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## JavaScript Object Notation (JSON) Pointer

### Abstract

JSON Pointer defines a string syntax for identifying a specific value within a JavaScript Object Notation (JSON) document.

### Status of This Memo

This is an Internet Standards Track document.

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## 1. Introduction

This specification defines JSON Pointer, a string syntax for identifying a specific value within a JavaScript Object Notation (JSON) document [RFC4627]. JSON Pointer is intended to be easily expressed in JSON string values as well as Uniform Resource Identifier (URI) [RFC3986] fragment identifiers.

## 2. Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

This specification expresses normative syntax rules using Augmented Backus-Naur Form (ABNF) [RFC5234] notation.

## 3. Syntax

A JSON Pointer is a Unicode string (see [RFC4627], Section 3) containing a sequence of zero or more reference tokens, each prefixed by a '/' (%x2F) character.

Because the characters '~' (%x7E) and '/' (%x2F) have special meanings in JSON Pointer, '~' needs to be encoded as '~0' and '/' needs to be encoded as '~1' when these characters appear in a reference token.

The ABNF syntax of a JSON Pointer is:

```
json-pointer    = *( "/" reference-token )
reference-token = *( unescaped / escaped )
unescaped      = %x00-2E / %x30-7D / %x7F-10FFFF
                ; %x2F ('/') and %x7E ('~') are excluded from 'unescaped'
escaped        = "~" ( "0" / "1" )
                ; representing '~' and '/', respectively
```

It is an error condition if a JSON Pointer value does not conform to this syntax (see Section 7).

Note that JSON Pointers are specified in characters, not as bytes.

#### 4. Evaluation

Evaluation of a JSON Pointer begins with a reference to the root value of a JSON document and completes with a reference to some value within the document. Each reference token in the JSON Pointer is evaluated sequentially.

Evaluation of each reference token begins by decoding any escaped character sequence. This is performed by first transforming any occurrence of the sequence '~1' to '/', and then transforming any occurrence of the sequence '~0' to '~'. By performing the substitutions in this order, an implementation avoids the error of turning '~01' first into '~1' and then into '/', which would be incorrect (the string '~01' correctly becomes '~1' after transformation).

The reference token then modifies which value is referenced according to the following scheme:

- o If the currently referenced value is a JSON object, the new referenced value is the object member with the name identified by the reference token. The member name is equal to the token if it has the same number of Unicode characters as the token and their code points are byte-by-byte equal. No Unicode character normalization is performed. If a referenced member name is not unique in an object, the member that is referenced is undefined, and evaluation fails (see below).

- o If the currently referenced value is a JSON array, the reference token MUST contain either:
  - \* characters comprised of digits (see ABNF below; note that leading zeros are not allowed) that represent an unsigned base-10 integer value, making the new referenced value the array element with the zero-based index identified by the token, or
  - \* exactly the single character "-", making the new referenced value the (nonexistent) member after the last array element.

The ABNF syntax for array indices is:

```
array-index = %x30 / ( %x31-39 *(%x30-39) )  
             ; "0", or digits without a leading "0"
```

Implementations will evaluate each reference token against the document's contents and will raise an error condition if it fails to resolve a concrete value for any of the JSON pointer's reference tokens. For example, if an array is referenced with a non-numeric token, an error condition will be raised. See Section 7 for details.

Note that the use of the "-" character to index an array will always result in such an error condition because by definition it refers to a nonexistent array element. Thus, applications of JSON Pointer need to specify how that character is to be handled, if it is to be useful.

Any error condition for which a specific action is not defined by the JSON Pointer application results in termination of evaluation.

## 5. JSON String Representation

A JSON Pointer can be represented in a JSON string value. Per [RFC4627], Section 2.5, all instances of quotation mark '"' (%x22), reverse solidus '\' (%x5C), and control (%x00-1F) characters MUST be escaped.

Note that before processing a JSON string as a JSON Pointer, backslash escape sequences must be unescaped.

For example, given the JSON document

```
{
  "foo": ["bar", "baz"],
  "": 0,
  "a/b": 1,
  "c%d": 2,
  "e^f": 3,
  "g|h": 4,
  "i\\j": 5,
  "k\"l": 6,
  " ": 7,
  "m~n": 8
}
```

The following JSON strings evaluate to the accompanying values:

```
" " // the whole document
"/foo" ["bar", "baz"]
"/foo/0" "bar"
"/" 0
"/a~1b" 1
"/c%d" 2
"/e^f" 3
"/g|h" 4
"/i\\j" 5
"/k\"l" 6
"/ " 7
"/m~0n" 8
```

## 6. URI Fragment Identifier Representation

A JSON Pointer can be represented in a URI fragment identifier by encoding it into octets using UTF-8 [RFC3629], while percent-encoding those characters not allowed by the fragment rule in [RFC3986].

Note that a given media type needs to specify JSON Pointer as its fragment identifier syntax explicitly (usually, in its registration [RFC6838]). That is, just because a document is JSON does not imply that JSON Pointer can be used as its fragment identifier syntax. In particular, the fragment identifier syntax for application/json is not JSON Pointer.

Given the same example document as above, the following URI fragment identifiers evaluate to the accompanying values:

```
#           // the whole document
#/foo      ["bar", "baz"]
#/foo/0    "bar"
#/         0
#/a~1b     1
#/c%25d    2
#/e%5Ef    3
#/g%7Ch    4
#/i%5Cj    5
#/k%22l    6
#/%20      7
#/m~0n     8
```

## 7. Error Handling

In the event of an error condition, evaluation of the JSON Pointer fails to complete.

Error conditions include, but are not limited to:

- o Invalid pointer syntax
- o A pointer that references a nonexistent value

This specification does not define how errors are handled. An application of JSON Pointer SHOULD specify the impact and handling of each type of error.

For example, some applications might stop pointer processing upon an error, while others may attempt to recover from missing values by inserting default ones.

## 8. Security Considerations

A given JSON Pointer is not guaranteed to reference an actual JSON value. Therefore, applications using JSON Pointer should anticipate this situation by defining how a pointer that does not resolve ought to be handled.

Note that JSON pointers can contain the NUL (Unicode U+0000) character. Care is needed not to misinterpret this character in programming languages that use NUL to mark the end of a string.

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## 10. References

### 10.1. Normative References

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