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**The BagIt File Packaging Format (V1.0)**  
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Abstract

This document describes BagIt, a set of hierarchical file layout conventions for storage and transfer of arbitrary digital content. A "bag" has just enough structure to enclose descriptive metadata "tags" and a file "payload" but does not require knowledge of the payload's internal semantics. This BagIt format is suitable for reliable storage and transfer.

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## [1.](#) Introduction

### [1.1.](#) Purpose

BagIt is a set of hierarchical file layout conventions designed to support storage and transfer of arbitrary digital content. A bag consists of a directory containing the payload files and other accompanying metadata files known as "tag" files. The "tags" are metadata files intended to facilitate and document the storage and transfer of the bag. Processing a bag does not require any understanding of the payload file contents and the payload files can be accessed without processing the BagIt metadata.

The name, BagIt, is inspired by the "enclose and deposit" method [[ENCDEP](#)], sometimes referred to as "bag it and tag it". BagIt differs from serialized archive formats such as MIME, TAR, or ZIP in two general areas:

1. Strong integrity assurances. The format supports cryptographic-quality hash algorithms (see [Section 2.4](#)) and allows for in-place upgrades to add additional manifests using stronger algorithms without breaking backwards compatibility.
2. Direct file access. Because BagIt specifies an actual filesystem hierarchy rather than a serialized representation of one, files can be accessed using standard operating system utilities, implementations do not need to process a potentially large archive file to extract a subset of data, and the format imposes no size limits for either individual files or a bag.

BagIt is widely used for preserving digital assets originating from different domains. Organizations involved in digital preservation with BagIt include the Library of Congress, Dryad Data Repository, NSF DataONE, and the Rockefeller Archive Center. Software implementations are available for many languages including Python, Ruby, Java, Perl, and PHP. It is also used in the libraries of many universities, such as Cornell, Purdue, Stanford, Ghent University, New York University, and the University of California.

### [1.2.](#) Requirements

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.

Implementers are strongly encouraged to review the interoperability considerations described in [Section 6.1](#).

### **[1.3](#). Terminology**

The following terms have precise definitions as used in this document:

**bag** A set of opaque files contained within the structure defined by this document.

**bag declaration** The file required to be in all bags conforming to this document. Contains values necessary to process the rest of a bag. See [Section 2.1.1](#).

**bag checksum algorithm** The name of a cryptographic checksum algorithm which has been normalized for use in a manifest or tag manifest file name (e.g. "sha512") as described in [Section 2.4](#).

**manifest** A tag file that maps filepaths to checksums. A manifest can be a payload manifest [Section 2.1.3](#) or a tag manifest [Section 2.2.1](#).

**payload** The data encapsulated by the bag as a set of named files, which may be organized in sub-directories. The contents of the payload files are opaque to this document, and, with respect to BagIt processing, are always considered as sequences of uninterpreted octets. See [Section 2.1.2](#).

**tag directory** A directory that contains one or more tag files.

**tag file** A file which contains metadata about the bag or its payload. This document defines the standard BagIt tag files: the bag declaration in "bagit.txt" [Section 2.1.1](#), payload manifests [Section 2.1.3](#), tag manifests [Section 2.2.1](#), bag metadata in "bag-info.txt" [Section 2.2.2](#), and remote payload in "fetch.txt" [Section 2.2.3](#). This document also allows other arbitrary tag files as described in [Section 2.2.4](#).

**complete** A bag which contains every element required by this document, every payload file listed in a manifest, and any optional files which are listed in a tag manifest. See [Section 3](#).

**valid** A complete bag where every checksum in every manifest has been successfully verified against the corresponding file.



## **2. Structure**

A bag MUST consist of a base directory containing:

1. a set of required and optional tag files [Section 2.2](#)
2. a sub-directory named "data", called the payload directory.  
[Section 2.1.2](#)
3. a set of optional tag directories

The tag files in the base directory consist of one or more files named "manifest-algorithm.txt" (see [Section 2.1.3](#) and [Section 2.4](#)), a file named "bagit.txt" (see [Section 2.1.1](#)), and zero or more additional tag files (see [Section 2.2](#)). The tag files and directories are in arbitrary file hierarchies and MAY have any name that is not reserved for a file or directory in this document.

The base directory can have any name.

```
<base directory>/
|
+-- bagit.txt
|
+-- manifest-<algorithm>.txt
|
+-- [additional tag files]
|
+-- data/
|   |
|   +-- [payload files]
|
+-- [tag directories]/
|   |
|   +-- [tag files]
```

### **2.1. Required Elements**

#### **2.1.1. Bag Declaration: bagit.txt**

The "bagit.txt" tag file MUST consist of exactly two lines in this order:





BagIt-Version: M.N

Tag-File-Character-Encoding: ENCODING

`_M.N_` identifies the BagIt major (M) and minor (N) version numbers. `_ENCODING_` identifies the character set encoding used by the remaining tag files. `_ENCODING_` SHOULD be "UTF-8" but for backwards compatibility it MAY be any other encoding registered in [\[RFC2978\]](#). The bag declaration itself MUST be encoded in UTF-8, and MUST NOT contain a byte-order mark (BOM) [\[RFC3629\]](#).

The number for this version of BagIt is "1.0".

### **[2.1.2.](#) Payload Directory: data/**

The base directory MUST contain a sub-directory named "data".

The payload directory contains the arbitrary digital content within the bag. The files under the payload directory are called payload files, or the payload. Each payload file is treated as an opaque octet stream when verifying file correctness. Payload files MAY be organized in arbitrary sub-directory structures within the payload directory, however for the purpose of this document such sub-directory structures and filenames have no given meaning.

### **[2.1.3.](#) Payload Manifest: manifest-algorithm.txt**

A payload manifest file provides a complete listing of each payload file name along with a corresponding checksum to permit data integrity checking. A bag can have more than one payload manifest, with each using a different checksum algorithm. Manifest entries MUST satisfy the following constraints:

- o Every bag MUST contain at least one payload manifest file and MAY contain more than one.
- o Every payload manifest MUST list every payload file name exactly once.
- o A payload manifest file MUST have a name of the form "manifest-`_algorithm_`.txt", where `_algorithm_` is a string specifying the checksum algorithm used by that manifest as described in [Section 2.4](#).

Example payload manifest filenames

manifest-sha256.txt  
manifest-sha512.txt



Each line of a payload manifest file MUST be of the form:

checksum filepath

where `_filepath_` is the pathname of a file relative to the base directory, and `_checksum_` is a hex-encoded checksum calculated according to `_algorithm_` over every octet in the file.

- o The hex-encoded checksum MAY use uppercase and/or lowercase letters.
- o The slash character ('/') MUST be used as a path separator in `_filepath_`.
- o One or more linear whitespace characters (spaces or tabs) MUST separate `_checksum_` from `_filepath_`.
- o There is no limitation on the length of a pathname.
- o The payload manifest MUST NOT reference files outside the payload directory.
- o If a `_filepath_` includes a line feed (LF), a carriage return (CR), carriage return plus line feed (CRLF) or percent sign (%), those characters (and only those) MUST be percent-encoded following [\[RFC3986\]](#).

A manifest MUST NOT reference directories. Bag creators who wish to create an otherwise empty directory have typically done so by creating an empty placeholder file with a name such as ".keep".

## **[2.2.](#) Optional Elements**

### **[2.2.1.](#) Tag Manifest: tagmanifest-algorithm.txt**

A tag manifest is a tag file that lists other tag files and checksums for those tag files generated using a particular bag checksum algorithm.

A bag MAY contain one or more tag manifests, in which case each tag manifest SHOULD list the same set of tag files.

Each tag manifest MUST list every payload manifest. Each tag manifest MUST NOT list any tag manifests, but SHOULD list the remaining tag files present in the bag.

A tag manifest file MUST have a name of the form "tagmanifest-`_algorithm_.txt`", where `_algorithm_` is a string following the format



described in [Section 2.4](#) specifying the bag checksum algorithm used in that manifest.

Tag manifests SHOULD use the same algorithms as the payload manifests that are present in the bag.

Example tag manifest filenames:

```
tagmanifest-sha256.txt  
tagmanifest-sha512.txt
```

A tag manifest file has the same form as the payload file manifest file described in [Section 2.1.3](#), but MUST NOT list any payload files. As a result, no `_filepath_` listed in a tag manifest begins "data/".

### **[2.2.2](#). Bag Metadata: bag-info.txt**

The "bag-info.txt" file is a tag file that contains metadata elements describing the bag and the payload. The metadata elements contained in the "bag-info.txt" file are intended primarily for human use. All metadata elements are OPTIONAL and MAY be repeated. Because "bag-info.txt" is intended for human reading and editing, ordering MAY be significant and the ordering of metadata elements MUST be preserved.

A metadata element MUST consist of a label, a colon ":", a single linear whitespace character (space or tab), and a value, terminated with a line feed (CR), carriage return (LF) or carriage return plus line feed (CRLF).

The label MUST NOT contain colon (:), line feeds (LF) or carriage returns (CR). The label MAY contain linear whitespace characters, but MUST NOT start or end with whitespace.

It is RECOMMENDED that lines not exceed 79 characters in length. Long values MAY be continued onto the next line by inserting a line feed (LF), a carriage return (CR), or carriage return plus line feed (CRLF) and indenting the next line with one or more linear white space (spaces or tabs). Except for linebreaks such padding does not form part of the value.

Implementations wishing to support previous BagIt versions MUST accept multiple linear whitespace before and after the colon when the bag version is earlier than 1.0; such whitespace does not form part of the label or value.

The following are reserved metadata elements. The use of these reserved metadata elements are OPTIONAL but encouraged. Reserved metadata element names are case-insensitive. Except where indicated



otherwise, these metadata element names MAY be repeated to capture multiple values.

Source-Organization Organization transferring the content.

Organization-Address Mailing address of the source organization.

Contact-Name Person at the source organization who is responsible for the content transfer.

Contact-Phone International format telephone number of person or position responsible.

Contact-Email Fully qualified email address of person or position responsible.

External-Description A brief explanation of the contents and provenance.

Bagging-Date Date (YYYY-MM-DD) that the content was prepared for transfer. This metadata element SHOULD NOT be repeated.

External-Identifier A sender-supplied identifier for the bag.

Bag-Size Size or approximate size of the bag being transferred, followed by an abbreviation such as MB (megabytes), GB, or TB; for example, 42600 MB, 42.6 GB, or .043 TB. Compared to Payload-Oxum (described next), Bag-Size is intended for human consumption. This metadata element SHOULD NOT be repeated.

Payload-Oxum The "octetstream sum" of the payload, intended for the purpose of quickly detecting incomplete bags before performing checksum validation. This is strictly an optimization and implementations MUST perform the standard checksum validation process before proclaiming a bag to be valid. This element MUST NOT be present more than once and, if present, MUST be in the form "\_OctetCount\_.StreamCount\_", where \_OctetCount\_ is the total number of octets (8-bit bytes) across all payload file content and \_StreamCount\_ is the total number of payload files. This metadata element MUST NOT be repeated.

Bag-Group-Identifier A sender-supplied identifier for the set, if any, of bags to which it logically belongs. This identifier SHOULD be unique across the sender's content, and if recognizable as belonging to a globally unique scheme, the receiver SHOULD make an effort to honor reference to it. This metadata element SHOULD NOT be repeated.





**Bag-Count** Two numbers separated by "of", in particular, "N of T", where T is the total number of bags in a group of bags and N is the ordinal number within the group; if T is not known, specify it as "?" (question mark). Examples: 1 of 2, 4 of 4, 3 of ?, 89 of 145. This metadata element SHOULD NOT be repeated. If this metadata element is present, it is RECOMMENDED to also include the Bag-Group-Identifier element.

**Internal-Sender-Identifier** An alternate sender-specific identifier for the content and/or bag.

**Internal-Sender-Description** A sender-local explanation of the contents and provenance.

In addition to these metadata elements, other arbitrary metadata elements MAY also be present.

An example "bag-info.txt" file

```
Source-Organization: F00 University
Organization-Address: 1 Main St., Cupertino, California, 11111
Contact-Name: Jane Doe
Contact-Phone: +1 111-111-1111
Contact-Email: example@example.com
External-Description: Uncompressed greyscale TIFF images from the
                      F00 papers colle...
Bagging-Date: 2008-01-15
External-Identifier: university_foo_001
Payload-Oxum: 279164409832.1198
Bag-Group-Identifier: university_foo
Bag-Count: 1 of 15
Internal-Sender-Identifier: /storage/images/foo
Internal-Sender-Description: Uncompressed greyscale TIFFs created
                             from microfilm and are...
```

### **2.2.3. Fetch File: fetch.txt**

For reasons of efficiency, a bag MAY be sent with a list of files to be fetched and added to the payload before it can meaningfully be checked for completeness. The fetch file allows a bag to be transmitted with "holes" in it, which can be practical for several reasons. For example, it obviates the need for the sender to stage a large serialized copy of the content while the bag is transferred to the receiver. Also, this method allows a sender to construct a bag from components that are either a subset of logically related components (e.g., the localized logical object could be much larger than what is intended for export) or assembled from logically distributed sources (e.g., the object components for export are not



stored locally under one filesystem tree). An OPTIONAL tag file called the fetch file contains such a list.

The fetch file MUST be named "fetch.txt". Every file listed in the fetch file MUST be listed in every payload manifest. A fetch file MUST NOT list any tag files.

Each line of a fetch file MUST be of the form:

```
url length filepath
```

where `_url_` identifies the file to be fetched and MUST be an absolute URI as defined in [\[RFC3986\]](#), `_length_` is the number of octets in the file (or "-", to leave it unspecified), and `_filepath_` identifies the corresponding payload file, relative to the base directory.

The slash character ('/') MUST be used as a path separator in `_filepath_`. One or more linear whitespace characters (spaces or tabs) MUST separate these three values, and any such characters in the `_url_` MUST be percent-encoded [\[RFC3986\]](#). If `_filename_` includes a line feed (LF), a carriage return (CR), carriage return plus line feed (CRLF) or percent sign (%), those characters (and only those) MUST be percent-encoded following [\[RFC3986\]](#). There is no limitation on the length of any of the fields in the fetch file.

#### **[2.2.4.](#) Other Tag Files**

A bag MAY contain other tag files that are not defined by this document. Implementations MUST perform standard checksum validation on any tag file which is listed in a tag manifest but MUST otherwise ignore their contents.

### **[2.3.](#) Text Tag File Format**

All tag files specifically described in this document MUST adhere to the text tag file format described below. Other tag files MAY adhere to the text tag file format described below.

Text tag files are line-oriented, and each line MUST be terminated by a line feed (LF), a carriage return (CR), or carriage return plus newline (CRLF). It is RECOMMENDED that the last line in a tag file also ends with LF, CR, or CRLF. Text tag file names MUST end in the extension ".txt".

In all text tag files except for the bag declaration file, text MUST use the character encoding specified in the "bagit.txt" bag declaration file. Text tag files except for the bag declaration file MAY include a byte-order mark (BOM) only if the specified encoding



requires it for proper decoding. In accordance with [\[RFC3629\]](#), when "bagit.txt" specifies UTF-8 the tag files MUST NOT begin with a byte-order mark (BOM). See [Section 2.1.1](#)

The use of UTF-8 for text tag files is strongly RECOMMENDED. A future version of BagIt may disallow encodings other than UTF-8.

#### **[2.4.](#) Bag Checksum Algorithms**

The payload manifest and tag manifests permit validating the integrity of the payload and tag files in a bag produced by the checksum algorithms. Checksum values MUST be encoded so as to conform to the manifest format specified in [Section 2.1.3](#). However, the internal details of a checksum are outside the scope of this document.

To avoid future ambiguity, the checksum algorithm SHOULD be registered in IANA's "Named Information Hash Algorithm Registry" [\[ni-registry\]](#) according to [\[RFC6920\]](#), but MAY for backwards compatibility also be MD5 [\[RFC1321\]](#) or SHA-1 [\[RFC3174\]](#).

The name of the checksum algorithm MUST be normalized for use in the manifest's filename by lowercasing the common name of the algorithm and removing all non-alphanumeric characters. Following is a partial list mapping common algorithm names to normalized names:

- o MD5: md5
- o SHA-1: sha1
- o sha-256: sha256
- o sha-512: sha512

Starting with BagIt 1.0, bag creation and validation tools MUST support the SHA-256 and SHA-512 algorithms [\[RFC6234\]](#) and SHOULD enable SHA-512 by default when creating new bags. For backwards compatibility implementers SHOULD support MD5 [\[RFC1321\]](#) and SHA-1 [\[RFC3174\]](#). Implementers are encouraged to simplify the process of adding additional manifests using new algorithms to streamline the process of in-place upgrades.

### **[3.](#) Complete and Valid bags**

A `_complete_` bag MUST meet the following requirements:

1. Every required element MUST be present ([Section 2.1](#)).



2. Every file listed in every tag manifest MUST be present.
3. Every file listed in every payload manifest MUST be present.
4. For BagIt 1.0, every payload file MUST be listed in every payload manifest. Note that older versions of BagIt allowed payload files to be listed in just one of the manifests.
5. Every element present MUST conform to BagIt 1.0.

A `_valid_` bag MUST meet the following requirements:

1. The bag MUST be `_complete_`.
2. Every checksum in every payload manifest and tag manifest has been successfully verified against the contents of the corresponding file.

## **4. Examples**

### **4.1. Example of a basic bag**

This is the layout of a basic bag containing an image and a companion OCR file. Lines of file content are shown with added parentheses to indicate each complete line. For brevity this example uses MD5 rather than the recommended SHA-512.

```
myfirstbag/
|
|  manifest-md5.txt
|    (49afb86a1ca9f34b677a3f09655eae9 data/27613-h/images/q172.png)
|    (408ad21d50cef31da4df6d9ed81b01a7 data/27613-h/images/q172.txt)
|
|  bagit.txt
|    (BagIt-version: 1.0                                     )
|    (Tag-File-Character-Encoding: UTF-8                     )
|
\--- data/
|
|  27613-h/images/q172.png
|    (... image bytes ...)
|
|  27613-h/images/q172.txt
|    (... OCR text ...)
|
....
```





## **4.2. Example bag using fetch.txt**

This is the layout of a bag which expects the receiver to download the files listed in the payload manifests prior to validation. Lines of file content are shown with added parentheses to indicate each complete line. For brevity this example uses MD5 rather than the recommended SHA-512.

```
highsmith-tahoe/
|
|  manifest-md5.txt
|  (102b0e6effe208ef9b29864946de9e22 data/23364a.tif          )
|
|  fetch.txt
|  (https://cdn.loc.gov/master/pnp/highsm/23300/23364a.tif
|    216951362 data/23364a.tif                                )
|
|  bagit.txt
|  (BagIt-version: 1.0                                         )
|  (Tag-File-Character-Encoding: UTF-8                         )
|
|  bag-info.txt
|  (Internal-Sender-Description: Download link found at       )
|  ( https://www.loc.gov/resource/highsm.23364/                    )
```

## **5. Security Considerations**

### **5.1. Special directory characters**

The paths specified in the payload manifests, tag manifests, and fetch files do not prohibit special directory characters which have special meaning on some operating systems. Implementers **MUST** ensure that files outside the bag directory structure are not accessed when reading or writing files based on paths specified in a bag.

All implementations **SHOULD** have a test suite to guard against special directory characters.

For example, a maliciously crafted "tagmanifest-sha512.txt" file might contain entries which begin with a path character such as "/", "..", or a "~username" home directory reference in an attempt to cause a naive implementation to leak or overwrite targeted files on a POSIX operating system.

Windows implementations **SHOULD** test their implementations to ensure that safety-checks prevent use of drive letters and the less commonly used namespace sequences (e.g. "\\?\C:\...") described in [[MSFNAM](#)].



To assist implementers, the Library of Congress conformance suite [[LC-CONFORMANCE-SUITE](#)] has some tests for invalid bags which are expected to fail on POSIX or Windows clients.

## **5.2. Control of URLs in fetch.txt**

Implementers of tools that complete bags by retrieving URLs listed in a fetch file need to be aware that some of those URLs might point to hosts, intentionally or unintentionally, that are not under control of the bag's sender. Moreover, older checksum algorithms, even if reasonable for detecting corruption during transit, may not offer strong cryptographic protection against intentional spoofing.

## **5.3. File sizes in fetch.txt**

The size of files, as optionally reported in the fetch file, cannot be guaranteed to match the actual file size to be downloaded. Implementers SHOULD take steps to monitor and abort transfer when the received file size exceeds the file size reported in the fetch file. Implementers SHOULD NOT use the file size in the fetch file for critical resource allocation, such as buffer sizing or storage requisitioning.

# **6. Practical Considerations (non-normative)**

## **6.1. Interoperability**

This section lists practical considerations for implementers and users. None of the points below are required but they are recommended for general-purpose usage.

Upon discovering errors in bags, an implementation is free to take action (for example, logging or reporting) in an application-specific manner. This document does not mandate any particular action.

The Library of Congress conformance suite [[LC-CONFORMANCE-SUITE](#)] is provided as a public resource to test new implementations for compatibility and error handling.

### **6.1.1. Filename normalization**

This section provides background information on various challenges caused by differences in how operating systems, filesystems, and common tools handle filenames followed by a list of recommendations for implementers in [Section 6.1.1.3](#).



#### **6.1.1.1. Case sensitivity**

There are two challenges for interoperability related to filename case:

- o Filesystems such as FAT or EXFAT always convert filenames to uppercase: "example.txt" will be stored as "EXAMPLE.TXT"
- o Many Unix filesystems save filenames exactly as provided, allowing multiple files which differ only in case: "example.txt" and "Example.txt" are separate files
- o NTFS and Apple's HFS Plus usually preserve case when storing files but are case-insensitive when retrieving them. A file saved as "Example.txt" will be retrieved by that name but will also be retrieved as "EXAMPLE.TXT", "example.txt", etc.

#### **6.1.1.2. Unicode normalization**

The Unicode specification has common cases where different character sequences produce the same human-meaningful text. These are referred to as "canonically equivalent" and the Unicode specification defines different normalization forms -- see [[UNICODE-TR15](#)] for the full details and a brief example below:

The common surname "Nunez" normalized in different forms

Normalization Form D (Decomposition):

Char	UTF8 Hex	Name
-----		
N	4e	LATIN CAPITAL LETTER N
u	75	LATIN SMALL LETTER U
\u0301	cc81	COMBINING ACUTE ACCENT
n	6e	LATIN SMALL LETTER N
\u0303	cc83	COMBINING TILDE
e	65	LATIN SMALL LETTER E
z	7a	LATIN SMALL LETTER Z

Normalization Form C (Canonical Composition):

Char	UTF8 Hex	Name
-----		
N	4e	LATIN CAPITAL LETTER N
u	c3ba	LATIN SMALL LETTER U WITH ACUTE
n	c3b1	LATIN SMALL LETTER N WITH TILDE
e	65	LATIN SMALL LETTER E
z	7a	LATIN SMALL LETTER Z



Unicode normalization is relevant to BagIt implementors because different systems have different standards for normalization:

- o Apple's HFS Plus filesystem always normalizes filenames to a fully-decomposed form based on the Unicode 2.0 specification (see [\[TN1150\]](#)).
- o Windows treats filenames as opaque character sequences (see [\[MSFNAM\]](#)) and will store and return the encoded bytes exactly as provided.
- o Linux and other common Unix systems are generally similar to Windows in storing and returning opaque byte streams but this behaviour is technically filesystem-dependent.
- o Utilities used for file management, transfer, and archival may ignore this issue, apply an arbitrary normalization form, or allow the user to control how normalization is applied.

In practice, this means that the encoded filename stored in a manifest may fail a simple file existence check because the filename's normalization was changed at some point after the manifest was written. This situation is very confusing for users because the filenames are visually indistinguishable and the "missing" file is obviously present in the payload directory.

#### **6.1.1.3. Recommendations**

- o Implementations SHOULD discourage the creation of bags containing files which differ only in case.
- o Implementations SHOULD prevent the creation of bags containing files which differ only in normalization form.
- o BagIt implementations SHOULD tolerate differences in normalization form by comparing both the list of filesystem and manifest names after applying the same normalization form to both.
- o Implementations SHOULD issue a warning when multiple manifests are present which differ only in case or normalization form.

#### **6.1.2. Windows and Unix file naming**

As specified above, only the Unix-based path separator ('/') may be used inside filenames listed in BagIt manifest and fetch.txt files. When bags are exchanged between Windows and Unix platforms, the path separator SHOULD be translated as needed. Receivers of bags on physical media SHOULD be prepared for filesystems created under





either Windows or Unix. Besides the fundamental difference between path separators ('\ ' and '/'), generally, Windows filesystems have more limitations than Unix filesystems.

Windows path names have a maximum of 255 characters, and none of these characters may be used in a path component:

< > : " / | ? \*

Windows also reserves the following names, with or without a file extension:

CON, PRN, AUX, NUL  
COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9  
LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9

See [[MSFNAM](#)] for more information and possible alternatives.

#### **6.1.3. Legacy checksum tools**

Some bags have been manually assembled using checksum utilities such as those contained in the GNU Coreutils package (md5sum, sha1sum, etc.), collectively referred to here as "md5sum". Implementers who desire wide support of legacy content should be aware of some known quirks of these tools:

md5sum can be run in "text mode" which causes it to normalize line-endings on some operating systems. On Unix-like systems both modes will usually produce the same results but on systems like Windows they can produce different results based on the file contents. The md5sum output format has two characters between the checksum and the filepath: the first is always a space and the second is an asterisk ("\*") for binary mode and a space for text mode.

A final note about md5sum-generated manifests is that for a `_filepath_` containing a backslash ('\ '), the manifest line will have a backslash inserted in front of the `_checksum_` and, under Windows, the backslashes inside `_filepath_` can be doubled.

Implementers MAY wish to accept this format by ignoring a leading asterisk or handling differences in line termination gracefully but, if so, implementations MUST warn the user that the bag in question will fail strict validation. In such cases it is RECOMMENDED that tools provide an easy option to update the bag with valid manifests.



## **7. Augmented Backus-Naur Form (non-normative)**

The Augmented Backus-Naur Form (ABNF) rules provided below are non-normative. If there is a discrepancy between requirements in the normative sections and the ABNF, the requirements in the normative sections prevail. Some definitions use the core rules (e.g. DIGIT, HEXDIG, etc) as defined in [[RFC4234](#)]

### **7.1. Bag Declaration: bagit.txt**

bagit.txt ABNF rules:

```
bagit-txt = "BagIt-Version: " 1*DIGIT "." 1*DIGIT ending
           "Tag-File-Character-Encoding: " encoding ending
encoding  = 1*CHAR
ending    = CR / LF / CRLF
```

### **7.2. Payload Manifest: manifest-algorithm.txt**

Payload Manifest ABNF rules:

```
payload-manifest      = 1*payload-manifest-line
payload-manifest-line = checksum 1*WSP filepath ending
checksum              = 1*case-hexdig
case-hexdig           = DIGIT / "A" / "a" / "B" / "b" / "C" / "c" /
                        "D" / "d" / "E" / "e" / "F" / "f"
filepath              = "data/"
                        1*( unreserved / pct-encoded / sub-delims )
unreserved             = ALPHA / DIGIT / "-" / "." / "_" / "~"
sub-delims             = "!" / "$" / "&" / DQUOTE / "'" / "(" / ")" /
                        "*" / "+" / "," / ";" / "=" / "/"
pct-encoded            = "%0D" / "%0d" / "%0A" / "%0a" / "%25"
ending                 = CR / LF / CRLF
```

### **7.3. Bag Metadata: bag-info.txt**

bag-info.txt ABNF rules:

```
metadata      = 1*metadata-line
metadata-line = key ":" WSP value ending *(continuation ending)
key           = 1*non-reserved
value         = 1*non-reserved
continuation  = WSP 1*non-reserved
non-reserved  = VCHAR / WSP
               ; any valid character for the specific encoding
               ; except those that match "ending"
ending        = CR / LF / CRLF
```



#### **7.4. Fetch File: fetch.txt**

fetch.txt ABNF rules:

```
fetch      = 1*fetch-line
fetch-line = url 1*WSP length 1*WSP filepath ending
url        = <absolute-URI, see \[RFC3986\], Section 4.3>
length     = 1*DIGIT / "-"
filepath   = ("data/"
              1*( unreserved / pct-encoded / sub-delims ))
ending     = CR / LF / CRLF
```

#### **8. Contributors**

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#### **10. IANA Considerations**

This draft does not request any action from IANA.

#### **11. References**

##### **11.1. Normative References**

[ni-registry]

IANA, "Named Information Hash Algorithm Registry", 9 2016, <<https://www.iana.org/assignments/named-information/named-information.xhtml>>.

[RFC1321] Rivest, R., "The MD5 Message-Digest Algorithm", [RFC 1321](#), DOI 10.17487/RFC1321, April 1992, <<https://www.rfc-editor.org/info/rfc1321>>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.



- [RFC2978] Freed, N. and J. Postel, "IANA Charset Registration Procedures", [BCP 19](#), [RFC 2978](#), DOI 10.17487/RFC2978, October 2000, <<https://www.rfc-editor.org/info/rfc2978>>.
- [RFC3174] Eastlake 3rd, D. and P. Jones, "US Secure Hash Algorithm 1 (SHA1)", [RFC 3174](#), DOI 10.17487/RFC3174, September 2001, <<https://www.rfc-editor.org/info/rfc3174>>.
- [RFC3629] Yergeau, F., "UTF-8, a transformation format of ISO 10646", STD 63, [RFC 3629](#), DOI 10.17487/RFC3629, November 2003, <<https://www.rfc-editor.org/info/rfc3629>>.
- [RFC3986] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax", STD 66, [RFC 3986](#), DOI 10.17487/RFC3986, January 2005, <<https://www.rfc-editor.org/info/rfc3986>>.
- [RFC6234] Eastlake 3rd, D. and T. Hansen, "US Secure Hash Algorithms (SHA and SHA-based HMAC and HKDF)", [RFC 6234](#), DOI 10.17487/RFC6234, May 2011, <<https://www.rfc-editor.org/info/rfc6234>>.
- [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>>.
- [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>>.

## **[11.2](#). Informative References**

- [ENCDEP] Tabata, K., "A Collaboration Model between Archival Systems to Enhance the Reliability of Preservation by an Enclose-and-Deposit Method", 2005, <<http://www.iwaw.net/05/papers/iwaw05-tabata.pdf>>.
- [LC-CONFORMANCE-SUITE]  
The Library of Congress, "BagIt Conformance Suite", 2016-, <<https://github.com/LibraryOfCongress/bagit-conformance-suite/>>.
- [MSFNAM] Microsoft, Inc., "Naming a File", 2008, <<http://msdn2.microsoft.com/en-us/library/aa365247.aspx>>.





- [RFC4234] Crocker, D., Ed. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", [RFC 4234](#), DOI 10.17487/RFC4234, October 2005, <<https://www.rfc-editor.org/info/rfc4234>>.
- [TN1150] Apple Inc., "Technical Note TN1150: HFS Plus Volume Format", 3 2004, <<https://developer.apple.com/legacy/library/technotes/tn/tn1150.html>>.
- [UNICODE-TR15] Unicode Consortium, "Unicode(R) Standard Annex #15: Unicode Normalization Forms", 2 2016, <<http://www.unicode.org/reports/tr15/>>.

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