Order. If SUI_Parameter_Strict_Order is

returned to True, ALL preceding commands MUST complete before the next command is executed.

7.5.2. SUIParameterCoerceConditionFailure

When executing a command sequence inside SUIRunSequence and a condition failure occurs, the manifest processor aborts the sequence. If Coerce Condition Failure is True, it returns Success. Otherwise, it returns the original condition failure.

SUIParameterCoerceConditionFailure is scoped to the enclosing SUIDirectiveRunSequence. Its value is discarded when SUIDirectiveRunSequence terminates.

7.6. SUIParameterEncryptionInfo

Encryption Info defines the mechanism that Fetch or Copy should use to decrypt the data they transfer. SUIParameterEncryptionInfo is encoded as a COSEEncryptTagged or a COSEEncrypt0Tagged, wrapped in a bstr

7.7. SUIParameterCompressionInfo

Compression Info defines any information that is required for a device to perform decompression operations. Typically, this includes the algorithm identifier.

SUIParameterCompressionInfo is defined by the following CDDL:

```
SUICompressionInfo = {  
    suit-compression-algorithm => SUICompressionAlgorithms  
    ? suit-compression-parameters => bstr  
}
```

```
SUICompressionAlgorithms /= SUICompressionAlgorithm_gzip  
SUICompressionAlgorithms /= SUICompressionAlgorithm_bzip2  
SUICompressionAlgorithms /= SUICompressionAlgorithm_deflate  
SUICompressionAlgorithms /= SUICompressionAlgorithm_LZ4  
SUICompressionAlgorithms /= SUICompressionAlgorithm_lzma
```

7.8. SUIParameterUnpackInfo

SUIUnpackInfo defines the information required for a device to interpret a packed format, such as elf, hex, or binary diff.

SUIUnpackInfo is defined by the following CDDL:


```
SUIT_Unpack_Info = {  
    suit-unpack-algorithm => SUIT_Unpack_Algorithms  
    ? suit-unpack-parameters => bstr  
}  
  
SUIT_Unpack_Algorithms // = SUIT_Unpack_Algorithm_Delta  
SUIT_Unpack_Algorithms // = SUIT_Unpack_Algorithm_Hex  
SUIT_Unpack_Algorithms // = SUIT_Unpack_Algorithm_Elf
```

7.9. SUIT_Parameters CDDL

The following CDDL describes all SUIT_Parameters.


```

SUIT_Parameters //= (suit-parameter-strict-order => bool)
SUIT_Parameters //= (suit-parameter-coerce-condition-failure => bool)
SUIT_Parameters //= (suit-parameter-vendor-id => bstr)
SUIT_Parameters //= (suit-parameter-class-id => bstr)
SUIT_Parameters //= (suit-parameter-device-id => bstr)
SUIT_Parameters //= (suit-parameter-uri => bstr)
SUIT_Parameters //= (suit-parameter-encryption-info => bstr .cbor
SUIT_Encryption_Info)
SUIT_Parameters //= (suit-parameter-compression-info => bstr .cbor
SUIT_Compression_Info)
SUIT_Parameters //= (suit-parameter-unpack-info => bstr .cbor SUIT_Unpack_Info)
SUIT_Parameters //= (suit-parameter-source-component => bstr .cbor
SUIT_Component_Identifier)
SUIT_Parameters //= (suit-parameter-image-digest => bstr .cbor SUIT_Digest)
SUIT_Parameters //= (suit-parameter-image-size => uint)
SUIT_Parameters //= (suit-parameter-uri-list => bstr .cbor SUIT_URI_List)
SUIT_Parameters //= (suit-parameter_custom => int/bool/bstr)

SUIT_URI_List = [ + [priority: int, uri: tstr] ]

SUIT_Encryption_Info= COSE_Encrypt_Tagged/COSE_Encrypt0_Tagged
SUIT_Compression_Info = {
    suit-compression-algorithm => SUIT_Compression_Algorithms
    ? suit-compression-parameters => bstr
}

SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_gzip
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_bzip2
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_deflate
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_LZ4
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_lzma

SUIT_Unpack_Info = {
    suit-unpack-algorithm => SUIT_Unpack_Algorithms
    ? suit-unpack-parameters => bstr
}

SUIT_Unpack_Algorithms //= SUIT_Unpack_Algorithm_Delta
SUIT_Unpack_Algorithms //= SUIT_Unpack_Algorithm_Hex
SUIT_Unpack_Algorithms //= SUIT_Unpack_Algorithm_Elf

```

7.10. SUIT_Command_Sequence

A SUIT_Command_Sequence defines a series of actions that the recipient MUST take to accomplish a particular goal. These goals are defined in the manifest and include:

1. Dependency Resolution

2. Payload Fetch

Moran, et al.

Expires April 30, 2020

[Page 22]

3. Payload Installation
4. Image Validation
5. Image Loading
6. Run or Boot

Each of these follows exactly the same structure to ensure that the parser is as simple as possible.

Lists of commands are constructed from two kinds of element:

1. Conditions that **MUST** be true-any failure is treated as a failure of the update/load/boot
2. Directives that **MUST** be executed.

The lists of commands are logically structured into sequences of zero or more conditions followed by zero or more directives. The *logical* structure is described by the following CDDL:

```
Command_Sequence = {  
    conditions => [ * Condition],  
    directives => [ * Directive]  
}
```

This introduces significant complexity in the parser, however, so the structure is flattened to make parsing simpler:

```
SUIT_Command_Sequence = [ + (SUIT_Condition/SUIT_Directive) ]
```

Each condition and directive is composed of:

1. A command code identifier
2. An argument block

Argument blocks are defined for each type of command.

Many conditions and directives apply to a given component, and these generally grouped together. Therefore, a special command to set the current component index is provided with a matching command to set the current dependency index. This index is a numeric index into the component ID tables defined at the beginning of the document. For the purpose of setting the index, the two component ID tables are considered to be concatenated together.

To facilitate optional conditions, a special directive is provided. It runs several new lists of conditions/directives, one after another, that are contained as an argument to the directive. By default, it assumes that a failure of a condition should not indicate a failure of the update/boot, but a parameter is provided to override this behaviour.

[7.11.](#) **SUIT_Condition**

Conditions are used to define mandatory properties of a system in order for an update to be applied. They can be pre-conditions or post-conditions of any directive or series of directives, depending on where they are placed in the list. Conditions include:

Condition Code	Condition Name	Argument Type
1	Vendor Identifier	nil
2	Class Identifier	nil
3	Image Match	nil
4	Use Before	Unsigned Integer timestamp
5	Component Offset	Unsigned Integer
24	Device Identifier	nil
25	Image Not Match	nil
26	Minimum Battery	Unsigned Integer
27	Update Authorised	Integer
28	Version	List of Integers
nint	Custom Condition	bstr

Each condition MUST report a success code on completion. If a condition reports failure, then the current sequence of commands MUST terminate. If a recipient encounters an unknown Condition Code, it MUST report a failure.

Positive Condition numbers are reserved for IANA registration. Negative numbers are reserved for proprietary, application-specific directives.

7.11.1. Identifier Conditions

There are three identifier-based conditions: `suit-condition-vendor-identifier`, `suit-condition-class-identifier`, and `suit-condition-device-identifier`. Each of these conditions match a [RFC 4122](#) [RFC4122] UUID that MUST have already been set as a parameter. The installing device MUST match the specified UUID in order to consider the manifest valid. These identifiers MAY be scoped by component.

The recipient uses the ID parameter that has already been set using the Set Parameters directive. If no ID has been set, this condition fails. `suit-condition-class-identifier` and `suit-condition-vendor-identifier` are REQUIRED to implement. `suit-condition-device-identifier` is OPTIONAL to implement.

7.11.2. `suit-condition-image-match`

Verify that the current component matches the digest parameter for the current component. The digest is verified against the digest specified in the Component's parameters list. If no digest is specified, the condition fails. `suit-condition-image-match` is REQUIRED to implement.

7.11.3. `suit-condition-image-not-match`

Verify that the current component does not match the supplied digest. If no digest is specified, then the digest is compared against the digest specified in the Components list. If no digest is specified and the component is not present in the Components list, the condition fails. `suit-condition-image-not-match` is OPTIONAL to implement.

7.11.4. `suit-condition-use-before`

Verify that the current time is BEFORE the specified time. `suit-condition-use-before` is used to specify the last time at which an update should be installed. One argument is required, encoded as a POSIX timestamp, that is seconds after 1970-01-01 00:00:00. Timestamp conditions MUST be evaluated in 64 bits, regardless of encoded CBOR size. `suit-condition-use-before` is OPTIONAL to implement.

7.11.5. `suit-condition-minimum-battery`

`suit-condition-minimum-battery` provides a mechanism to test a device's battery level before installing an update. This condition is for use in primary-cell applications, where the battery is only ever discharged. For batteries that are charged, `suit-directive-wait`

is more appropriate, since it defines a "wait" until the battery level is sufficient to install the update. `suit-condition-minimum-battery` is specified in mWh. `suit-condition-minimum-battery` is OPTIONAL to implement.

7.11.6. `suit-condition-update-authorized`

Request Authorisation from the application and fail if not authorised. This can allow a user to decline an update. Argument is an integer priority level. Priorities are application defined. `suit-condition-update-authorized` is OPTIONAL to implement.

7.11.7. `suit-condition-version`

`suit-condition-version` allows comparing versions of firmware. Verifying image digests is preferred to version checks because digests are more precise. The image can be compared as:

- Greater
- Greater or Equal
- Equal
- Lesser or Equal
- Lesser

Versions are encoded as a CBOR list of integers. Comparisons are done on each integer in sequence. Comparison stops after all integers in the list defined by the manifest have been consumed OR after a non-equal match has occurred. For example, if the manifest defines a comparison, "Equal [[1](#)]", then this will match all version sequences starting with 1. If a manifest defines both "Greater or Equal [[1](#),0]" and "Lesser [[1](#),10]", then it will match versions 1.0.x up to, but not including 1.10.

The following CDDL describes `SUIT_Condition_Version_Argument`


```
SUIT_Condition_Version_Argument = [  
    suit-condition-version-comparison: SUIT_Condition_Version_Comparison_Types,  
    suit-condition-version-comparison: SUIT_Condition_Version_Comparison_Value  
]  
SUIT_Condition_Version_Comparison_Types /=  
SUIT_Condition_Version_Comparison_Greater  
SUIT_Condition_Version_Comparison_Types /=  
SUIT_Condition_Version_Comparison_Greater_Equal  
SUIT_Condition_Version_Comparison_Types /=  
SUIT_Condition_Version_Comparison_Equal  
SUIT_Condition_Version_Comparison_Types /=  
SUIT_Condition_Version_Comparison_Lesser_Equal  
SUIT_Condition_Version_Comparison_Types /=  
SUIT_Condition_Version_Comparison_Lesser  
SUIT_Condition_Version_Comparison_Greater = 1  
SUIT_Condition_Version_Comparison_Greater_Equal = 2  
SUIT_Condition_Version_Comparison_Equal = 3  
SUIT_Condition_Version_Comparison_Lesser_Equal = 4  
SUIT_Condition_Version_Comparison_Lesser = 5  
  
SUIT_Condition_Version_Comparison_Value = [+int]
```

While the exact encoding of versions is application-defined, semantic versions map conveniently. For example,

- 1.2.3 = [[1](#), [2](#), [3](#)]
- 1.2-rc3 = [[1](#), [2](#), -1, 3]
- 1.2-beta = [[1](#), [2](#), -2]
- 1.2-alpha = [[1](#), [2](#), -3]
- 1.2-alpha4 = [[1](#), [2](#), -3, 4]

suit-condition-version is OPTIONAL to implement.

7.11.8. SUIT_Condition_Custom

SUIT_Condition_Custom describes any proprietary, application specific condition. This is encoded as a negative integer, chosen by the firmware developer, and a bstr that encodes the parameters passed to the system that evaluates the condition matching that integer. SUIT_Condition_Custom is OPTIONAL to implement.

7.11.9. Identifiers

Many conditions use identifiers to determine whether a manifest matches a given recipient or not. These identifiers are defined to

be [RFC 4122](#) [RFC4122] UUIDs. These UUIDs are explicitly NOT human-readable. They are for machine-based matching only.

A device may match any number of UUIDs for vendor or class identifier. This may be relevant to physical or software modules. For example, a device that has an OS and one or more applications might list one Vendor ID for the OS and one or more additional Vendor IDs for the applications. This device might also have a Class ID that must be matched for the OS and one or more Class IDs for the applications.

A more complete example: A device has the following physical components: 1. A host MCU 2. A WiFi module

This same device has three software modules: 1. An operating system 2. A WiFi module interface driver 3. An application

Suppose that the WiFi module's firmware has a proprietary update mechanism and doesn't support manifest processing. This device can report four class IDs:

1. hardware model/revision
2. OS
3. WiFi module model/revision
4. Application

This allows the OS, WiFi module, and application to be updated independently. To combat possible incompatibilities, the OS class ID can be changed each time the OS has a change to its API.

This approach allows a vendor to target, for example, all devices with a particular WiFi module with an update, which is a very powerful mechanism, particularly when used for security updates.

7.11.9.1. Creating UUIDs:

UUIDs MUST be created according to [RFC 4122](#) [[RFC4122](#)]. UUIDs SHOULD use versions 3, 4, or 5, as described in [RFC4122](#). Versions 1 and 2 do not provide a tangible benefit over version 4 for this application.

The RECOMMENDED method to create a vendor ID is: Vendor ID = UUID5(DNS_PREFIX, vendor domain name)

The RECOMMENDED method to create a class ID is: Class ID = UUID5(Vendor ID, Class-Specific-Information)

Class-specific information is composed of a variety of data, for example:

- Model number
- Hardware revision
- Bootloader version (for immutable bootloaders)

[7.11.10.](#) **SUIT_Condition CDDL**

The following CDDL describes SUIT_Condition:

```
SUIT_Condition //= (suit-condition-vendor-identifier, nil)
SUIT_Condition //= (suit-condition-class-identifier, nil)
SUIT_Condition //= (suit-condition-device-identifier, nil)
SUIT_Condition //= (suit-condition-image-match, nil)
SUIT_Condition //= (suit-condition-image-not-match, nil)
SUIT_Condition //= (suit-condition-use-before, uint)
SUIT_Condition //= (suit-condition-minimum-battery, uint)
SUIT_Condition //= (suit-condition-update-authorised, int)
SUIT_Condition //= (suit-condition-version,
SUIT_Condition_Version_Argument)
SUIT_Condition //= (suit-condition-component-offset, uint)
SUIT_Condition //= (suit-condition-custom, bstr)

SUIT_Condition_Version_Argument = [
    suit-condition-version-comparison: SUIT_Condition_Version_Comparison_Types,
    suit-condition-version-comparison: SUIT_Condition_Version_Comparison_Value
]
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-
greater
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-
greater-equal
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-
equal
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-
lesser-equal
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-
lesser

SUIT_Condition_Version_Comparison_Value = [+int]
```

[7.12.](#) **SUIT_Directive**

Directives are used to define the behaviour of the recipient.
Directives include:

Directive Code	Directive Name
12	Set Component Index
13	Set Dependency Index
14	Abort
15	Try Each
16	Reserved
17	Reserved
18	Process Dependency
19	Set Parameters
20	Override Parameters
21	Fetch
22	Copy
23	Run
29	Wait
30	Run Sequence
31	Run with Arguments
32	Swap

When a Recipient executes a Directive, it MUST report a success code. If the Directive reports failure, then the current Command Sequence MUST terminate.

7.12.1. suit-directive-set-component-index

Set Component Index defines the component to which successive directives and conditions will apply. The supplied argument MUST be either a boolean or an unsigned integer index into the concatenation of suit-components and suit-dependency-components. If the following directives apply to ALL components, then the boolean value "True" is used instead of an index. True does not apply to dependency

components. If the following directives apply to NO components, then the boolean value "False" is used. When `suit-directive-set-dependency-index` is used, `suit-directive-set-component-index = False` is implied. When `suit-directive-set-component-index` is used, `suit-directive-set-dependency-index = False` is implied.

The following CDDL describes the argument to `suit-directive-set-component-index`.

`SUIT_Directive_Set_Component_Index_Argument = uint/bool`

7.12.2. suit-directive-set-dependency-index

Set Dependency Index defines the manifest to which successive directives and conditions will apply. The supplied argument MUST be either a boolean or an unsigned integer index into the dependencies. If the following directives apply to ALL dependencies, then the boolean value "True" is used instead of an index. If the following directives apply to NO dependencies, then the boolean value "False" is used. When `suit-directive-set-component-index` is used, `suit-directive-set-dependency-index = False` is implied. When `suit-directive-set-dependency-index` is used, `suit-directive-set-component-index = False` is implied.

Typical operations that require `suit-directive-set-dependency-index` include setting a source URI, invoking "Fetch," or invoking "Process Dependency" for an individual dependency.

The following CDDL describes the argument to `suit-directive-set-dependency-index`.

`SUIT_Directive_Set_Manifest_Index_Argument = uint/bool`

7.12.3. suit-directive-abort

Unconditionally fail. This operation is typically used in conjunction with `suit-directive-try-each`.

7.12.4. suit-directive-run-sequence

To enable conditional commands, and to allow several strictly ordered sequences to be executed out-of-order, `suit-directive-run-sequence` allows the manifest processor to execute its argument as a `SUIT_Command_Sequence`. The argument must be wrapped in a `bstr`.

When a sequence is executed, any failure of a condition causes immediate termination of the sequence.

The following CDDL describes the `SUIT_Run_Sequence` argument.

```
SUIT_Directive_Run_Sequence_Argument = bstr .cbor SUIT_Command_Sequence
```

When `suit-directive-run-sequence` completes, it forwards the last status code that occurred in the sequence. If the `Coerce on Condition Failure` parameter is true, then `suit-directive-run-sequence` only fails when a directive in the argument sequence fails.

`SUIT_Parameter_Coerce_Condition_Failure` defaults to `False` when `suit-directive-run-sequence` begins. Its value is discarded when `suit-directive-run-sequence` terminates.

7.12.5. suit-directive-try-each

This command runs several `suit-directive-run-sequence` one after another, in a strict order. Use this command to implement a "try/catch-try/catch" sequence. Manifest processors MAY implement this command.

`SUIT_Parameter_Coerce_Condition_Failure` is initialised to `True` at the beginning of each sequence. If one sequence aborts due to a condition failure, the next is started. If no sequence completes without condition failure, then `suit-directive-try-each` returns an error. If a particular application calls for all sequences to fail and still continue, then an empty sequence (`nil`) can be added to the Try Each Argument.

The following CDDL describes the `SUIT_Try_Each` argument.

```
SUIT_Directive_Try_Each_Argument = [  
  + bstr .cbor SUIT_Command_Sequence,  
  nil / bstr .cbor SUIT_Command_Sequence  
]
```

7.12.6. suit-directive-process-dependency

Execute the commands in the common section of the current dependency, followed by the commands in the equivalent section of the current dependency. For example, if the current section is "fetch payload," this will execute "common" in the current dependency, then "fetch payload" in the current dependency. Once this is complete, the command following `suit-directive-process-dependency` will be processed.

If the current dependency is `False`, this directive has no effect. If the current dependency is `True`, then this directive applies to all

dependencies. If the current section is "common," this directive MUST have no effect.

When `SUIT_Process_Dependency` completes, it forwards the last status code that occurred in the dependency.

The argument to `suit-directive-process-dependency` is defined in the following CDDL.

```
SUIT_Directive_Process_Dependency_Argument = nil
```

7.12.7. suit-directive-set-parameters

`suit-directive-set-parameters` allows the manifest to configure behaviour of future directives by changing parameters that are read by those directives. When dependencies are used, `suit-directive-set-parameters` also allows a manifest to modify the behaviour of its dependencies.

Available parameters are defined in [Section 7.5](#).

If a parameter is already set, `suit-directive-set-parameters` will skip setting the parameter to its argument. This provides the core of the override mechanism, allowing dependent manifests to change the behaviour of a manifest.

The argument to `suit-directive-set-parameters` is defined in the following CDDL.

```
SUIT_Directive_Set_Parameters_Argument = {+ SUIT_Parameters}
```

N.B.: A directive code is reserved for an optimisation: a way to set a parameter to the contents of another parameter, optionally with another component ID.

7.12.8. suit-directive-override-parameters

`suit-directive-override-parameters` replaces any listed parameters that are already set with the values that are provided in its argument. This allows a manifest to prevent replacement of critical parameters.

Available parameters are defined in [Section 7.5](#).

The argument to `suit-directive-override-parameters` is defined in the following CDDL.

```
SUIT_Directive_Override_Parameters_Argument = {+ SUIT_Parameters}
```


7.12.9. suit-directive-fetch

suit-directive-fetch instructs the manifest processor to obtain one or more manifests or payloads, as specified by the manifest index and component index, respectively.

suit-directive-fetch can target one or more manifests and one or more payloads. suit-directive-fetch retrieves each component and each manifest listed in component-index and manifest-index, respectively. If component-index or manifest-index is True, instead of an integer, then all current manifest components/manifests are fetched. The current manifest's dependent-components are not automatically fetched. In order to pre-fetch these, they MUST be specified in a component-index integer.

suit-directive-fetch typically takes no arguments unless one is needed to modify fetch behaviour. If an argument is needed, it must be wrapped in a bstr.

suit-directive-fetch reads the URI or URI List parameter to find the source of the fetch it performs.

The behaviour of suit-directive-fetch can be modified by setting one or more of SUIT_Parameter_Encryption_Info, SUIT_Parameter_Compression_Info, SUIT_Parameter_Unpack_Info. These three parameters each activate and configure a processing step that can be applied to the data that is transferred during suit-directive-fetch.

The argument to suit-directive-fetch is defined in the following CDDL.

```
SUIT_Directive_Fetch_Argument = nil/bstr
```

7.12.10. suit-directive-copy

suit-directive-copy instructs the manifest processor to obtain one or more payloads, as specified by the component index. suit-directive-copy retrieves each component listed in component-index, respectively. If component-index is True, instead of an integer, then all current manifest components are copied. The current manifest's dependent-components are not automatically copied. In order to copy these, they MUST be specified in a component-index integer.

The behaviour of suit-directive-copy can be modified by setting one or more of SUIT_Parameter_Encryption_Info, SUIT_Parameter_Compression_Info, SUIT_Parameter_Unpack_Info. These

three parameters each activate and configure a processing step that can be applied to the data that is transferred during suit-directive-copy.

N.B. Fetch and Copy are very similar. Merging them into one command may be appropriate.

suit-directive-copy reads its source from
SUIT_Parameter_Source_Component.

The argument to suit-directive-copy is defined in the following CDDL.

SUIT_Directive_Copy_Argument = nil

7.12.11. suit-directive-swap

suit-directive-swap instructs the manifest processor to move the source to the destination and the destination to the source simultaneously. Swap has nearly identical semantics to suit-directive-copy except that suit-directive-swap replaces the source with the current contents of the destination in an application-defined way. If SUIT_Parameter_Compression_Info or SUIT_Parameter_Encryption_Info are present, they must be handled in a symmetric way, so that the source is decompressed into the destination and the destination is compressed into the source. The source is decrypted into the destination and the destination is encrypted into the source. suit-directive-swap is OPTIONAL to implement.

7.12.12. suit-directive-run

suit-directive-run directs the manifest processor to transfer execution to the current Component Index. When this is invoked, the manifest processor MAY be unloaded and execution continues in the Component Index. Arguments provided to Run are forwarded to the executable code located in Component Index, in an application-specific way. For example, this could form the Linux Kernel Command Line if booting a linux device.

If the executable code at Component Index is constructed in such a way that it does not unload the manifest processor, then the manifest processor may resume execution after the executable completes. This allows the manifest processor to invoke suitable helpers and to verify them with image conditions.

The argument to suit-directive-run is defined in the following CDDL.

SUIT_Directive_Run_Argument = nil/bstr

7.12.13. suit-directive-wait

suit-directive-wait directs the manifest processor to pause until a specified event occurs. Some possible events include:

1. Authorisation
2. External Power
3. Network availability
4. Other Device Firmware Version
5. Time
6. Time of Day
7. Day of Week

The following CDDL defines the encoding of these events.

```
SUIT_Wait_Events //= (suit-wait-event-authorisation => int)
SUIT_Wait_Events //= (suit-wait-event-power => int)
SUIT_Wait_Events //= (suit-wait-event-network => int)
SUIT_Wait_Events //= (suit-wait-event-other-device-version
    => SUIT_Wait_Event_Argument_Other_Device_Version)
SUIT_Wait_Events //= (suit-wait-event-time => uint); Timestamp
SUIT_Wait_Events //= (suit-wait-event-time-of-day
    => uint); Time of Day (seconds since 00:00:00)
SUIT_Wait_Events //= (suit-wait-event-day-of-week
    => uint); Days since Sunday

SUIT_Wait_Event_Argument_Authorisation = int ; priority
SUIT_Wait_Event_Argument_Power = int ; Power Level
SUIT_Wait_Event_Argument_Network = int ; Network State
SUIT_Wait_Event_Argument_Other_Device_Version = [
    other-device: bstr,
    other-device-version: [+int]
]
SUIT_Wait_Event_Argument_Time = uint ; Timestamp
SUIT_Wait_Event_Argument_Time_Of_Day = uint ; Time of Day (seconds since
00:00:00)
SUIT_Wait_Event_Argument_Day_Of_Week = uint ; Days since Sunday
```


7.12.14. SUIT_Directive CDDL

The following CDDL describes SUIT_Directive:

```

SUIT_Directive //= (suit-directive-set-component-index,  uint/bool)
SUIT_Directive //= (suit-directive-set-dependency-index, uint/bool)
SUIT_Directive //= (suit-directive-run-sequence,
                    bstr .cbor SUIT_Command_Sequence)
SUIT_Directive //= (suit-directive-try-each,
                    SUIT_Directive_Try_Each_Argument)
SUIT_Directive //= (suit-directive-process-dependency,  nil)
SUIT_Directive //= (suit-directive-set-parameters,
                    {+ SUIT_Parameters})
SUIT_Directive //= (suit-directive-override-parameters,
                    {+ SUIT_Parameters})
SUIT_Directive //= (suit-directive-fetch,                nil)
SUIT_Directive //= (suit-directive-copy,                nil)
SUIT_Directive //= (suit-directive-run,                  nil)
SUIT_Directive //= (suit-directive-wait,
                    { + SUIT_Wait_Events })
SUIT_Directive //= (suit-directive-run-with-arguments,  bstr)

SUIT_Directive_Try_Each_Argument = [
    + bstr .cbor SUIT_Command_Sequence,
    nil / bstr .cbor SUIT_Command_Sequence
]

SUIT_Wait_Events //= (suit-wait-event-authorisation => int)
SUIT_Wait_Events //= (suit-wait-event-power => int)
SUIT_Wait_Events //= (suit-wait-event-network => int)
SUIT_Wait_Events //= (suit-wait-event-other-device-version
    => SUIT_Wait_Event_Argument_Other_Device_Version)
SUIT_Wait_Events //= (suit-wait-event-time => uint); Timestamp
SUIT_Wait_Events //= (suit-wait-event-time-of-day
    => uint); Time of Day (seconds since 00:00:00)
SUIT_Wait_Events //= (suit-wait-event-day-of-week
    => uint); Days since Sunday

SUIT_Wait_Event_Argument_Authorisation = int ; priority
SUIT_Wait_Event_Argument_Power = int ; Power Level
SUIT_Wait_Event_Argument_Network = int ; Network State
SUIT_Wait_Event_Argument_Other_Device_Version = [
    other-device: bstr,
    other-device-version: [+int]
]
SUIT_Wait_Event_Argument_Time = uint ; Timestamp
SUIT_Wait_Event_Argument_Time_Of_Day = uint ; Time of Day (seconds since
00:00:00)
SUIT_Wait_Event_Argument_Day_Of_Week = uint ; Days since Sunday

```


8. Dependency processing

Dependencies need careful handling on constrained systems. A dependency tree that is too deep can cause recursive handling to overflow stack space. Systems that parse all dependencies into an object tree can easily fill up available memory. Too many dependencies can overrun available storage space.

The dependency handling system in this document is designed to address as many of these problems as possible.

Dependencies MAY be addressed in one of three ways:

1. Iterate by component
2. Iterate by manifest
3. Out-of-order

Because each manifest has a list of components and a list of components defined by its dependencies, it is possible for the manifest processor to handle one component at a time, traversing the manifest tree once for each listed component. This, however consumes significant processing power.

Alternatively, it is possible for a device with sufficient memory to accumulate all parameters for all listed component IDs. This will naturally consume more memory, but it allows the device to process the manifests in a single pass.

It is expected that the simplest and most power sensitive devices will use option 2, with a fixed maximum number of components.

Advanced devices may make use of the Strict Order parameter and enable parallel processing of some segments, or it may reorder some segments. To perform parallel processing, once the Strict Order parameter is set to False, the device may fork a process for each command until the Strict Order parameter is returned to True or the command sequence ends. Then, it joins all forked processes before continuing processing of commands. To perform out-of-order processing, a similar approach is used, except the device consumes all commands after the Strict Order parameter is set to False, then it sorts these commands into its preferred order, invokes them all, then continues processing.

9. Access Control Lists

To manage permissions in the manifest, there are three models that can be used.

First, the simplest model requires that all manifests are authenticated by a single trusted key. This mode has the advantage that only a root manifest needs to be authenticated, since all of its dependencies have digests included in the root manifest.

This simplest model can be extended by adding key delegation without much increase in complexity.

A second model requires an ACL to be presented to the device, authenticated by a trusted party or stored on the device. This ACL grants access rights for specific component IDs or component ID prefixes to the listed identities or identity groups. Any identity may verify an image digest, but fetching into or fetching from a component ID requires approval from the ACL.

A third model allows a device to provide even more fine-grained controls: The ACL lists the component ID or component ID prefix that an identity may use, and also lists the commands that the identity may use in combination with that component ID.

10. SUIT digest container

[RFC 8152](#) [[RFC8152](#)] provides containers for signature, MAC, and encryption, but no basic digest container. The container needed for a digest requires a type identifier and a container for the raw digest data. Some forms of digest may require additional parameters. These can be added following the digest. This structure is described by the following CDDL.

The algorithms listed are sufficient for verifying integrity of Firmware Updates as of this writing, however this may change over time.


```
        "directive-set-var" : {
            "size": 32567
        },
    },
    {
        "try-each" : [
            [
                {"condition-component-offset" : "<offset A>"},
                {
                    "directive-set-var": {
                        "digest" : "<SHA256 A>"
                    }
                }
            ],
            [
                {"condition-component-offset" : "<offset B>"},
                {
                    "directive-set-var": {
                        "digest" : "<SHA256 B>"
                    }
                }
            ],
            [{ "abort" : null }]
        ]
    }
]
}
"fetch" : [
    {
        "try-each" : [
            [
                {"condition-component-offset" : "<offset A>"},
                {
                    "directive-set-var": {
                        "uri" : "<URI A>"
                    }
                }
            ],
            [
                {"condition-component-offset" : "<offset B>"},
                {
                    "directive-set-var": {
                        "uri" : "<URI B>"
                    }
                }
            ],
            [{ "directive-abort" : null }]
        ]
    }
]
```



```

    },
    "fetch" : null
  ]
}

```

12. Full CDDL

In order to create a valid SUIF Manifest document the structure of the corresponding CBOR message MUST adhere to the following CDDL data definition.

```

SUIT_Outer_Wrapper = {
  suit-authentication-wrapper => bstr .cbor SUIT_Authentication_Wrapper /
nil,
  $$SUIT_Manifest_Wrapped,
  suit-dependency-resolution => bstr .cbor SUIT_Command_Sequence,
  suit-payload-fetch         => bstr .cbor SUIT_Command_Sequence,
  suit-install                => bstr .cbor SUIT_Command_Sequence,
  suit-text                   => bstr .cbor SUIT_Text_Map,
  suit-coswid                 => bstr .cbor concise-software-identity
}

```

```

SUIT_Authentication_Wrapper = [ + (
  COSE_Mac_Tagged /
  COSE_Sign_Tagged /
  COSE_Mac0_Tagged /
  COSE_Sign1_Tagged)
]

```

```

SUIT_Encryption_Wrapper = COSE_Encrypt_Tagged / COSE_Encrypt0_Tagged

```

```

$$SUIT_Manifest_Wrapped //= (suit-manifest => bstr .cbor SUIT_Manifest)
$$SUIT_Manifest_Wrapped //= (
  suit-manifest-encryption-info => bstr .cbor SUIT_Encryption_Wrapper,
  suit-manifest-encrypted       => bstr
)

```

```

COSE_Mac_Tagged = any
COSE_Sign_Tagged = any
COSE_Mac0_Tagged = any
COSE_Sign1_Tagged = any
COSE_Encrypt_Tagged = any
COSE_Encrypt0_Tagged = any

```

```

SUIT_Digest = [
  suit-digest-algorithm-id : $suit-digest-algorithm-ids,
  suit-digest-bytes : bytes,
  ? suit-digest-parameters : any
]

```



```
; Named Information Hash Algorithm Identifiers
suit-digest-algorithm-ids /= algorithm-id-sha224
suit-digest-algorithm-ids /= algorithm-id-sha256
suit-digest-algorithm-ids /= algorithm-id-sha384
suit-digest-algorithm-ids /= algorithm-id-sha512
suit-digest-algorithm-ids /= algorithm-id-sha3-224
suit-digest-algorithm-ids /= algorithm-id-sha3-256
suit-digest-algorithm-ids /= algorithm-id-sha3-384
suit-digest-algorithm-ids /= algorithm-id-sha3-512
```

```
SUIT_Manifest = {
    suit-manifest-version          => 1,
    suit-manifest-sequence-number => uint,
    ? suit-common                  => bstr .cbor SUIT_Common,
    ? suit-dependency-resolution  => SUIT_Digest / bstr .cbor
SUIT_Command_Sequence,
    ? suit-payload-fetch          => SUIT_Digest / bstr .cbor
SUIT_Command_Sequence,
    ? suit-install                => SUIT_Digest / bstr .cbor
SUIT_Command_Sequence
    ? suit-validate               => bstr .cbor SUIT_Command_Sequence
    ? suit-load                   => bstr .cbor SUIT_Command_Sequence
    ? suit-run                    => bstr .cbor SUIT_Command_Sequence
    ? suit-text                   => SUIT_Digest / bstr .cbor SUIT_Text_Map
    ? suit-coswid                 => SUIT_Digest / bstr .cbor concise-software-
identity
}
```

```
SUIT_Common = {
    ? suit-dependencies           => bstr .cbor SUIT_Dependencies,
    ? suit-components             => bstr .cbor SUIT_Components,
    ? suit-dependency-components => bstr .cbor SUIT_Component_References,
    ? suit-common-sequence        => bstr .cbor SUIT_Command_Sequence,
}
```

```
SUIT_Dependencies      = [ + SUIT_Dependency ]
SUIT_Components         = [ + SUIT_Component_Identifier ]
SUIT_Component_References = [ + SUIT_Component_Reference ]
```

```
concise-software-identity = any
```

```
SUIT_Dependency = {
    suit-dependency-digest => SUIT_Digest,
    suit-dependency-prefix => SUIT_Component_Identifier,
}
```

```
SUIT_Component_Identifier = [* bstr]
```

```
SUIT_Component_Reference = {  
  suit-component-identifier => SUIT_Component_Identifier,  
  suit-component-dependency-index => uint
```

```
}
```

```
SUIT_Command_Sequence = [ + (SUIT_Condition // SUIT_Directive //  
SUIT_Command_Custom) ]
```

```
SUIT_Command_Custom = (nint, bstr)  
SUIT_Condition //= (suit-condition-vendor-identifier, nil)  
SUIT_Condition //= (suit-condition-class-identifier, nil)  
SUIT_Condition //= (suit-condition-device-identifier, nil)  
SUIT_Condition //= (suit-condition-image-match, nil)  
SUIT_Condition //= (suit-condition-image-not-match, nil)  
SUIT_Condition //= (suit-condition-use-before, uint)  
SUIT_Condition //= (suit-condition-minimum-battery, uint)  
SUIT_Condition //= (suit-condition-update-authorised, int)  
SUIT_Condition //= (suit-condition-version,  
SUIT_Condition_Version_Argument)  
SUIT_Condition //= (suit-condition-component-offset, uint)  
SUIT_Condition //= (suit-condition-custom, bstr)
```

```
RFC4122_UUID = bstr .size 16
```

```
SUIT_Condition_Version_Argument = [  
    suit-condition-version-comparison: SUIT_Condition_Version_Comparison_Types,  
    suit-condition-version-comparison: SUIT_Condition_Version_Comparison_Value  
]
```

```
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-  
greater
```

```
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-  
greater-equal
```

```
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-  
equal
```

```
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-  
lesser-equal
```

```
SUIT_Condition_Version_Comparison_Types /= suit-condition-version-comparison-  
lesser
```

```
suit-condition-version-comparison-greater = 1
```

```
suit-condition-version-comparison-greater-equal = 2
```

```
suit-condition-version-comparison-equal = 3
```

```
suit-condition-version-comparison-lesser-equal = 4
```

```
suit-condition-version-comparison-lesser = 5
```

```
SUIT_Condition_Version_Comparison_Value = [+int]
```

```
SUIT_Directive //= (suit-directive-set-component-index, uint/bool)
```

```
SUIT_Directive //= (suit-directive-set-dependency-index, uint/bool)
```

```
SUIT_Directive //= (suit-directive-run-sequence, bstr .cbor
```

```
SUIT_Command_Sequence)
```

```
SUIT_Directive //= (suit-directive-try-each,  
SUIT_Directive_Try_Each_Argument)  
SUIT_Directive //= (suit-directive-process-dependency,      nil)  
SUIT_Directive //= (suit-directive-set-parameters,          {+  
SUIT_Parameters})  
SUIT_Directive //= (suit-directive-override-parameters,     {+  
SUIT_Parameters})  
SUIT_Directive //= (suit-directive-fetch,                    nil)  
SUIT_Directive //= (suit-directive-copy,                      nil)  
SUIT_Directive //= (suit-directive-swap,                      nil)
```

```
SUIT_Directive //= (suit-directive-run, nil)
SUIT_Directive //= (suit-directive-wait, { +
SUIT_Wait_Events })
SUIT_Directive //= (suit-directive-run-with-arguments, bstr)

SUIT_Directive_Try_Each_Argument = [
  + bstr .cbor SUIT_Command_Sequence,
  nil / bstr .cbor SUIT_Command_Sequence
]

SUIT_Wait_Events //= (suit-wait-event-authorisation => int)
SUIT_Wait_Events //= (suit-wait-event-power => int)
SUIT_Wait_Events //= (suit-wait-event-network => int)
SUIT_Wait_Events //= (suit-wait-event-other-device-version
=> SUIT_Wait_Event_Argument_Other_Device_Version)
SUIT_Wait_Events //= (suit-wait-event-time => uint); Timestamp
SUIT_Wait_Events //= (suit-wait-event-time-of-day
=> uint); Time of Day (seconds since 00:00:00)
SUIT_Wait_Events //= (suit-wait-event-day-of-week
=> uint); Days since Sunday

SUIT_Wait_Event_Argument_Authorisation = int ; priority
SUIT_Wait_Event_Argument_Power = int ; Power Level
SUIT_Wait_Event_Argument_Network = int ; Network State
SUIT_Wait_Event_Argument_Other_Device_Version = [
  other-device: bstr,
  other-device-version: [+int]
]
SUIT_Wait_Event_Argument_Time = uint ; Timestamp
SUIT_Wait_Event_Argument_Time_Of_Day = uint ; Time of Day (seconds since
00:00:00)
SUIT_Wait_Event_Argument_Day_Of_Week = uint ; Days since Sunday

SUIT_Parameters //= (suit-parameter-strict-order => bool)
SUIT_Parameters //= (suit-parameter-coerce-condition-failure => bool)
SUIT_Parameters //= (suit-parameter-vendor-id => bstr)
SUIT_Parameters //= (suit-parameter-class-id => bstr)
SUIT_Parameters //= (suit-parameter-device-id => bstr)
SUIT_Parameters //= (suit-parameter-uri => bstr)
SUIT_Parameters //= (suit-parameter-encryption-info => bstr .cbor
SUIT_Encryption_Info)
SUIT_Parameters //= (suit-parameter-compression-info => bstr .cbor
SUIT_Compression_Info)
SUIT_Parameters //= (suit-parameter-unpack-info => bstr .cbor SUIT_Unpack_Info)
SUIT_Parameters //= (suit-parameter-source-component => bstr .cbor
SUIT_Component_Identifier)
SUIT_Parameters //= (suit-parameter-image-digest => bstr .cbor SUIT_Digest)
```



```
SUIT_Parameters //= (suit-parameter-image-size => uint)
SUIT_Parameters //= (suit-parameter-uri-list => bstr .cbor
SUIT_Component_URI_List)
SUIT_Parameters //= (suit-parameter-custom => int/bool/bstr)

SUIT_Component_URI_List = [ + [priority: int, uri: tstr] ]
```

```
SUIT_Priority_Parameter_List = [ + [priority: int, parameters: { +  
SUIT_Parameters }} ] ]
```

```
SUIT_Encryption_Info = COSE_Encrypt_Tagged/COSE_Encrypt0_Tagged  
SUIT_Compression_Info = {  
    suit-compression-algorithm => SUIT_Compression_Algorithms  
    ? suit-compression-parameters => bstr  
}
```

```
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_gzip  
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_bzip2  
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_lz4  
SUIT_Compression_Algorithms /= SUIT_Compression_Algorithm_lzma
```

```
SUIT_Compression_Algorithm_gzip = 1  
SUIT_Compression_Algorithm_bzip2 = 2  
SUIT_Compression_Algorithm_deflate = 3  
SUIT_Compression_Algorithm_lz4 = 4  
SUIT_Compression_Algorithm_lzma = 7
```

```
SUIT_Unpack_Info = {  
    suit-unpack-algorithm => SUIT_Unpack_Algorithms  
    ? suit-unpack-parameters => bstr  
}
```

```
SUIT_Unpack_Algorithms /= SUIT_Unpack_Algorithm_Delta  
SUIT_Unpack_Algorithms /= SUIT_Unpack_Algorithm_Hex  
SUIT_Unpack_Algorithms /= SUIT_Unpack_Algorithm_Elf
```

```
SUIT_Unpack_Algorithm_Delta = 1  
SUIT_Unpack_Algorithm_Hex = 2  
SUIT_Unpack_Algorithm_Elf = 3
```

```
SUIT_Text_Map = {int => tstr}
```

```
suit-authentication-wrapper = 1  
suit-manifest = 2
```

```
suit-manifest-encryption-info = 3  
suit-manifest-encrypted = 4
```

```
suit-manifest-version = 1  
suit-manifest-sequence-number = 2  
suit-common = 3  
suit-dependency-resolution = 7  
suit-payload-fetch = 8  
suit-install = 9  
suit-validate = 10  
suit-load = 11
```


suit-run = 12
suit-text = 13
suit-coswid = 14

suit-dependencies = 1
suit-components = 2
suit-dependency-components = 3
suit-common-sequence = 4

suit-dependency-digest = 1
suit-dependency-prefix = 2

suit-component-identifier = 1
suit-component-dependency-index = 2

suit-command-custom = nint

suit-condition-vendor-identifier = 1
suit-condition-class-identifier = 2
suit-condition-image-match = 3
suit-condition-use-before = 4
suit-condition-component-offset = 5
suit-condition-custom = 6

suit-condition-device-identifier = 24
suit-condition-image-not-match = 25
suit-condition-minimum-battery = 26
suit-condition-update-authorised = 27
suit-condition-version = 28

suit-directive-set-component-index = 12
suit-directive-set-dependency-index = 13
suit-directive-abort = 14
suit-directive-try-each = 15
suit-directive-do-each = 16 ; TBD
suit-directive-map-filter = 17 ; TBD
suit-directive-process-dependency = 18
suit-directive-set-parameters = 19
suit-directive-override-parameters = 20
suit-directive-fetch = 21
suit-directive-copy = 22
suit-directive-run = 23

suit-directive-wait = 29
suit-directive-run-sequence = 30
suit-directive-run-with-arguments = 31
suit-directive-swap = 32


```
suit-wait-event-argument-authorisation = 1
suit-wait-event-power = 2
suit-wait-event-network = 3
suit-wait-event-other-device-version = 4
suit-wait-event-time = 5
suit-wait-event-time-of-day = 6
suit-wait-event-day-of-week = 7
suit-wait-event-authorisation = 8

suit-parameter-strict-order = 1
suit-parameter-coerce-condition-failure = 2
suit-parameter-vendor-id = 3
suit-parameter-class-id = 4
suit-parameter-device-id = 5
suit-parameter-uri = 6
suit-parameter-encryption-info = 7
suit-parameter-compression-info = 8
suit-parameter-unpack-info = 9
suit-parameter-source-component = 10
suit-parameter-image-digest = 11
suit-parameter-image-size = 12

suit-parameter-uri-list = 24
suit-parameter-uri-list-append = 25
suit-parameter-prioritised-parameters = 26

suit-parameter-custom = nint

suit-compression-algorithm = 1
suit-compression-parameters = 2

suit-unpack-algorithm = 1
suit-unpack-parameters = 2
```

13. Examples

The following examples demonstrate a small subset of the functionality of the manifest. However, despite this, even a simple manifest processor can execute most of these manifests.

None of these examples include authentication. This is provided via [RFC 8152](#) [RFC8152], and is omitted for clarity.

[13.1.](#) Example 0:

Secure boot only.

The following JSON shows the intended behaviour of the manifest.

```
{
  "structure-version": 1,
  "sequence-number": 1,
  "run-image": [
    { "directive-set-component": 0 },
    { "condition-image": null },
    { "directive-run": null }
  ],
  "common": {
    "common-sequence": [
      {
        "directive-set-var": {
          "digest": "00112233445566778899aabbccddeeff"
            "0123456789abcdeffedcba9876543210",
          "size": 34768
        }
      }
    ],
    "components": [
      [
        "Flash",
        78848
      ]
    ]
  }
}
```

Converted into the SUIT manifest, this produces:


```

{
  / auth object / 1 : h'd28443a10126a1044874657374206b6579f658405e5f'
                      h'b84f9e9729a4d74096ad485921e842b4e320cc3fa177'
                      h'8c2807377e1969e42449b3261109d273df4b3ceb9a61'
                      h'06a46f0a7938de9a8441ab515b82463b39ee',
  / manifest / 2 : h'a40101020103583ea2024c818245466c6173684300340104'
                  h'582c8213a20b8202582000112233445566778899aabbccdd'
                  h'eeff0123456789abcdeffedcba98765432100c1987d00c47'
                  h'860c0003f617f6' \
  {
    / structure-version / 1 : 1,
    / sequence-number / 2 : 1,
    / common / 3 : h'a2024c818245466c6173684300340104582c8213a20b82'
                  h'02582000112233445566778899aabbccddeeff01234567'
                  h'89abcdeffedcba98765432100c1987d0' \ {
      / components / 2 : h'818245466c61736843003401' \
      [
        [h'466c617368', h'003401'],
      ],
      / common-sequence / 4 : h'8213a20b820258200011223344556677'
                            h'8899aabbccddeeff0123456789abcdef'
                            h'fedcba98765432100c1987d0' \ [
        / set-vars / 19, {
          / digest / 11 : [ 2,
                          h'00112233445566778899aabbccddeeff0123456789ab'
                          h'cdeffedcba9876543210' ],
          / size / 12 : 34768,
        },
      ],
    },
    / run-image / 12 : h'860c0003f617f6' \ [
      / set-component-index / 12, 0,
      / condition-image / 3, None,
      / run / 23, None,
    ],
  }
}

```

Total size of outer wrapper without COSE authentication object: 85

Outer:

```

a201f602584fa40101020103583ea2024c818245466c6173684300340104582c8213a20b
8202582000112233445566778899aabbccddeeff0123456789abcdeffedcba9876543210
0c1987d00c47860c0003f617f6

```

Total size of outer wrapper with COSE authentication object: 170

Signed Outer:

```
a2015854d28443a10126a1044874657374206b6579f658405e5fb84f9e9729a4d74096ad
485921e842b4e320cc3fa1778c2807377e1969e42449b3261109d273df4b3ceb9a6106a4
6f0a7938de9a8441ab515b82463b39ee02584fa40101020103583ea2024c818245466c61
73684300340104582c8213a20b8202582000112233445566778899aabbccddeeff012345
6789abcdeffedcba98765432100c1987d00c47860c0003f617f6
```

[13.2.](#) Example 1:

Simultaneous download and installation of payload.

The following JSON shows the intended behaviour of the manifest.

```
{
  "structure-version": 1,
  "sequence-number": 2,
  "apply-image": [
    { "directive-set-component": 0 },
    {
      "directive-set-var": {
        "uri": "http://example.com/file.bin"
      }
    },
    { "directive-fetch": null }
  ],
  "common": {
    "common-sequence": [
      {
        "directive-set-var": {
          "digest": "00112233445566778899aabbccddeeff"
            "0123456789abcdeffedcba9876543210",
          "size": 34768
        }
      }
    ],
    "components": [
      [
        "Flash",
        78848
      ]
    ]
  }
}
```

Converted into the SUIT manifest, this produces:


```

{
  / auth object / 1 : h'd28443a10126a1044874657374206b6579f658403d4e'
                      h'9ff1ca8803a81ae1e2b13df28c527a4d6975e860035e'
                      h'e9a88576b5e6f2bf12f33017e88157bcff58d712e7f8'
                      h'010821ae0f82f78eb681b61697345e655cf4',
  / manifest / 2 : h'a40101020203583ea2024c818245466c6173684300340104'
                  h'582c8213a20b8202582000112233445566778899aabbccdd'
                  h'eeff0123456789abcdeffedcba98765432100c1987d00958'
                  h'25860c0013a106781b687474703a2f2f6578616d706c652e'
                  h'636f6d2f66696c652e62696e15f6' \
  {
    / structure-version / 1 : 1,
    / sequence-number / 2 : 2,
    / common / 3 : h'a2024c818245466c6173684300340104582c8213a20b82'
                  h'02582000112233445566778899aabbccddeeff01234567'
                  h'89abcdeffedcba98765432100c1987d0' \ {
      / components / 2 : h'818245466c61736843003401' \
      [
        [h'466c617368', h'003401'],
      ],
      / common-sequence / 4 : h'8213a20b820258200011223344556677'
                            h'8899aabbccddeeff0123456789abcdef'
                            h'fedcba98765432100c1987d0' \ [
        / set-vars / 19, {
          / digest / 11 : [ 2,
                          h'00112233445566778899aabbccddeeff0123456789ab'
                          h'cdeffedcba9876543210' ],
          / size / 12 : 34768,
        },
      ],
    },
  / apply-image / 9 : h'860c0013a106781b687474703a2f2f6578616d70'
                    h'6c652e636f6d2f66696c652e62696e15f6' \ [
    / set-component-index / 12, 0,
    / set-vars / 19, {
      / uri / 6 : http://example.com/file.bin,
    },
    / fetch / 21, None,
  ],
}
}

```

Total size of outer wrapper without COSE authentication object: 116

Outer:


```
a201f602586ea40101020203583ea2024c818245466c6173684300340104582c8213a20b
8202582000112233445566778899aabbccddeeff0123456789abcdeffedcba9876543210
0c1987d0095825860c0013a106781b687474703a2f2f6578616d706c652e636f6d2f6669
6c652e62696e15f6
```

Total size of outer wrapper with COSE authentication object: 201

Signed Outer:

```
a2015854d28443a10126a1044874657374206b6579f658403d4e9ff1ca8803a81ae1e2b1
3df28c527a4d6975e860035ee9a88576b5e6f2bf12f33017e88157bcff58d712e7f80108
21ae0f82f78eb681b61697345e655cf402586ea40101020203583ea2024c818245466c61
73684300340104582c8213a20b8202582000112233445566778899aabbccddeeff012345
6789abcdeffedcba98765432100c1987d0095825860c0013a106781b687474703a2f2f65
78616d706c652e636f6d2f66696c652e62696e15f6
```

13.3. Example 2:

Compatibility test, simultaneous download and installation, and secure boot.

The following JSON shows the intended behaviour of the manifest.


```

{
  "structure-version": 1,
  "sequence-number": 3,
  "common": {
    "common-sequence": [
      {
        "directive-set-var": {
          "vendor-id": "fa6b4a53-d5ad-5fdf-be9d-e663e4d41ffe",
          "class-id": "1492af14-2569-5e48-bf42-9b2d51f2ab45",
          "digest": "00112233445566778899aabbccddeeff"
            "0123456789abcdeffedcba9876543210",
          "size": 34768
        }
      },
      { "condition-vendor-id": null },
      { "condition-class-id": null }
    ],
    "components": [
      [
        "Flash",
        78848
      ]
    ]
  },
  "apply-image": [
    { "directive-set-component": 0 },
    {
      "directive-set-var": {
        "uri": "http://example.com/file.bin"
      }
    },
    { "directive-fetch": null }
  ],
  "run-image": [
    { "directive-set-component": 0 },
    { "condition-image": null },
    { "directive-run": null }
  ]
}

```

Converted into the SUIT manifest, this produces:

```

{
  / auth object / 1 : h'd28443a10126a1044874657374206b6579f65840e637'
    h'5a57596cb4a35a90a30b4099bccf7e2352a9829bf7bb'
    h'1b56cfc0e7113955be4fd360e366c94e32dfc344695b1'
    h'20b2c59732b2e3f079fc2693c5a459d9ce44',
  / manifest / 2 : h'a501010203035866a2024c818245466c6173684300340104'
}

```



```
h'58548613a40350fa6b4a53d5ad5fdfbe9de663e4d41ffe04'
h'501492af1425695e48bf429b2d51f2ab450b820258200011'
h'2233445566778899aabbccddeeff0123456789abcdeffedc'
h'ba98765432100c1987d001f602f6095825860c0013a10678'
h'1b687474703a2f2f6578616d706c652e636f6d2f66696c65'
h'2e62696e15f60c47860c0003f617f6' \
{
  / structure-version / 1 : 1,
  / sequence-number / 2 : 3,
  / common / 3 : h'a2024c818245466c617368430034010458548613a40350'
    h'fa6b4a53d5ad5fdfbe9de663e4d41ffe04501492af1425'
    h'695e48bf429b2d51f2ab450b8202582000112233445566'
    h'778899aabbccddeeff0123456789abcdeffedcba987654'
    h'32100c1987d001f602f6' \ {
    / components / 2 : h'818245466c61736843003401' \
    [
      [h'466c617368', h'003401'],
    ],
    / common-sequence / 4 : h'8613a40350fa6b4a53d5ad5fdfbe9de6'
      h'63e4d41ffe04501492af1425695e48bf'
      h'429b2d51f2ab450b8202582000112233'
      h'445566778899aabbccddeeff01234567'
      h'89abcdeffedcba98765432100c1987d0'
      h'01f602f6' \ [
      / set-vars / 19, {
        / vendor-id / 3 : h'fa6b4a53d5ad5fdfbe9de663e4d41f'
          h'fe',
        / class-id / 4 : h'1492af1425695e48bf429b2d51f2ab45',
        / digest / 11 : [ 2,
          h'00112233445566778899aabbccddeeff0123456789ab'
          h'cdeffedcba9876543210' ],
        / size / 12 : 34768,
      },
      / condition-vendor-id / 1, None,
      / condition-class-id / 2, None,
    ],
  },
  / apply-image / 9 : h'860c0013a106781b687474703a2f2f6578616d70'
    h'6c652e636f6d2f66696c652e62696e15f6' \ [
    / set-component-index / 12, 0,
    / set-vars / 19, {
      / uri / 6 : http://example.com/file.bin,
    },
    / fetch / 21, None,
  ],
  / run-image / 12 : h'860c0003f617f6' \ [
    / set-component-index / 12, 0,
    / condition-image / 3, None,
```



```

        / run / 23, None,
    ],
}
}

```

Total size of outer wrapper without COSE authentication object: 165

Outer:

```

a201f602589fa501010203035866a2024c818245466c617368430034010458548613a403
50fa6b4a53d5ad5fdfbe9de663e4d41ffe04501492af1425695e48bf429b2d51f2ab450b
8202582000112233445566778899aabbccddeeff0123456789abcdeffedcba9876543210
0c1987d001f602f6095825860c0013a106781b687474703a2f2f6578616d706c652e636f
6d2f66696c652e62696e15f60c47860c0003f617f6

```

Total size of outer wrapper with COSE authentication object: 250

Signed Outer:

```

a2015854d28443a10126a1044874657374206b6579f65840e6375a57596cb4a35a90a30b
4099bccf7e2352a9829bf7bb1b56cfc0e713955be4fd360e366c94e32dfc344695b120b2
c59732b2e3f079fc2693c5a459d9ce4402589fa501010203035866a2024c818245466c61
7368430034010458548613a40350fa6b4a53d5ad5fdfbe9de663e4d41ffe04501492af14
25695e48bf429b2d51f2ab450b8202582000112233445566778899aabbccddeeff012345
6789abcdeffedcba98765432100c1987d001f602f6095825860c0013a106781b68747470
3a2f2f6578616d706c652e636f6d2f66696c652e62696e15f60c47860c0003f617f6

```

13.4. Example 3:

Compatibility test, simultaneous download and installation, load from external storage, and secure boot.

The following JSON shows the intended behaviour of the manifest.

```

{
  "structure-version": 1,
  "sequence-number": 4,
  "common": {
    "common-sequence": [
      {
        "directive-set-var": {
          "vendor-id": "fa6b4a53-d5ad-5fdf-be9d-e663e4d41ffe",
          "class-id": "1492af14-2569-5e48-bf42-9b2d51f2ab45"
        }
      },
      { "directive-set-component": 0 },
      {
        "directive-set-var": {

```



```
        "digest": "00112233445566778899aabbccddeeff"
        "0123456789abcdeffedcba9876543210",
        "size": 34768
    }
},
{ "directive-set-component": 1 },
{
    "directive-set-var": {
        "digest": "00112233445566778899aabbccddeeff"
        "0123456789abcdeffedcba9876543210",
        "size": 34768
    }
},
{ "condition-vendor-id": null },
{ "condition-class-id": null }
],
"components": [
    [
        "Flash",
        78848
    ],
    [
        "RAM",
        1024
    ]
]
},
"apply-image": [
    { "directive-set-component": 0 },
    {
        "directive-set-var": {
            "uri": "http://example.com/file.bin"
        }
    },
    { "directive-fetch": null }
],
"run-image": [
    { "directive-set-component": 0 },
    { "condition-image": null },
    { "directive-set-component": 1 },
    {
        "directive-set-var": {
            "source-index": 0
        }
    },
    { "directive-fetch": null },
    { "condition-image": null },
    { "directive-run": null }
```



```
]
}
```

Converted into the SUIT manifest, this produces:

```
{
  / auth object / 1 : h'd28443a10126a1044874657374206b6579f65840ef4b'
                      h'399c55131a51bebafeb46da6e6b79c59417fdefea7b87'
                      h'e4234bf8f978094e3092c8506d8a912fbacaec5ba365'
                      h'24ae0e4bb1aa14197e4d0afe10ba47e29e5a',
  / manifest / 2 : h'a50101020403589fa20254828245466c6173684300340182'
                  h'4352414d4200040458858e13a20350fa6b4a53d5ad5fdfbe'
                  h'9de663e4d41ffe04501492af1425695e48bf429b2d51f2ab'
                  h'450c0013a20b8202582000112233445566778899aabbccdd'
                  h'eeff0123456789abcdeffedcba98765432100c1987d00c01'
                  h'13a20b8202582000112233445566778899aabbccddeeff01'
                  h'23456789abcdeffedcba98765432100c1987d001f602f609'
                  h'5825860c0013a106781b687474703a2f2f6578616d706c65'
                  h'2e636f6d2f66696c652e62696e15f60c518e0c0003f60c01'
                  h'13a10a0015f603f617f6' \
{
  / structure-version / 1 : 1,
  / sequence-number / 2 : 4,
  / common / 3 : h'a20254828245466c61736843003401824352414d420004'
                h'0458858e13a20350fa6b4a53d5ad5fdfbe9de663e4d41f'
                h'fe04501492af1425695e48bf429b2d51f2ab450c0013a2'
                h'0b8202582000112233445566778899aabbccddeeff0123'
                h'456789abcdeffedcba98765432100c1987d00c0113a20b'
                h'8202582000112233445566778899aabbccddeeff012345'
                h'6789abcdeffedcba98765432100c1987d001f602f6' \ {
    / components / 2 : h'828245466c61736843003401824352414d4200'
                      h'04' \
    [
      [h'466c617368', h'003401'],
      [h'52414d', h'0004'],
    ],
    / common-sequence / 4 : h'8e13a20350fa6b4a53d5ad5fdfbe9de6'
                          h'63e4d41ffe04501492af1425695e48bf'
                          h'429b2d51f2ab450c0013a20b82025820'
                          h'00112233445566778899aabbccddeeff'
                          h'0123456789abcdeffedcba9876543210'
                          h'0c1987d00c0113a20b82025820001122'
                          h'33445566778899aabbccddeeff012345'
                          h'6789abcdeffedcba98765432100c1987'
                          h'd001f602f6' \ [
      / set-vars / 19, {
        / vendor-id / 3 : h'fa6b4a53d5ad5fdfbe9de663e4d41f'
                        h'fe',
```



```

        / class-id / 4 : h'1492af1425695e48bf429b2d51f2ab45',
    },
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'00112233445566778899aabbccddeeff0123456789ab'
            h'cdeffedcba9876543210' ],
        / size / 12 : 34768,
    },
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'00112233445566778899aabbccddeeff0123456789ab'
            h'cdeffedcba9876543210' ],
        / size / 12 : 34768,
    },
    / condition-vendor-id / 1, None,
    / condition-class-id / 2, None,
],
},
/ apply-image / 9 : h'860c0013a106781b687474703a2f2f6578616d70'
                    h'6c652e636f6d2f66696c652e62696e15f6' \ [
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / uri / 6 : http://example.com/file.bin,
    },
    / fetch / 21, None,
],
/ run-image / 12 : h'8e0c0003f60c0113a10a0015f603f617f6' \ [
    / set-component-index / 12, 0,
    / condition-image / 3, None,
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / source-component / 10 : 0,
    },
    / fetch / 21, None,
    / condition-image / 3, None,
    / run / 23, None,
],
}
}

```

Total size of outer wrapper without COSE authentication object: 232

Outer:


```
a201f60258e2a50101020403589fa20254828245466c61736843003401824352414d4200
040458858e13a20350fa6b4a53d5ad5fdfe9de663e4d41ffe04501492af1425695e48bf
429b2d51f2ab450c0013a20b8202582000112233445566778899aabbccddee01234567
89abcdeffedcba98765432100c1987d00c0113a20b8202582000112233445566778899aa
bbccddee0123456789abcdeffedcba98765432100c1987d001f602f6095825860c0013
a106781b687474703a2f2f6578616d706c652e636f6d2f66696c652e62696e15f60c518e
0c0003f60c0113a10a0015f603f617f6
```

Total size of outer wrapper with COSE authentication object: 317

Signed Outer:

```
a2015854d28443a10126a1044874657374206b6579f65840ef4b399c55131a51bebafeb46
da6e6b79c59417fdefea7b87e4234bf8f978094e3092c8506d8a912fbacaec5ba36524ae
0e4bb1aa14197e4d0afe10ba47e29e5a0258e2a50101020403589fa20254828245466c61
736843003401824352414d4200040458858e13a20350fa6b4a53d5ad5fdfe9de663e4d4
1ffe04501492af1425695e48bf429b2d51f2ab450c0013a20b8202582000112233445566
778899aabbccddee0123456789abcdeffedcba98765432100c1987d00c0113a20b8202
582000112233445566778899aabbccddee0123456789abcdeffedcba98765432100c19
87d001f602f6095825860c0013a106781b687474703a2f2f6578616d706c652e636f6d2f
66696c652e62696e15f60c518e0c0003f60c0113a10a0015f603f617f6
```

13.5. Example 4:

Compatibility test, simultaneous download and installation, load and decompress from external storage, and secure boot.

The following JSON shows the intended behaviour of the manifest.

```
{
  "structure-version": 1,
  "sequence-number": 5,
  "common": {
    "common-sequence": [
      {
        "directive-set-var": {
          "vendor-id": "fa6b4a53-d5ad-5fdfe9de-e663e4d41ffe",
          "class-id": "1492af14-2569-5e48-bf42-9b2d51f2ab45"
        }
      },
      { "directive-set-component": 0 },
      {
        "directive-set-var": {
          "digest": "00112233445566778899aabbccddee0123456789abcdeffedcba9876543210",
          "size": 34768
        }
      }
    ],
  },
}
```



```
    { "directive-set-component": 1 },
    {
      "directive-set-var": {
        "digest": "0123456789abcdeffedcba9876543210"
          "00112233445566778899aabbccddeeff",
        "size": 34768
      }
    },
    { "condition-vendor-id": null },
    { "condition-class-id": null }
  ],
  "components": [
    [
      "Flash",
      78848
    ],
    [
      "RAM",
      1024
    ]
  ]
},
"apply-image": [
  { "directive-set-component": 0 },
  {
    "directive-set-var": {
      "uri": "http://example.com/file.bin"
    }
  },
  { "directive-fetch": null }
],
"load-image": [
  { "directive-set-component": 0 },
  { "condition-image": null },
  { "directive-set-component": 1 },
  {
    "directive-set-var": {
      "source-index": 0,
      "compression-info": {
        "algorithm": "gzip"
      }
    }
  },
  { "directive-copy": null }
],
"run-image": [
  { "condition-image": null },
  { "directive-run": null }
```



```
]
}
```

Converted into the SUIT manifest, this produces:

```
{
  / auth object / 1 : h'd28443a10126a1044874657374206b6579f65840e90d'
                      h'ab6e502bad8132adf86b4d78defaebac64fa6c6b2882'
                      h'd12b36f492b14ce75819ed3524de4d66ddfd5e1d80a5'
                      h'984004c1ac9b003b2da32589583a93c541dd',
  / manifest / 2 : h'a60101020503589fa20254828245466c6173684300340182'
                  h'4352414d4200040458858e13a20350fa6b4a53d5ad5fdfbe'
                  h'9de663e4d41ffe04501492af1425695e48bf429b2d51f2ab'
                  h'450c0013a20b8202582000112233445566778899aabbccdd'
                  h'eeff0123456789abcdeffedcba98765432100c1987d00c01'
                  h'13a20b820258200123456789abcdeffedcba987654321000'
                  h'112233445566778899aabbccddeeff0c1987d001f602f609'
                  h'5825860c0013a106781b687474703a2f2f6578616d706c65'
                  h'2e636f6d2f66696c652e62696e15f60b528a0c0003f60c01'
                  h'13a20843a101010a0016f60c458403f617f6' \
{
  / structure-version / 1 : 1,
  / sequence-number / 2 : 5,
  / common / 3 : h'a20254828245466c61736843003401824352414d420004'
                 h'0458858e13a20350fa6b4a53d5ad5fdfbe9de663e4d41f'
                 h'fe04501492af1425695e48bf429b2d51f2ab450c0013a2'
                 h'0b8202582000112233445566778899aabbccddeeff0123'
                 h'456789abcdeffedcba98765432100c1987d00c0113a20b'
                 h'820258200123456789abcdeffedcba9876543210001122'
                 h'33445566778899aabbccddeeff0c1987d001f602f6' \ {
    / components / 2 : h'828245466c61736843003401824352414d4200'
                       h'04' \
    [
      [h'466c617368', h'003401'],
      [h'52414d', h'0004'],
    ],
    / common-sequence / 4 : h'8e13a20350fa6b4a53d5ad5fdfbe9de6'
                           h'63e4d41ffe04501492af1425695e48bf'
                           h'429b2d51f2ab450c0013a20b82025820'
                           h'00112233445566778899aabbccddeeff'
                           h'0123456789abcdeffedcba9876543210'
                           h'0c1987d00c0113a20b82025820012345'
                           h'6789abcdeffedcba9876543210001122'
                           h'33445566778899aabbccddeeff0c1987'
                           h'd001f602f6' \ [
      / set-vars / 19, {
        / vendor-id / 3 : h'fa6b4a53d5ad5fdfbe9de663e4d41f'
                          h'fe',
```



```

        / class-id / 4 : h'1492af1425695e48bf429b2d51f2ab45',
    },
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'00112233445566778899aabbccddeeff0123456789ab'
            h'cdeffedcba9876543210' ]
        / size / 12 : 34768
    },
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'0123456789abcdeffedcba9876543210001122334455'
            h'66778899aabbccddeeff' ],
        / size / 12 : 34768,
    },
    / condition-vendor-id / 1, None,
    / condition-class-id / 2, None,
],
},
/ apply-image / 9 : h'860c0013a106781b687474703a2f2f6578616d70'
                    h'6c652e636f6d2f66696c652e62696e15f6' \ [
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / uri / 6 : http://example.com/file.bin,
    },
    / fetch / 21, None,
],
/ load-image / 11 : h'8a0c0003f60c0113a20843a101010a0016f6' \ [
    / set-component-index / 12, 0,
    / condition-image / 3, None,
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / compression-info / 8 : h'a10101',
        / source-component / 10 : 0,
    },
    / copy / 22, None,
],
/ run-image / 12 : h'8403f617f6' \ [
    / condition-image / 3, None,
    / run / 23, None,
],
}
}

```

Total size of outer wrapper without COSE authentication object: 240

Outer:


```
a201f60258eaa60101020503589fa20254828245466c61736843003401824352414d4200
040458858e13a20350fa6b4a53d5ad5fdfbe9de663e4d41ffe04501492af1425695e48bf
429b2d51f2ab450c0013a20b8202582000112233445566778899aabbccddee01234567
89abcdeffedcba98765432100c1987d00c0113a20b820258200123456789abcdeffedcba
987654321000112233445566778899aabbccddee0c1987d001f602f6095825860c0013
a106781b687474703a2f2f6578616d706c652e636f6d2f66696c652e62696e15f60b528a
0c0003f60c0113a20843a101010a0016f60c458403f617f6
```

Total size of outer wrapper with COSE authentication object: 325

Signed Outer:

```
a2015854d28443a10126a1044874657374206b6579f65840e90dab6e502bad8132adf86b
4d78defaebac64fa6c6b2882d12b36f492b14ce75819ed3524de4d66ddfd5e1d80a59840
04c1ac9b003b2da32589583a93c541dd0258eaa60101020503589fa20254828245466c61
736843003401824352414d4200040458858e13a20350fa6b4a53d5ad5fdfbe9de663e4d4
1ffe04501492af1425695e48bf429b2d51f2ab450c0013a20b8202582000112233445566
778899aabbccddee0123456789abcdeffedcba98765432100c1987d00c0113a20b8202
58200123456789abcdeffedcba987654321000112233445566778899aabbccddee0c19
87d001f602f6095825860c0013a106781b687474703a2f2f6578616d706c652e636f6d2f
66696c652e62696e15f60b528a0c0003f60c0113a20843a101010a0016f60c458403f617
f6
```

[13.6.](#) Example 5:

Compatibility test, download, installation, and secure boot.

The following JSON shows the intended behaviour of the manifest.

```
{
  "structure-version": 1,
  "sequence-number": 6,
  "common": {
    "common-sequence": [
      {
        "directive-set-var": {
          "vendor-id": "fa6b4a53-d5ad-5fdf-be9d-e663e4d41ffe",
          "class-id": "1492af14-2569-5e48-bf42-9b2d51f2ab45"
        }
      },
      { "directive-set-component": 0 },
      {
        "directive-set-var": {
          "digest": "00112233445566778899aabbccddee"
            "0123456789abcdeffedcba9876543210",
          "size": 34768
        }
      }
    ],
  },
}
```



```
    { "directive-set-component": 1 },
    {
      "directive-set-var": {
        "digest": "0123456789abcdeffedcba9876543210"
          "00112233445566778899aabbccddeeff",
        "size": 34768
      }
    },
    { "condition-vendor-id": null },
    { "condition-class-id": null }
  ],
  "components": [
    [
      "ext-Flash",
      78848
    ],
    [
      "Flash",
      1024
    ]
  ]
},
"apply-image": [
  { "directive-set-component": 0 },
  {
    "directive-set-var": {
      "uri": "http://example.com/file.bin"
    }
  },
  { "directive-fetch": null }
],
"load-image": [
  { "directive-set-component": 1 },
  { "condition-not-image": null },
  { "directive-set-component": 0 },
  { "condition-image": null },
  { "directive-set-component": 1 },
  {
    "directive-set-var": {
      "source-index": 0
    }
  },
  { "directive-fetch": null }
],
"run-image": [
  { "directive-set-component": 1 },
  { "condition-image": null },
  { "directive-run": null }
```



```
]
}
```

Converted into the SUIT manifest, this produces:

```
{
  / auth object / 1 : h'd28443a10126a1044874657374206b6579f658402282'
                      h'c1e7770b1806afb0cf78e74003af39166b9db14b0a7c'
                      h'172d18598c8be16e3cec48770fb8471675a5b3bab05a'
                      h'22e370a03320a7346f252f9629c3417ed153',
  / manifest / 2 : h'a6010102060358a2a202578282467b1b4595ab2143003401'
                  h'8245466c6173684200040458858e13a20350fa6b4a53d5ad'
                  h'5fdfbe9de663e4d41ffe04501492af1425695e48bf429b2d'
                  h'51f2ab450c0013a20b8202582000112233445566778899aa'
                  h'bbccddeeff0123456789abcdeffedcba98765432100c1987'
                  h'd00c0113a20b820258200123456789abcdeffedcba987654'
                  h'321000112233445566778899aabbccddeeff0c1987d001f6'
                  h'02f6095825860c0013a106781b687474703a2f2f6578616d'
                  h'706c652e636f6d2f66696c652e62696e15f60b528e0c0118'
                  h'19f60c0003f60c0113a10a0015f60c47860c0103f617f6' \
{
  / structure-version / 1 : 1,
  / sequence-number / 2 : 6,
  / common / 3 : h'a202578282467b1b4595ab21430034018245466c617368'
                h'4200040458858e13a20350fa6b4a53d5ad5fdfbe9de663'
                h'e4d41ffe04501492af1425695e48bf429b2d51f2ab450c'
                h'0013a20b8202582000112233445566778899aabbccdde'
                h'ff0123456789abcdeffedcba98765432100c1987d00c01'
                h'13a20b820258200123456789abcdeffedcba9876543210'
                h'00112233445566778899aabbccddeeff0c1987d001f602'
                h'f6' \ {
    / components / 2 : h'8282467b1b4595ab21430034018245466c6173'
                      h'68420004' \
    [
      [h'7b1b4595ab21', h'003401'],
      [h'466c617368', h'0004'],
    ],
    / common-sequence / 4 : h'8e13a20350fa6b4a53d5ad5fdfbe9de6'
                          h'63e4d41ffe04501492af1425695e48bf'
                          h'429b2d51f2ab450c0013a20b82025820'
                          h'00112233445566778899aabbccddeeff'
                          h'0123456789abcdeffedcba9876543210'
                          h'0c1987d00c0113a20b82025820012345'
                          h'6789abcdeffedcba9876543210001122'
                          h'33445566778899aabbccddeeff0c1987'
                          h'd001f602f6' \ [
      / set-vars / 19, {
        / vendor-id / 3 : h'fa6b4a53d5ad5fdfbe9de663e4d41f'
```



```
        h'fe',
        / class-id / 4 : h'1492af1425695e48bf429b2d51f2ab45',
    },
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'00112233445566778899aabbccddeeff0123456789ab'
            h'cdeffedcba9876543210' ],
        / size / 12 : 34768,
    },
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'0123456789abcdeffedcba9876543210001122334455'
            h'66778899aabbccddeeff' ],
        / size / 12 : 34768,
    },
    / condition-vendor-id / 1, None,
    / condition-class-id / 2, None,
],
},
/ apply-image / 9 : h'860c0013a106781b687474703a2f2f6578616d70'
    h'6c652e636f6d2f66696c652e62696e15f6' \ [
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / uri / 6 : http://example.com/file.bin,
    },
    / fetch / 21, None,
],
/ load-image / 11 : h'8e0c011819f60c0003f60c0113a10a0015f6' \ [
    / set-component-index / 12, 1,
    / condition-not-image / 25, None,
    / set-component-index / 12, 0,
    / condition-image / 3, None,
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / source-component / 10 : 0,
    },
    / fetch / 21, None,
],
/ run-image / 12 : h'860c0103f617f6' \ [
    / set-component-index / 12, 1,
    / condition-image / 3, None,
    / run / 23, None,
],
},
}
```


Total size of outer wrapper without COSE authentication object: 245

Outer:

```
a201f60258efa6010102060358a2a202578282467b1b4595ab21430034018245466c6173
684200040458858e13a20350fa6b4a53d5ad5fdfe9de663e4d41ffe04501492af142569
5e48bf429b2d51f2ab450c0013a20b8202582000112233445566778899aabbccddeeff01
23456789abcdeffedcba98765432100c1987d00c0113a20b820258200123456789abcdef
fedcba987654321000112233445566778899aabbccddeeff0c1987d001f602f609582586
0c0013a106781b687474703a2f2f6578616d706c652e636f6d2f66696c652e62696e15f6
0b528e0c011819f60c0003f60c0113a10a0015f60c47860c0103f617f6
```

Total size of outer wrapper with COSE authentication object: 330

Signed Outer:

```
a2015854d28443a10126a1044874657374206b6579f658402282c1e7770b1806afb0cf78
e74003af39166b9db14b0a7c172d18598c8be16e3cec48770fb8471675a5b3bab05a22e3
70a03320a7346f252f9629c3417ed1530258efa6010102060358a2a202578282467b1b45
95ab21430034018245466c6173684200040458858e13a20350fa6b4a53d5ad5fdfe9de6
63e4d41ffe04501492af1425695e48bf429b2d51f2ab450c0013a20b8202582000112233
445566778899aabbccddeeff0123456789abcdeffedcba98765432100c1987d00c0113a2
0b820258200123456789abcdeffedcba987654321000112233445566778899aabbccdde
ff0c1987d001f602f6095825860c0013a106781b687474703a2f2f6578616d706c652e63
6f6d2f66696c652e62696e15f60b528e0c011819f60c0003f60c0113a10a0015f60c4786
0c0103f617f6
```

[13.7.](#) Example 6:

Compatibility test, 2 images, simultaneous download and installation, and secure boot.

The following JSON shows the intended behaviour of the manifest.

```
{
  "structure-version": 1,
  "sequence-number": 7,
  "common": {
    "common-sequence": [
      {
        "directive-set-var": {
          "vendor-id": "fa6b4a53-d5ad-5fdf-be9d-e663e4d41ffe",
          "class-id": "1492af14-2569-5e48-bf42-9b2d51f2ab45"
        }
      },
      { "directive-set-component": 0 },
      {
        "directive-set-var": {
```



```
        "digest": "00112233445566778899aabbccddeeff"
        "0123456789abcdeffedcba9876543210",
        "size": 34768
    }
},
{ "directive-set-component": 1 },
{
    "directive-set-var": {
        "digest": "0123456789abcdeffedcba9876543210"
        "00112233445566778899aabbccddeeff",
        "size": 76834
    }
},
{ "condition-vendor-id": null },
{ "condition-class-id": null }
],
"components": [
    [
        "Flash",
        78848
    ],
    [
        "Flash",
        132096
    ]
]
},
"apply-image": [
    { "directive-set-component": 0 },
    {
        "directive-set-var": {
            "uri": "http://example.com/file1.bin"
        }
    },
    { "directive-set-component": 1 },
    {
        "directive-set-var": {
            "uri": "http://example.com/file2.bin"
        }
    },
    { "directive-set-component": true },
    { "directive-fetch": null }
],
"run-image": [
    { "directive-set-component": true },
    { "condition-image": null },
    { "directive-set-component": 0 },
    { "directive-run": null }
```



```
]
}
```

Converted into the SUIT manifest, this produces:

```
{
  / auth object / 1 : h'd28443a10126a1044874657374206b6579f65840d00c'
                      h'd62be643247904621f2956b11b97fcbcd22f87701dd9'
                      h'008e949f8c801f55d7095b545d6db0060bd47c5f78ee'
                      h'5cb1fea17c875a36a599aec4e8b876cfdae7',
  / manifest / 2 : h'a5010102070358a4a20257828245466c6173684300340182'
                  h'a45466c617368430004020458878e13a20350fa6b4a53d5ad'
                  h'5fdfbe9de663e4d41ffe04501492af1425695e48bf429b2d'
                  h'51f2ab450c0013a20b8202582000112233445566778899aa'
                  h'bbccddeeff0123456789abcdeffedcba98765432100c1987'
                  h'd00c0113a20b820258200123456789abcdeffedcba987654'
                  h'321000112233445566778899aabbccddeeff0c1a00012c22'
                  h'01f602f609584b8c0c0013a106781c687474703a2f2f6578'
                  h'616d706c652e636f6d2f66696c65312e62696e0c0113a106'
                  h'781c687474703a2f2f6578616d706c652e636f6d2f66696c'
                  h'65322e62696e0cf515f60c49880cf503f60c0017f6' \
{
  / structure-version / 1 : 1,
  / sequence-number / 2 : 7,
  / common / 3 : h'a20257828245466c617368430034018245466c61736843'
                h'0004020458878e13a20350fa6b4a53d5ad5fdfbe9de663'
                h'e4d41ffe04501492af1425695e48bf429b2d51f2ab450c'
                h'0013a20b8202582000112233445566778899aabbccdde'
                h'ff0123456789abcdeffedcba98765432100c1987d00c01'
                h'13a20b820258200123456789abcdeffedcba9876543210'
                h'00112233445566778899aabbccddeeff0c1a00012c2201'
                h'f602f6' \ {
    / components / 2 : h'828245466c617368430034018245466c617368'
                      h'43000402' \
    [
      [h'466c617368', h'003401'],
      [h'466c617368', h'000402'],
    ],
    / common-sequence / 4 : h'8e13a20350fa6b4a53d5ad5fdfbe9de6'
                          h'63e4d41ffe04501492af1425695e48bf'
                          h'429b2d51f2ab450c0013a20b82025820'
                          h'00112233445566778899aabbccddeeff'
                          h'0123456789abcdeffedcba9876543210'
                          h'0c1987d00c0113a20b82025820012345'
                          h'6789abcdeffedcba9876543210001122'
                          h'33445566778899aabbccddeeff0c1a00'
                          h'012c2201f602f6' \ [
      / set-vars / 19, {
```



```

        / vendor-id / 3 : h'fa6b4a53d5ad5fdfbe9de663e4d41f'
                           h'fe',
        / class-id / 4 : h'1492af1425695e48bf429b2d51f2ab45',
    },
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'00112233445566778899aabbccddeeff0123456789ab'
            h'cdeffedcba9876543210' ],
        / size / 12 : 34768,
    },
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / digest / 11 : [ 2,
            h'0123456789abcdeffedcba9876543210001122334455'
            h'66778899aabbccddeeff' ],
        / size / 12 : 76834,
    },
    / condition-vendor-id / 1, None,
    / condition-class-id / 2, None,
],
},
/ apply-image / 9 : h'8c0c0013a106781c687474703a2f2f6578616d70'
                   h'6c652e636f6d2f66696c65312e62696e0c0113a1'
                   h'06781c687474703a2f2f6578616d706c652e636f'
                   h'6d2f66696c65322e62696e0cf515f6' \ [
    / set-component-index / 12, 0,
    / set-vars / 19, {
        / uri / 6 : http://example.com/file1.bin
    },
    / set-component-index / 12, 1,
    / set-vars / 19, {
        / uri / 6 : http://example.com/file2.bin
    },
    / set-component-index / 12, True,
    / fetch / 21, None,
],
/ run-image / 12 : h'880cf503f60c0017f6' \ [
    / set-component-index / 12, True,
    / condition-image / 3, None,
    / set-component-index / 12, 0,
    / run / 23, None,
],
},
}

```

Total size of outer wrapper without COSE authentication object: 268

Outer:

```
a201f602590105a5010102070358a4a20257828245466c617368430034018245466c6173
68430004020458878e13a20350fa6b4a53d5ad5fdfe9de663e4d41ffe04501492af1425
695e48bf429b2d51f2ab450c0013a20b8202582000112233445566778899aabbccddeeff
0123456789abcdeffedcba98765432100c1987d00c0113a20b820258200123456789abcd
effedcba987654321000112233445566778899aabbccddeeff0c1a00012c2201f602f609
584b8c0c0013a106781c687474703a2f2f6578616d706c652e636f6d2f66696c65312e62
696e0c0113a106781c687474703a2f2f6578616d706c652e636f6d2f66696c65322e6269
6e0cf515f60c49880cf503f60c0017f6
```

Total size of outer wrapper with COSE authentication object: 353

Signed Outer:

```
a2015854d28443a10126a1044874657374206b6579f65840d00cd62be643247904621f29
56b11b97fcabcd22f87701dd9008e949f8c801f55d7095b545d6db0060bd47c5f78ee5cb1
fea17c875a36a599aec4e8b876cfdae702590105a5010102070358a4a20257828245466c
617368430034018245466c617368430004020458878e13a20350fa6b4a53d5ad5fdfe9d
e663e4d41ffe04501492af1425695e48bf429b2d51f2ab450c0013a20b82025820001122
33445566778899aabbccddeeff0123456789abcdeffedcba98765432100c1987d00c0113
a20b820258200123456789abcdeffedcba987654321000112233445566778899aabbccdd
eeff0c1a00012c2201f602f609584b8c0c0013a106781c687474703a2f2f6578616d706c
652e636f6d2f66696c65312e62696e0c0113a106781c687474703a2f2f6578616d706c65
2e636f6d2f66696c65322e62696e0cf515f60c49880cf503f60c0017f6
```

14. IANA Considerations

Several registries will be required for:

- standard Commands
- standard Parameters
- standard Algorithm identifiers
- standard text values

15. Security Considerations

This document is about a manifest format describing and protecting firmware images and as such it is part of a larger solution for offering a standardized way of delivering firmware updates to IoT devices. A more detailed discussion about security can be found in the architecture document [[Architecture](#)] and in [[Information](#)].

16. Mailing List Information

The discussion list for this document is located at the e-mail address suit@ietf.org [1]. Information on the group and information on how to subscribe to the list is at <https://www1.ietf.org/mailman/listinfo/suit> [2]

Archives of the list can be found at: <https://www.ietf.org/mail-archive/web/suit/current/index.html> [3]

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- David Brown
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18. References

18.1. Normative References

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- [RFC4122] Leach, P., Mealling, M., and R. Salz, "A Universally Unique IDentifier (UUID) URN Namespace", [RFC 4122](#), DOI 10.17487/RFC4122, July 2005, <<https://www.rfc-editor.org/info/rfc4122>>.
- [RFC8152] Schaad, J., "CBOR Object Signing and Encryption (COSE)", [RFC 8152](#), DOI 10.17487/RFC8152, July 2017, <<https://www.rfc-editor.org/info/rfc8152>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [BCP 14](#), [RFC 8174](#), DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.

[18.2.](#) Informative References

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Moran, B., "A Firmware Update Architecture for Internet of Things Devices", January 2019, <<https://tools.ietf.org/html/draft-ietf-suit-architecture-02>>.
- [Information]
Moran, B., "Firmware Updates for Internet of Things Devices - An Information Model for Manifests", January 2019, <<https://tools.ietf.org/html/draft-ietf-suit-information-model-02>>.
- [RFC6920] Farrell, S., Kutscher, D., Dannewitz, C., Ohlman, B., Keranen, A., and P. Hallam-Baker, "Naming Things with Hashes", [RFC 6920](#), DOI 10.17487/RFC6920, April 2013, <<https://www.rfc-editor.org/info/rfc6920>>.

[18.3.](#) URIs

- [1] <mailto:suit@ietf.org>
- [2] <https://www1.ietf.org/mailman/listinfo/suit>
- [3] <https://www.ietf.org/mail-archive/web/suit/current/index.html>

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