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Working Draft, Standard for C++ Ecosystem

Note: this is an early draft. It's known to be incomplet and incorrekt, and it has lots of bad fomattting.

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This document was prepared by Technical Committee ISO/IEC JTC1, Information technology, Subcommittee 22, Programming languages, their environments and system software interfaces, Working Group 21, C++.

The main changes are as follows:

— Initial release.

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2 Scope

[intro.scope]

- ¹ This document specifies formats, processes, definitions, and so on, that facilitates the interoperation of the tools and systems that implement, and interface with, the C++ programming language.
- ² C++ is a general purpose programming language described in ISO/IEC 14882:2020 *Programming languages — C++* (hereinafter referred to as the *C++ standard*).

3 Normative references

[intro.refs]

- ¹ The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Vocabulary ISO/IEC 2382, *Information technology — Vocabulary*

POSIX ISO/IEC 9945:2009, *Information technology — Portable Operating System Interface (POSIX®) Base Specifications, Issue 7*

C++ ISO/IEC 14882:2020, *Programming languages — C++*

JSON ISO/IEC 21778:2017, *Information technology — The JSON data interchange syntax*

Mathematics ISO 80000-2:2019, *Quantities and units — Part 2: Mathematics*

SemVer The SemVer Team. *Semantic Versioning 2.0.0*. June 18 2013. Available at: <https://semver.org/spec/v2.0.0.html>

4 Conformance

[intro.cnf]

¹ A conforming implementation shall meet the following criteria for conformance to this standard:

- (1.1) — An application shall support the minimum level functionality of introspection (6.9).

5 Terms and definitions

[intro.defs]

- ¹ For the purposes of this document, the terms and definitions given in ISO/IEC 2382, the terms and definitions given in ISO/IEC 14882:2020, and the following apply.
- ² ISO and IEC maintain terminology databases for use in standardization at the following addresses:
- (2.1) — ISO Online browsing platform: available at <https://www.iso.org/obp>
- (2.2) — IEC Electropedia: available at <https://www.electropedia.org/>
- ³ Terms that are used only in a small portion of this document are defined where they are used and italicized where they are defined.

5.1 **application** [defns.application]

a computer program that performs some desired function.

[*Note 1 to entry:* From POSIX. — *end note*]

5.2 **capability** [defns.capability]

an aspect of an overall specification that defines a subset of the entire specification.

5.3 **directory** [defns.directory]

a file that contains directory entries.

[*Note 1 to entry:* From POSIX. — *end note*]

5.4 **directory entry** [defns.direntry]

an object that associates a filename with a file.

[*Note 1 to entry:* From POSIX. — *end note*]

5.5 **file** [defns.file]

an object that can be written to, or read from, or both.

[*Note 1 to entry:* From POSIX. — *end note*]

5.6 **filename** [defns.filename]

a sequence of bytes used to name a file.

[*Note 1 to entry:* From POSIX. — *end note*]

5.7 **parent directory** [defns.parentdir]

a directory containing a directory entry for the file under discussion.

[*Note 1 to entry:* From POSIX. — *end note*]

5.8 **pathname** [defns.pathname]

a string that is used to identify a file.

[*Note 1 to entry:* From POSIX. — *end note*]

6 Introspection

[intspct]

6.1 Preamble

[intspct.pre]

- ¹ This clause describes options, output, and formats that describe what capabilities of this standard an application supports. An application shall support the *minimum level* functionality (6.9). An application can support the *full level* functionality (6.10).
- ² This clause specifies the `std.info` capability (6.7).

6.2 Overview

[intspct.overview]

- ¹ *application* [*std-info-opt* [*declaration*]] [*std-info-out-opt file*]

6.3 Options

[intspct.options]

- ¹ Applications shall accept one of two options syntax variations: `--name=value` (`--name` without a value) or `-name:value` (`-name` without a value).
- ² Applications shall indicate an error if invoked with an option syntax variation that it does not support.

[Note 1: An application will report the error in what is conventional for the platform it runs in. On POSIX and Windows it would return an error code, and optionally output to the error stream. — end note]

[Note 2: It is up to a program that interacts with an application implementing introspection to determine what option syntax variation the application supports. One method to accomplish that is to execute the application with one of the two syntax styles and use the error indication to conclude which syntax works. Another is to have a priori knowledge of which syntax variation works. — end note]

6.3.1 Information Option

[intspct.opt.info]

- ¹ This option shall be supported.

- ² *std-info-opt*

Outputs the version information of the capabilities supported by the application. The option is specified as `--std-info` or `-std-info`. The option can be specified zero or one time. The application shall support the option for *minimum level* (6.9) functionality.

6.3.2 Information Output Option

[intspct.opt.out]

- ¹ This option shall be supported.

- ² *std-info-out-opt file*

The pathname of a file to output the information to. The option is specified as `--std-info-out=file` or `-std-info-out:file`. If *file* is `'-'`, the standard output shall be used. The application shall support the option for *minimum level* (6.9) functionality. Not specifying this option while specifying the *std-info-opt* option (6.3.1) shall be equivalent to also specifying a *std-info-out-opt file* option where *file* is `'-'`.

6.3.3 Declaration Option

[intspct.opt.decl]

- ¹ This option should be supported.

- ² *std-info-opt declaration*

Declares the required capability version of the application. The option is specified as `--std-info=declaration` or `-std-info:declaration`. The option can be specified any number of times. The application shall support the option for *full level* (6.10) functionality.

6.4 Output

[intspct.output]

- ¹ An application shall output a valid JSON text file that conforms to the introspection schema (6.6) to the file specified in the options (6.3.2).

6.5 Files [intspct.file]

- 1 An application can provide an *introspection file* that contains valid JSON that conforms to the introspection schema (6.6).
- 2 An *introspection file* shall contain the same information as that produced from the *std-info-opt* information option (6.3.1).
- 3 An *introspection file* shall be named the same as the application with any filename extension replaced with the `stdinfo` filename extension. It is implementation defined how the filename of the introspection file replaces the application filename extension with the new `stdinfo` filename extension.
 [Note 1: For Windows, POSIX, and other platforms replacing the filename extension would remove any filename bytes after the last period (U+002E FULL STOP) and append the `stdinfo` sequence of bytes. — end note]
- 4 An *introspection file* shall either have the same parent directory as the application, have an implementation defined parent directory that is relative to the parent directory of the application, or have an implementation defined parent directory.

6.6 Schema [intspct.schema]

- 1 An introspection JSON text file shall contain one introspection JSON object (6.6.1).

6.6.1 Introspection Object [intspct.schema.obj]

- 1 The *introspection object* is the root JSON object of the introspection JSON text.
- 2 An *introspection object* can have the following fields.

6.6.2 JSON Schema Field [intspct.schema.schema]

- 1 *Name:* `$schema`
- 2 *Type:* `string`
- 3 *Value:* The value shall be a reference to a JSON Schema specification.
- 4 *Description:* An *introspection object* can contain this field. If an *introspection object* does not contain this field the value shall be a reference to the JSON Schema corresponding to the current edition of this standard.

6.6.3 Capability Field [intspct.schema.cap]

- 1 *Name:* *capability-identifier* (6.7)
- 2 *Type:* `string` or `array`
- 3 *Value:* (for `string`) The value shall be a *version-number* for *minimum level* functionality. Or the value shall be a *version-range* for *full level* functionality.
- 4 *Value:* (for `array`) The value can be a JSON `array` for *full level* functionality. If the value is a JSON `array` the items in the `array` shall be a *version-number* or *version-range*.
- 5 *Description:* An *introspection object* can contain this field one or more times. When the field appears more than one time the name of the fields shall be unique within the *introspection object*.

6.7 Capabilities [intspct.cap]

capability-identifier:
name *scope-designator* *name* *sub-capability-identifier*_{opt}

sub-capability-identifier:
scope-designator *name* *sub-capability-identifier*_{opt}

name:
 one or more of:
 U+0061 .. U+007A LATIN SMALL LETTER A .. Z
 U+005F LOW LINE

scope-designator:
 U+002E FULL STOP

- 1 A *capability-identifier* is composed of two or more *scope-designator* delimited *name* parts.
- 2 The *name* `std` in a *capability-identifier* is reserved for capabilities defined in this standard.
- 3 Applications can specify vendor designated *name* parts defined outside of this standard.

6.8 Versions

[intspct.vers]

- ¹ A version shall be either a single version number (6.8.1) or a version range (6.8.2).
- ² A single version number shall be equivalent to the inclusive version range spanning solely that single version number.

[Note 1: That is, the version number $i.j.k$ is equivalent to version range $[i.j.k, i.j.k]$. — end note]

6.8.1 Version Number

[intspct.vers.num]

- ¹ A version number shall conform to the SemVer <version core> syntax.
- ² A version number can be truncated to only <major> or <major>.<minor> syntax.
- ³ A version number composed of only <major> is equivalent to <major>.0.0.
- ⁴ A version number composed of only <major>.<minor> is equivalent to <major>.<minor>.0.
- ⁵ Version numbers define a total ordering where version number a is ordered before a version number b when a has a lower SemVer precedence than b .

6.8.2 Version Range

[intspct.vers.range]

version-range:

version-range-min-bracket version-min-number version-range-max-part_{opt} version-range-max-bracket

version-range-max-part:

U+002C COMMA version-max-number

version-min-number:

version-number

version-max-number:

version-number

version-range-min-bracket:

one of: U+005B LEFT SQUARE BRACKET U+0028 LEFT PARENTHESIS

version-range-max-bracket:

one of: U+005D RIGHT SQUARE BRACKET U+0029 RIGHT PARENTHESIS

- ¹ A version range is composed of either one version number bracketed, or two version numbers separated by a U+002C COMMA and bracketed.

[Example 1: A version range with a single version number "[1.0.0]". — end example]

[Example 2: A version range with a two version numbers "[1.0.0,2.0.0]". — end example]
- ² A version range a that is $[i, j]$ makes i and j inclusive version range numbers, defining a Mathematics closed interval.
- ³ A version range a that is (i, j) makes i and j exclusive version range numbers, defining a Mathematics open interval.
- ⁴ A version range a that is $(i, j]$ makes i an exclusive version number and j an inclusive version number, defining a Mathematics half-open interval.
- ⁵ A version range a that is $[i, j)$ makes j an exclusive version number.
- ⁶ A version range with a single inclusive version number x is equivalent to the version range $[x, x]$.
- ⁷ A version range with a single exclusive version number x is invalid.
- ⁸ An exclusive version number x does not include the version number x when compared to another version number y .
- ⁹ A version range a with version numbers i and j when compared to a version range b with version number m and n will result in an empty version range when: $j < m$ or $n < i$.
- ¹⁰ Otherwise if i or m are inclusive version numbers and if j or n are inclusive version numbers the resulting range when a is compare to b is the inclusive version numbers "lesser of i and m " and "lesser of j and n ".
- ¹¹ Otherwise if i or m are inclusive version numbers and if j or n are inclusive version numbers the resulting range when a is compare to b is the inclusive version number "lesser of i and m " and the exclusive version number "lesser of j and n ".

- ¹² Otherwise if *j* or *n* are inclusive version numbers the resulting range when *a* is compared to *b* is the exclusive version number "lesser of *i* and *m*" and the inclusive version number "lesser of *j* and *n*".
- ¹³ Otherwise the resulting range when *a* is compared to *b* is the exclusive version numbers "lesser of *i* and *m*" and "lesser of *j* and *n*".

6.9 Minimum Level [intspct.min]

- ¹ An application that supports the *minimum level* functionality indicates it by specifying a single version (6.8.1) as the value of the `std.info` capability (6.7).

[Example 1: { "std.info": "1.0.0" } — end example]

6.10 Full Level [intspct.full]

- ¹ An application can support the *full level* functionality as defined in this section. An application that reports supporting the *full level* functionality shall support all of the functionality in this section.
- ² An application that supports the *full level* functionality indicates it by specifying a version range (6.8.2) or an array of version range items as the value of the `std.info` capability (6.7).

[Example 1: { "std.info": "[1.0.0]" } — end example]

An application that responds with an array of version range items as the value of a capability field shall support the union of the range items indicated.

6.11 Introspection Information [intspct.info]

- ¹ An application shall output an introspection schema (6.6) that contains one capability field for each capability that the application supports when given the `--std-info` option (6.3.1).
- ² An application shall indicate the single version (6.8.1) or version range (6.8.2) of each capability it supports as the value of the capability field.

6.12 Introspection Declaration [intspct.dcl]

- ¹ An application that supports the *full level* functionality when given one or more *std-info-opt declaration* options shall conform its functionality to the indicated edition of this standard in the given *declaration version-number* for the given capability.

declaration:

capability-identifier U+003D EQUALS SIGN *version-number*

- ² An application, when not given a *std-info-opt declaration* option for a capability it supports, should conform its functionality to the most recent version of the standard it supports for that capability.
- ³ An application, when given a capability declaration option and the given version is outside of the version range that the application supports, should indicate an error.

6.13 Compatability [intspct.compat]

- ¹ An application shall indicate, per SemVer specification, that version *n* of the interface it implements is *backward compatible* with another version *p* of the interface that another application implements when the <major> number is the same in version *n* and *p* and version *n* follows version *p*.

Annex A (informative)

Tool Introspection JSON Schema [intsjschm]

A.1 General [intsjschm.general]

- ¹ This Annex defines the introspection capability schema (6.6) in terms of a *JSON Schema*. A *JSON Schema* refers to the IETF RFC draft "JSON Schema: A Media Type for Describing JSON Documents" as specified in <https://json-schema.org/draft/2020-12/json-schema-core.html>.
- ² This JSON Schema can be referenced as the `$schema` field with URI value of `"https://raw.githubusercontent.com/cplusplus/ecosystem-is/release/schema/std_info-1.0.0.json"`.

A.2 JSON Schema Specification [intsjschm.spec]

```
{
  "$schema": "https://json-schema.org/draft/2020-12/schema",
  "$id":
    "https://raw.githubusercontent.com/cplusplus/ecosystem-is/release/schema/std_info-1.0.0.json",
  "title": "Tool Introspection Version 1.0.0 JSON Schema",
  "$defs": {
    "VersionMin": {
      "type": "string",
      "pattern": "^[0-9]+(.[0-9]+){0,2}$"
    },
    "VersionFull": {
      "type": "string",
      "pattern": "^[([0-9]+(.[0-9]+){0,2})\\\\"$"
    },
    "VersionRange": {
      "type": "string",
      "pattern": "^[([0-9]+(.[0-9]+){0,2},[0-9]+(.[0-9]+){0,2})\\\\"$"
    },
    "Version": {
      "oneOf": [
        {
          "$ref": "#/$defs/VersionMin"
        },
        {
          "$ref": "#/$defs/VersionFull"
        },
        {
          "$ref": "#/$defs/VersionRange"
        }
      ]
    },
    "Versions": {
      "type": "array",
      "items": {
        "$ref": "#/$defs/Version"
      }
    },
    "VersionSpec": {
      "oneOf": [
        {
          "$ref": "#/$defs/Version"
        },
        {
          "$ref": "#/$defs/Versions"
        }
      ]
    }
  }
}
```

```
    }
  },
  "anyOf": [
    {
      "type": "object",
      "properties": {
        "$schema": {
          "description":
            "JSON Schema URI for the version of the tool introspection format.",
          "type": "string",
          "format": "uri"
        },
        "std.info": {
          "description": "The Tool Introspection format version.",
          "$ref": "#/$defs/VersionSpec"
        }
      },
      "patternProperties": {
        "^[a-z_]+(\\.?[a-z_]+)$": {
          "$ref": "#/$defs/VersionSpec"
        }
      },
      "additionalProperties": false
    }
  ],
  "required": [
    "std.info"
  ]
}
```

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