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JSCalendar 2.0: A JSON Representation of Calendar Data
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Abstract

This specification defines version "2.0" of JSCalendar, a data model and JSON representation of calendar data that can be used for storage and data exchange in a calendaring and scheduling environment. This document obsoletes RFC 8984, also referred to as version "1.0" in this document. The newly defined version "2.0" aims to improve interoperability with existing iCalendar-based systems. It also aligns its definitions with JSContact, such as the IANA registry policy, validation requirements, and versioning scheme.

Note

This note is to be removed before publishing as an RFC.

Differences from RFC 8984 are documented in Appendix A.

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1. Introduction

This document defines a data model for calendar event and task objects, or groups of such objects, in electronic calendar applications and systems. The format aims to be unambiguous, extendable, and simple to process.

The key design considerations for this data model are as follows:

- * The attributes of the calendar entry represented must be described as simple key-value pairs. Simple events are simple to represent; complex events can be modeled accurately.
- * Wherever possible, there should be only one way to express the desired semantics, reducing complexity.
- * The data model should avoid ambiguities, which often lead to interoperability issues between implementations.
- * The data model should be generally compatible with the iCalendar data format [RFC5545] [RFC7986] and extensions, but the specification should add new attributes where the iCalendar format currently lacks expressivity, and drop seldom-used, obsolete, or redundant properties. This means translation with no loss of semantics should be easy with most common iCalendar files.
- * Extensions, such as new properties and components, should not require updates to this document.

The representation of this data model is defined in the Internet JSON (I-JSON) format [RFC7493], which is a strict subset of the JSON data interchange format [RFC8259]. Using JSON is mostly a pragmatic choice: its widespread use makes JSCalendar easier to adopt and the ready availability of production-ready JSON implementations eliminates a whole category of parser-related interoperability issues, which iCalendar has often suffered from.

1.1. Relation to iCalendar and jCal

The iCalendar data format [RFC5545], a widely deployed interchange format for calendaring and scheduling data, has served calendaring vendors for a long time but contains some ambiguities and pitfalls that cannot be overcome without backward-incompatible changes.

Sources of implementation errors include the following:

- * iCalendar defines various formats for local times, UTC, and dates.

- * iCalendar requires custom time zone definitions within a single calendar component.
- * iCalendar's definition of recurrence rules is ambiguous and has resulted in differing interpretations, even between experienced calendar developers.
- * The iCalendar format itself causes interoperability issues due to misuse of CRLF-terminated strings, line continuations, and subtle differences among iCalendar parsers.

In recent years, many new products and services have appeared that wish to use a JSON representation of calendar data within their APIs. The JSON format for iCalendar data, jCal [RFC7265], is a direct mapping between iCalendar and JSON. In its effort to represent full iCalendar semantics, it inherits all the same pitfalls and uses a complicated JSON structure.

As a consequence, since the standardization of jCal, the majority of implementations and service providers either kept using iCalendar or came up with their own proprietary JSON representations, which are incompatible with each other and often suffer from common pitfalls, such as storing event start times in UTC (which become incorrect if the time zone's rules change in the future). JSCalendar meets the demand for JSON-formatted calendar data that is free of such known problems and provides a standard representation as an alternative to the proprietary formats.

Two additional documents define the relation of JSCalendar and iCalendar: [I-D.ietf-calext-icalendar-jscalendar-extensions] defines new iCalendar properties and parameters. [I-D.ietf-calext-jscalendar-icalendar] defines how to convert JSCalendar data from and to iCalendar.

1.2. Relation to obsolete RFC 8984

This document obsoletes the data model originally defined in [RFC8984]. The goal of this new document is to improve interoperability with systems that also make use of iCalendar [RFC5545]. It obsoletes elements which semantically conflict with related iCalendar elements. It reserves elements which require further work by IETF. Further differences from [RFC8984] are documented in Appendix A.

This document also aligns general definitions of JSCalendar with JSContact [RFC9553]: It defines the same notation for specifying data types (Section 1.4), redefines the PatchObject type to allow patching existing array entries (Section 1.5.9) and provides the same guidance

on how to process URIs and internationalized text (Section 1.5.9). Also, it defines the same validation scheme (Section 1.5.9), the same versioning scheme (Section 1.9), and the same IANA registry policy and change procedures (Section 7.2).

1.3. Notational Conventions

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.

The underlying format used for this specification is JSON. Consequently, the terms "object" and "array" as well as the four primitive types (strings, numbers, booleans, and null) are to be interpreted as described in Section 1 of [RFC8259].

Some examples in this document contain "partial" JSON documents used for illustrative purposes. In these examples, an ellipsis "..." is used to indicate a portion of the document that has been removed for compactness.

1.4. Data Type Notations

This section introduces the notations and terminology used to define data types in JSCalendar.

The underlying format for JSCalendar is JSON, so its data types also build on JSON values. The terms "object" and "array" as well as the four primitive types ("strings", "numbers", "booleans", and "null") are to be interpreted as described in Section 1 of [RFC8259]. All JSCalendar data MUST be valid according to the constraints given in I-JSON [RFC7493]. Unless otherwise noted, all member names in JSON objects and all string values are case-sensitive. Within the context of JSON objects, the term "key" is synonymous with "member name" as defined in Section 1 of [RFC8259].

1.4.1. Objects and Properties

JSCalendar defines data types for calendar information such as calendar events and todo list items. This information typically consists of multiple related elements; for example, a datetime and a duration value together define the timespan of a calendar event. These related elements are organized in JSCalendar objects. A JSCalendar object is a JSON object that has the following:

1. A unique type name registered in the IANA "JSCalendar Types" registry (Section 7.5).
2. One or more object members for which the name and allowed value types are specified. Such members are called "properties".
3. One property named @type with a string value that matches the type name of the JSCalendar object. In general, this property does not need to be set explicitly as outlined in Section 1.4.4.

The following sections specify how to define JSCalendar object types. Sections 1.7 and 1.8 then define the exact requirements for property names.

The next paragraph illustrates how a JSCalendar object is defined. The names "Foo" and "baz" are only for demonstration and have no meaning outside the example.

A Foo object has the following properties:

@type: String. The JSCalendar type of the object. The value MUST be "Foo", if set.

baz: Number (mandatory). The baz level of the contact. The value MUST be an integer greater than 0 and less than 10.

The above paragraph illustrates the following:

- * It defines a JSCalendar object type named "Foo" having two properties, named "@type" and "baz".
- * The @type property adheres to the rules outlined in Section 1.4.4. Because of this, it is neither defined to be mandatory nor optional, as this depends on how the Foo object type is used.
- * The baz property value MUST be valid according to the definition of the Number type.
- * The property has one attribute, "mandatory", which specifies that the property MUST be present for a value of the Foo object type to be valid.
- * The free-text description of the baz property describes the semantics and further restrictions for its values.

1.4.2. Type Signatures

Type signatures are given for all JSON values and JSCalendar definitions in this document. The following conventions are used:

String: The JSON string type.

Number: The JSON number type.

Boolean: The JSON boolean type.

A[B]: A JSON object where all keys are of type A and all values are of type B.

A[]: A JSON array of values of type A.

A|B: The value is either of type A or of type B.

*: The type is undefined (the value could be any type, although permitted values may be constrained by the context of this value).

Section 1.5 defines common data types, including signed or unsigned integers and dates.

1.4.3. Property Attributes

Object properties may also have a set of attributes defined along with the type signature. These have the following meanings:

mandatory: The property MUST be set for an instance of this object to be valid.

optional: The property can, but need not, be set for an instance of this object to be valid.

default: This is followed by a JSON value. That value will be used for this property if it is omitted.

defaultType: This is followed by the name of a JSCalendar object type. A property value of JSCalendar object type is expected to be of this named type, in case it omits the @type property.

1.4.4. The @type Property

@type: String. The JSCalendar type of a JSON object. It MUST match the type name of the JSCalendar object of which the JSON object is an instance of.

The purpose of the @type property is to help implementations identify which JSCalendar object type a given JSON object represents. Implementations MUST validate that JSON objects with this property conform to the specification of the JSCalendar object type of that name.

In many cases, the @type property value is implied by where its object occurs in JSCalendar data. Assuming that both A and B are JSCalendar object types:

- * An object that is set as the value for a property with type signature "A" MAY have the @type property set. If the @type property is not set, then its value is implied to be A by the property definition.
- * An object that is set as the value for a property with type signature "A|B (defaultType: A)" MAY have the @type property set if it is an instance of A. It MUST have the @type property set if it is an instance of B. If, instead, the defaultType attribute is not defined, then the @type property MUST also be set for A.
- * An object that is not the value of a property, such as the topmost object in JSON data (directly or as a member of an array), MUST have the @type property set.

1.5. Common Data Types

In addition to the standard JSON data types, the following data types are used in this specification:

1.5.1. Id

Where "Id" is given as a data type, it means a String of at least 1 and a maximum of 255 octets in size, and it MUST only contain characters from the "URL and Filename Safe" base64url alphabet, as defined in Section 5 of [RFC4648], excluding the pad character ("="). This means the allowed characters are the ASCII alphanumeric characters ("A-Za-z0-9"), hyphen ("-"), and underscore ("_").

In many places in JSCalendar, a JSON map is used where the map keys are of type Id and the map values are all the same type of object. This construction represents an unordered set of objects, with the added advantage that each entry has a name (the corresponding map key). This allows for more concise patching of objects, and, when applicable, for the objects in question to be referenced from other objects within the JSCalendar object.

Unless otherwise specified for a particular property, there are no uniqueness constraints on an Id value (other than, of course, the requirement that you cannot have two values with the same key within a single JSON map). For example, two Event objects might use the same Ids in their respective links properties or, within the same Event object, the same Id could appear in the participants and alerts properties. These situations do not imply any semantic connections among the objects.

1.5.2. Int

Where "Int" is given as a data type, it means an integer in the range $-2^{53}+1 \leq \text{value} \leq 2^{53}-1$, the safe range for integers stored in a floating-point double, represented as a JSON Number.

1.5.3. UnsignedInt

Where "UnsignedInt" is given as a data type, it means an integer in the range $0 \leq \text{value} \leq 2^{53}-1$, represented as a JSON Number.

1.5.4. UTCDateTime

This is a String in the "date-time" format [RFC3339], with the further restrictions that any letters MUST be in uppercase, and the time offset MUST be the character "Z". Fractional second values MUST NOT be included.

For example, "2010-10-10T10:10:10Z" is conformant, but "2010-10-10T10:10:10.0Z" or "2010-10-10T10:10:10.123Z" are invalid.

1.5.5. LocalDateTime

This is a date-time String with no time zone/offset information. It is otherwise in the same format as UTCDateTime. For example, "2006-01-02T15:04:05" is valid. The time zone to associate with the LocalDateTime comes from the timeZone property of the JSCalendar object (see Section 3.6.1). If no time zone is specified, the LocalDateTime is _floating_. Floating date-times are not tied to any specific time zone. Instead, they occur in each time zone at the given wall-clock time (as opposed to the same instant point in time).

A time zone may have a period of discontinuity, for example, a change from standard time to daylight savings time. When converting local date-times that fall in the discontinuity to UTC, the offset before the transition MUST be used.

For example, in the "America/Los_Angeles" time zone, the date-time "2020-11-01T01:30:00" occurs twice: before the daylight savings time (DST) transition with a UTC offset of -07:00 and again after the transition with an offset of -08:00. When converting to UTC, we therefore use the offset before the transition (-07:00), so it becomes "2020-11-01T08:30:00Z".

Similarly, in the "Australia/Melbourne" time zone, the date-time "2020-10-04T02:30:00" does not exist; the clocks are moved forward one hour for DST on that day at 02:00. However, such a value may appear during calculations (see duration semantics in Section 1.5.6) or due to a change in time zone rules (so it was valid when the event was first created). Again, it is interpreted as though the offset before the transition is in effect (+10:00); therefore, when converted to UTC, we get "2020-10-03T16:30:00Z".

1.5.6. Duration

Where Duration is given as a type, it means a length of time represented by a subset of the ISO 8601 duration format, as specified by the following ABNF [RFC5234]:

```
dur-second  = 1*DIGIT "S"
dur-minute  = 1*DIGIT "M" [dur-second]
dur-hour    = 1*DIGIT "H" [dur-minute]
dur-time    = "T" (dur-hour / dur-minute / dur-second)
dur-day     = 1*DIGIT "D"
dur-week    = 1*DIGIT "W"
dur-cal     = (dur-week [dur-day] / dur-day)

duration    = "P" (dur-cal [dur-time] / dur-time)
```

A duration specifies an abstract number of weeks, days, hours, minutes, and/or seconds. A duration specified using weeks or days does not always correspond to an exact multiple of 24 hours. The number of hours/minutes/seconds may vary if it overlaps a period of discontinuity in the event's time zone, for example, a change from standard time to daylight savings time. Leap seconds MUST NOT be considered when adding or subtracting a duration to/from a `LocalDateTime`.

To add a duration to a `LocalDateTime`:

1. Add any week or day components of the duration to the date. A week is always the same as seven days.
2. If a time zone applies to the `LocalDateTime`, convert it to a `UTCDateTime` following the semantics in Section 1.5.5.

3. Add any hour, minute, or second components of the duration (in absolute time).
4. Convert the resulting UTCDateTime back to a LocalDateTime in the time zone that applies.

To subtract a duration from a LocalDateTime, the steps apply in reverse:

1. If a time zone applies to the LocalDateTime, convert it to UTC following the semantics in Section 1.5.5.
2. Subtract any hour, minute, or second components of the duration (in absolute time).
3. Convert the resulting UTCDateTime back to LocalDateTime in the time zone that applies.
4. Subtract any week or day components of the duration from the date.
5. If the resulting time does not exist on the date due to a discontinuity in the time zone, use the semantics in Section 1.5.5 to convert to UTC and back to get a valid LocalDateTime.

These semantics match the iCalendar DURATION value type ([RFC5545], Section 3.3.6).

1.5.7. SignedDuration

A SignedDuration represents a length of time that may be positive or negative and is typically used to express the offset of a point in time relative to an associated time. It is represented as a Duration, optionally preceded by a sign character. It is specified by the following ABNF:

```
signed-duration = ["+" / "-"] duration
```

A negative sign indicates a point in time at or before the associated time; a positive or no sign indicates a time at or after the associated time.

1.5.8. TimeZoneId

Where "TimeZoneId" is given as a data type, it means a String that is a time zone name in the IANA Time Zone Database [TZDB]. The zone rules of the respective IANA time zone records apply.

1.5.9. PatchObject

A PatchObject is of type "String[*]" and represents an unordered set of patches on a JSON object. Each key is a path represented in a subset of the JSON Pointer format [RFC6901]. The paths have an implicit leading "/", so each key is prefixed with "/" before applying the JSON Pointer evaluation algorithm.

A patch within a PatchObject is only valid if all the following conditions apply:

1. The pointer MAY reference inside an array, but if the last reference token in the pointer is an array index, then the patch value MUST NOT be null. The pointer MUST NOT use "-" as an array index in any of its reference tokens (i.e., you MUST NOT insert/delete from an array, but you MAY replace the contents of its existing members. To add or remove members, one needs to replace the complete array value).
2. All reference tokens prior to the last (i.e., the value after the final slash) MUST already exist as values in the object being patched. If the last reference token is an array index, then a member at this index MUST already exist in the referenced array.
3. There MUST NOT be two patches in the PatchObject where the pointer of one is the prefix of the pointer of the other, e.g., "alerts/1/offset" and "alerts".
4. The value for the patch MUST be valid for the property being set (of the correct type and obeying any other applicable restrictions), or if null, the property MUST be optional.

The value associated with each pointer determines how to apply that patch:

- * If null, remove the property from the patched object. If the key is not present, this is a no-op.
- * If non-null, set the value given as the value for this property (this may be a replacement or addition to the object being patched).

A PatchObject does not define its own @type (Section 1.4.4) property. Instead, the @type property in a patch MUST be handled as any other patched property value.

Implementations MUST reject a PatchObject in its entirety if any of its patches are invalid. Implementations MUST NOT apply partial patches.

The PatchObject format is used to significantly reduce file size and duplicated content when specifying variations to a common object, such as with recurring events or when translating the data into multiple languages. It can also better preserve semantic intent if only the properties that should differ between the two objects are patched. For example, if one person is not going to a particular instance of a regularly scheduled event, in iCalendar, you would have to duplicate the entire event in the override. In JSCalendar, this is a small patch to show the difference. As only this property is patched, if the location of the event is changed, the occurrence will automatically still inherit this.

1.5.10. Relation

A Relation object defines the relation to other objects, using a possibly empty set of relation types. The object that defines this relation is the linking object, while the other object is the linked object. A Relation object has the following properties:

@type: String.

This specifies the type of this object. This MUST be "Relation", if set.

relation: String[Boolean] (optional; default: empty Object).

This describes how the linked object is related to the linking object. The relation is defined as a set of relation types. Keys in the set MUST be one of the following values, specified in the property definition where the Relation object is used, a value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

first: The linked object is the first in a series the linking object is part of.

next: The linked object is next in a series the linking object is part of.

child: The linked object is a subpart of the linking object.

parent: The linking object is a subpart of the linked object.

The value for each key in the map MUST be true. The empty Object value represents a "parent" relation, unless defined differently for a specific property.

1.5.11. Link

A Link object represents an external resource associated with the linking object. It has the following properties:

@type: String.

This specifies the type of this object. This MUST be "Link", if set.

href: String (mandatory).

This is a URI[RFC3986] from which the resource may be fetched.

This MAY be a data: URL [RFC2397], but it is recommended that the file be hosted on a server to avoid embedding arbitrarily large data in JSCalendar object instances.

contentType: String (optional).

This is the media type [RFC6838] of the resource, if known.

size: UnsignedInt (optional).

This is the size, in octets, of the resource when fully decoded (i.e., the number of octets in the file the user would download), if known. Note that this is an informational estimate, and implementations must be prepared to handle the actual size being quite different when the resource is fetched.

rel: String (optional).

This identifies the relation of the linked resource to the object. If set, the value MUST be a link relation type as defined in Section 2.1 of [RFC8288] .

display: String[Boolean] (optional).

This is a set of intended purposes of a link to an image. The keys MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

badge: an image meant to be displayed alongside the title of the object

graphic: a full image replacement for the object itself

fullsize: an image that is used to enhance the object

thumbnail: a smaller variant of "fullsize" to be used when space for the image is constrained

The value for each key in the map MUST be true.

title: String (optional).

This is a human-readable, plain-text description of the resource.

1.6. Internationalization

JSCalendar aims to be used for international calendaring data.

Notably, text values such as event titles or locations are likely to cover a wide range of languages and cultures. This section describes internationalization for free-form text values as well as Uniform Resource Identifiers (URIs).

1.6.1. Free-Form Text

Properties having free-form text values MAY contain any valid sequence of Unicode characters encoded as a JSON string. Such values can contain unidirectional left-to-right and right-to-left text, as well as bidirectional text using Unicode Directional Formatting Characters as described in Section 2 of [UBiDi]. Implementations setting bidirectional text MUST make sure that each property value complies with the requirements of the Unicode Bidirectional Algorithm. Implementations MUST NOT assume that text values of adjacent properties are processed or displayed as a combined string; for example, the values of an event title and description may or may not be rendered together.

1.6.2. URIs

Several properties require their string value to be a URI as defined in [RFC3986]. Implementations MUST make sure to use proper percent-encoding for URIs that cannot be represented using unreserved URI characters. Section 3.1 of [RFC3987] defines how to convert Internationalized Resource Identifiers to URIs. JSCalendar makes no recommendation on how to display URIs, but the WHATWG URL Living Standard (see "Internationalization and special characters" (Section 4.8.3) of [WHATWG-URL]) provides guidance for URLs found in the context of a web browser.

1.7. Validating JSCalendar

This specification distinguishes between three kinds of properties regarding validation: IANA-registered properties and unknown properties, which are defined in this section, and vendor-specific properties, which are defined in Section 1.8.1. A JSCalendar object is invalid if any of its properties are invalid.

This document defines whether each property is mandatory or optional. A mandatory property **MUST** be present for a JSCalendar object to be valid. An optional property does not need to be present. The values of both required and optional properties **MUST** adhere to the data type and definition of that property.

1.7.1. Case-Sensitivity

All property names, object type names, and enumerated values are case-sensitive, unless explicitly stated otherwise in their definitions. Implementations **MUST** handle a JSCalendar object as invalid if a type name, property name, or enumerated value only differs in case from one defined for any JSCalendar version known to that implementation. This applies regardless of what JSCalendar version the object defines in its version (Section 3.1.2) property. Section 1.7.4 defines how to handle unknown properties.

1.7.2. IANA-Registered Properties

An IANA-registered property is any property that has been registered according to the IANA property registry rules as outlined in Section 7. All properties defined in this specification, including their object value types and enumerated values, are registered at IANA.

Implementations **MUST** validate IANA-registered properties in JSCalendar data, unless they are unknown to the implementation (Section 1.7.4). They **MUST** reject invalid IANA-registered properties. A property is invalid if its name matches the name of an IANA-registered property but the value violates its definition according to the JSCalendar specification version defined in the version (Section 3.1.2) property.

IANA-registered property names **MUST NOT** contain ASCII control characters (U+0000 to U+001F, U+007F), the COLON (U+003A), or the QUOTATION MARK (U+0022). They **MUST** only contain ASCII alphanumeric characters that match the ALPHA and DIGIT rules defined in Appendix B.1 of [RFC5234] or the COMMERCIAL AT (U+0040) character. IANA-registered property names **MUST** be notated in lower camel case.

1.7.3. Reserved Properties

IANA-registered properties can be reserved (Section 7.2). Implementations **MUST NOT** set properties having a reserved name in JSCalendar objects for which this property is reserved, or all objects if the property context in the registry is "not applicable". Reserved properties have no type and their type signature is "not applicable". Any JSCalendar object including a property which is

reserved in context of this object MUST be considered invalid.

This document reserves one property:

1.7.3.1. extra

extra: not applicable. The reserved property "extra" provides implementors with a property name that is certain to never occur as a property in any JSCalendar object. Implementations might want to map unknown or vendor-specific properties to a variable with this name, but this is implementation-specific.

1.7.4. Unknown Properties

Implementations may encounter JSCalendar data where a property name is unknown to that implementation but the name adheres to the syntactic restrictions of IANA-registered property names. Implementations MUST make sure that such a name does not violate the case-sensitivity rules defined in Section 1.7.1. If the property name is valid, then implementations MUST NOT treat such properties as invalid. Instead, they MUST preserve them in the JSCalendar object.

Implementations that create or update JSCalendar data MUST only set IANA-registered properties or vendor-specific properties. Preserving properties that are unknown to the implementation is to allow applications and services to interoperate without data loss, even if not all of them implement the same set of JSCalendar extensions.

1.7.5. Enumerated Values

Several properties in this document restrict their allowed values to a list of String values. These values are case-sensitive. If not noted otherwise for a specific property, the initial list of values for such properties is registered at IANA in the "JSCalendar Enum Values" registry (Section 7.6). Implementations MUST only set IANA-registered or vendor-specific (Section 1.8.2) values for such properties.

1.8. Vendor-Specific Extensions

Vendors may extend properties and values for experimentation or to store contacts data that is only useful for a single service or application. Such extensions are not meant for interoperation. If, instead, interoperation is desired, vendors are strongly encouraged to define and register new properties, types, and values at IANA as defined in Section 7. Section 1.7.2 defines the naming conventions for IANA-registered elements.

1.8.1. Vendor-Specific Properties

Vendor-specific property names MUST start with a vendor-specific prefix followed by a name, as produced by the "v-extension" ABNF below. The prefix and name together form the property name. The vendor-specific prefix MUST be a domain name under control of the service or application that sets the property, but it need not resolve in the Domain Name System [RFC1034] [RFC1035]. The prefix "ietf.org" and its subdomain names are reserved for IETF specifications. The name MUST NOT contain the TILDE (U+007E) and SOLIDUS (U+002F) characters, as these require special escaping when encoding a JSON Pointer [RFC6901] for that property.

Vendor-specific properties MAY be set in any JSCalendar object. Implementations MUST preserve vendor-specific properties in JSCalendar data, irrespective if they know their use. They MUST NOT reject the property value as invalid, unless they are in control of the vendor-specific property as outlined in the above paragraph.

The ABNF rule "v-extension" formally defines valid vendor-specific property names. Note that the vendor prefix allows for more values than Internationalized Domain Names (IDNs)[RFC8499]; therefore, JSCalendar implementations can simply validate property names without implementing the full set of rules that apply to domain names.

```
v-extension = v-prefix ":" v-name
```

```
v-prefix = v-label *("." v-label)
```

```
v-label = alnum-int / alnum-int *(alnum-int / "-") alnum-int
```

```
alnum-int = ALPHA / DIGIT / NON-ASCII  
; see RFC 6350, Section 3.3
```

```
v-name = 1*(WSP / "!" / %x23-2e / %x30-7d / NON-ASCII)  
; any characters except CTLs, DQUOTE, SOLIDUS, and TILDE
```

Figure 1: ABNF Rules for Vendor-Specific Property Names

The value of vendor-specific properties can be any valid JSON value, and naming restrictions do not apply to such values. Specifically, if the property value is a JSON object, then the keys of such objects need not be named as vendor-specific properties, as illustrated in Figure 2:

```
"example.com:foo": "bar",
"example.com:foo2": {
  "bar": "baz"
}
```

Figure 2: Examples of Vendor-Specific Properties

1.8.2. Vendor-Specific Values

Some JSCalendar IANA-registered properties allow their values to be vendor-specific. One such example is a Participant object's "kind" (Section 3.4.6) property, which enumerates its standard values but also allows for arbitrary vendor-specific values. Such vendor-specific values **MUST** be valid "v-extension" values as defined in Section 1.8.1. The example in Figure 3 illustrates this:

```
"kind": "example.com:baz"
```

Figure 3: Example of a Vendor-Specific Value

Vendors are strongly encouraged to specify a new standard value once a vendor-specific one turns out to also be useful for other systems.

1.9. Versioning

A JSCalendar Group (Section 2.3), Event (Section 2.1) and Task (Section 2.2) indicate which JSCalendar version its IANA-registered properties and values are based on. The version is indicated both in the version (Section 3.1.2) property of a JSCalendar object and in the version (Section 7.1) parameter of the JSCalendar media type. All IANA-registered elements indicate the version at which they were introduced or obsoleted.

A JSCalendar version consists of a major and minor version.

Differing major version values indicate substantial differences in JSCalendar semantics and format. Implementations **MUST** be prepared for property definitions and other JSCalendar elements that differ in a backwards-incompatible manner.

Differing minor version values indicate additions that enrich JSCalendar data but do not introduce backwards-incompatible changes. Typically, these are new property enum values or properties with a narrow semantic scope. A new minor version **MUST NOT** require implementations to change their processing of JSCalendar data. Changing the major version number resets the minor version number to zero.

1.9.1. Version Format and Requirements

A version value starts with the numeric major version, followed by the FULL STOP character (U+002E), followed by the numeric minor version. Later versions are numerically higher than former versions, with the major version being more significant than the minor version. A version value is produced by the following ABNF:

```
jsversion = 1*DIGIT "." 1*DIGIT
```

Figure 4: The ABNF for JSCalendar Version Values

1.9.2. Current Version

This specification registers JSCalendar version values "1.0" and "2.0" in the JSCalendar Version registry. Version "2.0" applies for JSCalendar data that conforms with the specifications in this document. Version "1.0" applies for JSCalendar data that conforms with the now obsolete specifications of [RFC8984].

2. JSCalendar Objects

This section describes the calendar object types specified by JSCalendar.

2.1. Event

Media type: application/jscalendar+json;type=event

An Event represents a scheduled amount of time on a calendar, typically a meeting, appointment, reminder, or anniversary. It is required to start at a certain point in time and typically has a non-zero duration. Multiple participants may partake in the event.

The @type (Section 1.4.4) property is mandatory, it MUST be set to value "Event".

2.2. Task

Media type: application/jscalendar+json;type=task

A Task represents an action item, assignment, to-do item, or work item. It may start and be due at certain points in time, take some estimated time to complete, and recur, none of which is required.

The @type (Section 1.4.4) property is mandatory, it MUST be set to value "Task".

2.3. Group

Media type: application/jscalendar+json;type=group

A Group is a collection of Event (Section 2.1) and/or Task (Section 2.2) objects. Typically, objects are grouped by topic (e.g., by keywords) or calendar membership.

The @type (Section 1.4.4) property is mandatory, it MUST be set to value "Group".

3. Common Properties

This section describes the properties that are common to the various JSCalendar object types. Specific JSCalendar object types may only support a subset of these properties. The object type definitions in Section 4 describe the set of supported properties per type.

3.1. Metadata Properties

3.1.1. uid

uid: String (mandatory). This is a globally unique identifier used to associate objects representing the same event, task, group, or other object across different systems, calendars, and views. For recurring events and tasks, the UID is associated with the base object and therefore is the same for all occurrences; the combination of the UID with a recurrenceId identifies a particular instance.

The generator of the identifier MUST guarantee that the identifier is unique. [RFC9562] describes a range of established algorithms to generate universally unique identifiers (UUIDs). UUID version 4, described in Section 4.4 of [RFC9562], is RECOMMENDED.

For compatibility with UUIDs [RFC5545], implementations MUST be able to receive and persist values of at least 255 octets for this property, but they MUST NOT truncate values in the middle of a UTF-8 multi-octet sequence.

3.1.2. version

version: String. The JSCalendar version of this object. The value MUST be one of the IANA-registered JSCalendar Version values for the version property.

For version "2.0" or higher, a Group object MUST set the "version" property, but the Event or Task objects that are values in its "entries" property MUST NOT set the "version" property. In contrast, an Event or Task object that is represented without an enclosing Group object MUST set the "version" property, unless specified otherwise. This is to prevent conflicting version values to occur in JSCalendar data.

For version "1.0", the "version" property is optional. If it is set, the same rules as described for version "2.0" apply.

3.1.3. relatedTo

`relatedTo`: String[Relation] (optional). This relates the object to other JSCalendar objects. Each key in the map is the uid property value of a related object. The value defines the type of the relation.

If an object is split to make a "this and future" change to a recurrence, the original object MUST be truncated to end at the previous occurrence before this split, and a new object is created to represent all the occurrences after the split. A next relation MUST be set on the original object's `relatedTo` property, keyed by the uid of the new object. A "first" relation MUST be set on the new object, keyed by the uid of the first object in the series. Clients can then follow these uid keys to get the complete set of objects if the user wishes to modify them all at once.

3.1.4. prodId

`prodId`: String (optional). This is the identifier for the product that last updated the JSCalendar object. This should be set whenever the data in the object is modified (i.e., whenever the updated property is set).

The vendor of the implementation MUST ensure that this is a globally unique identifier, using some technique such as a Formal Public Identifier (FPI) value, as defined in [ISO.9070.1991].

This property SHOULD NOT be used to alter the interpretation of a JSCalendar object beyond the semantics specified in this document. For example, it is not to be used to further the understanding of nonstandard properties, a practice that is known to cause long-term interoperability problems.

3.1.5. created

`created`: UTCDateTime (optional). This is the date and time this

object was initially created.

3.1.6. updated

updated: `UTCDateTime` (mandatory). This is the date and time the data in this object was last modified (or its creation date/time if not modified since).

3.1.7. sequence

sequence: `UnsignedInt` (optional; default: 0). This property indicates the revision of the calendar object. For scheduled calendar objects, its value must be incremented according to the rules of the scheduling protocol, e.g. [I-D.ietf-jmap-calendars] or [RFC5546].

3.1.8. method

method: `String` (optional). This is the iTIP [RFC5546] method, in lowercase. This MUST only be present if the JSCalendar object represents an iTIP scheduling message.

3.2. What and Where Properties

3.2.1. title

title: `String` (optional; default: empty `String`). This is a short summary of the object.

3.2.2. description

description: `String` (optional; default: empty `String`). This is a longer-form text description of the object. The content is formatted according to the `descriptionContentType` property.

3.2.3. descriptionContentType

descriptionContentType: `String` (optional; default: "text/plain"). This describes the media type [RFC6838] of the contents of the description property. Media types MUST be subtypes of type "text" and SHOULD be "text/plain" or "text/html" [MEDIATYPES]. They MAY include parameters, and the "charset" parameter value MUST be "utf-8", if specified.

3.2.4. showWithoutTime

showWithoutTime: `Boolean` (optional; default: "false"). This

indicates that the time is not important to display to the user when rendering this calendar object. An example of this is an event that conceptually occurs all day or across multiple days, such as "New Year's Day" or "Italy Vacation". While the time component is important for free-busy calculations and checking for scheduling clashes, calendars may choose to omit displaying it and/or display the object separately to other objects to enhance the user's view of their schedule.

Such events are also commonly known as "all-day" events.

3.2.5. locations

`locations: Id[Location]` (optional). This is a map of location ids to Location objects, representing locations associated with the object.

A Location object has the following properties. It MUST have at least one property other than the `@type` property.

`@type: String`.

This specifies the type of this object. This MUST be "Location", if set.

`name: String` (optional).

This is the human-readable name or short description of the location, such as an address.

`locationTypes: String[Boolean]` (optional).

This is a set of one or more location types that describe this location. All types MUST be from the "Location Types Registry" [LOCATIONTYPES], as defined in [RFC4589]. The set is represented as a map, with the keys being the location types. The value for each key in the map MUST be true.

`coordinates: String` (optional).

This is a "geo:" URI [RFC5870] for the location.

`links: Id[Link]` (optional).

This is a map of link ids to Link objects, representing external resources associated with this location, for example, an image. If there are no links, this MUST be omitted (rather than specified as an empty set).

3.2.6. mainLocationId

`mainLocationId: String` (optional). This indicates which of the

multiple entries in the `locations` property can be considered the main location for the event or task. A client implementation MAY choose to display this location more prominently. The main location is undefined if this property is not set. If this property is set, then its value MUST match a key in the `locations` property and the `name` property of that main `Location` object MUST be set.

3.2.7. `virtualLocations`

`virtualLocations`: `Id[VirtualLocation]` (optional). This is a map of virtual location ids to `VirtualLocation` objects, representing virtual locations, such as video conferences or chat rooms, associated with the object.

A `VirtualLocation` object has the following properties.

`@type`: `String`.

This specifies the type of this object. This MUST be `"VirtualLocation"`, if set.

`name`: `String` (optional; default: empty `String`).

This is the human-readable name or short description of the virtual location, such as an access code.

`uri`: `String` (mandatory).

This is a `URI[RFC3986]` that represents how to connect to this virtual location.

This may be a telephone number (represented using the `"tel:"` scheme, e.g., `"tel:+1-555-555-5555"`) for a teleconference, a web address for online chat, or any custom `URI`.

`features`: `String[Boolean]` (optional).

A set of features supported by this virtual location. The set is represented as a map, with the keys being the feature. The value for each key in the map MUST be `true`.

The feature MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8). Any value the client or server doesn't understand should be treated the same as if this feature is omitted.

`audio`: Audio conferencing

`chat`: Chat or instant messaging

feed: Blog or atom feed

moderator: Provides moderator-specific features

phone: Phone conferencing

screen: Screen sharing

video: Video conferencing

3.2.8. links

links: Id[Link] (optional). This is a map of link ids to Link objects, representing external resources associated with the object.

Links with a rel of "enclosure" MUST be considered by the client to be attachments for download.

Links with a rel of "describedby" MUST be considered by the client to be alternative representations of the description.

Links with a rel of "icon" MUST be considered by the client to be images that it may use when presenting the calendar data to a user. The display property may be set to indicate the purpose of this image.

3.2.9. locale

locale: String (optional). This is the language tag, as defined in [RFC5646], that best describes the locale used for the text in the calendar object, if known.

3.2.10. keywords

keywords: String[Boolean] (optional). This is a set of keywords or tags that relate to the object. The set is represented as a map, with the keys being the keywords. The value for each key in the map MUST be true.

3.2.11. categories

categories: String[Boolean] (optional). This is a set of categories that relate to the calendar object. The set is represented as a map, with the keys being the categories specified as URIs. The value for each key in the map MUST be true.

In contrast to keywords, categories are typically structured. For example, a vendor owning the domain "example.com" might define the categories "http://example.com/categories/sports/american-football" and "http://example.com/categories/music/r-b".

3.2.12. color

color: String (optional). This is a color clients MAY use when displaying this calendar object. The value is a color name taken from the set of names defined in Section 4.3 of [CSS3] or an RGB value in six-digit hexadecimal notation, as defined in Section 4.2.1 of [CSS3]. Values are case-insensitive.

3.3. Recurrence Properties

Some events and tasks occur at regular or irregular intervals. Rather than having to copy the data for every occurrence, there can be a base event with a rule to generate recurrences and/or overrides that add extra dates or exceptions to the rule.

The recurrence set is the complete set of instances for an object. It is generated by considering the following properties in order, all of which are optional:

1. The recurrenceRule property (Section 3.3.3) generates a set of extra date-times on which the object occurs.
2. The recurrenceOverrides property (Section 3.3.4) defines date-times that are added or excluded to form the final set. (This property may also contain changes to the object to apply to particular instances.)

3.3.1. recurrenceId

recurrenceId: LocalDateTime (optional). If present, this JSCalendar object represents one occurrence of a recurring JSCalendar object. If present, the recurrenceRule and recurrenceOverrides properties MUST NOT be present.

The value is a date-time either produced by the recurrenceRule of the base event or added as a key to the recurrenceOverrides property of the base event.

3.3.2. recurrenceIdTimeZone

recurrenceIdTimeZone: TimeZoneId|null (optional; default: null). Identifies

the time zone of the main JSCalendar object, of which this JSCalendar object is a recurrence instance. It MUST NOT be set if the recurrenceId property is not set.

3.3.3. recurrenceRule

recurrenceRule: RecurrenceRule (optional). This a recurrence rule (a repeating pattern) for recurring calendar objects.

An Event recurs by applying the recurrence rule to the start date-time.

A Task recurs by applying the recurrence rule to the start date-time, if defined; otherwise, it recurs by the due date-time, if defined. If the task defines neither a start nor due date-time, it MUST NOT define a recurrenceRule property.

A RecurrenceRule object is a JSON object mapping of a RECUR value type in iCalendar [RFC5545] [RFC7529] and has the same semantics. It has the following properties:

@type: String.

This specifies the type of this object. This MUST be "RecurrenceRule", if set.

frequency: String (mandatory).

This is the time span covered by each iteration of this recurrence rule (see Section 3.3.3.1 for full semantics). This MUST be one of the following values:

- * yearly
- * monthly
- * weekly
- * daily
- * hourly
- * minutely
- * secondly

This is the FREQ part from iCalendar, converted to lowercase.

interval: UnsignedInt (optional; default: 1).

This is the interval of iteration periods at which the recurrence repeats. If included, it MUST be an integer ≥ 1 .

This is the INTERVAL part from iCalendar.

rscale: String (optional; default: "gregorian").

This is the calendar system in which this recurrence rule operates, in lowercase. This MUST be either a CLDR-registered calendar system name [CLDR] or a vendor-specific value (see Section 1.8).

This is the RSCALE part from iCalendar RSCALE [RFC7529], converted to lowercase.

skip: String (optional; default: "omit").

This is the behavior to use when the expansion of the recurrence produces invalid dates. This property only has an effect if the frequency is "yearly" or "monthly". It MUST be one of the following values:

- * omit
- * backward
- * forward

This is the SKIP part from iCalendar RSCALE [RFC7529], converted to lowercase.

firstDayOfWeek: String (optional; default: "mo").

This is the day on which the week is considered to start, represented as a lowercase, abbreviated, and two-letter English day of the week. If included, it MUST be one of the following values:

- * mo
- * tu
- * we
- * th
- * fr
- * sa
- * su

This is the WKST part from iCalendar.

byDay: NDay[] (optional).

These are days of the week on which to repeat. An NDay object has the following properties:

@type: String.

This specifies the type of this object. This MUST be "NDay", if set.

day: String (mandatory).

This is a day of the week on which to repeat; the allowed values are the same as for the firstDayOfWeek recurrenceRule property.

This is the day of the week of the BYDAY part in iCalendar, converted to lowercase.

nthOfPeriod: Int (optional).

If present, rather than representing every occurrence of the weekday defined in the day property, it represents only a specific instance within the recurrence period. The value can be positive or negative but MUST NOT be zero. A negative integer means the nth-last occurrence within that period (i.e., -1 is the last occurrence, -2 the one before that, etc.).

This is the ordinal part of the BYDAY value in iCalendar (e.g., 1 or -3).

byMonthDay: Int[] (optional).

These are the days of the month on which to repeat. Valid values are between 1 and the maximum number of days any month may have in the calendar given by the rscale property and the negative values of these numbers. For example, in the Gregorian calendar, valid values are 1 to 31 and -31 to -1. Negative values offset from the end of the month. The array MUST have at least one entry if included.

This is the BYMONTHDAY part in iCalendar.

byMonth: String[] (optional).

These are the months in which to repeat. Each entry is a string representation of a number, starting from "1" for the first month in the calendar (e.g., "1" means January with the Gregorian calendar), with an optional "L" suffix (see [RFC7529]) for leap months (this MUST be uppercase, e.g., "3L"). The array MUST have at least one entry if included.

This is the BYMONTH part from iCalendar.

byYearDay: Int[] (optional).

These are the days of the year on which to repeat. Valid values are between 1 and the maximum number of days any year may have in the calendar given by the rscale property and the negative values of these numbers. For example, in the Gregorian calendar, valid values are 1 to 366 and -366 to -1. Negative values offset from the end of the year. The array MUST have at least one entry if included.

This is the BYYEARDAY part from iCalendar.

byWeekNo: Int[] (optional).

These are the weeks of the year in which to repeat. Valid values are between 1 and the maximum number of weeks any year may have in the calendar given by the rscale property and the negative values of these numbers. For example, in the Gregorian calendar, valid values are 1 to 53 and -53 to -1. The array MUST have at least one entry if included.

This is the BYWEEKNO part from iCalendar.

byHour: UnsignedInt[] (optional).

These are the hours of the day in which to repeat. Valid values are 0 to 23. The array MUST have at least one entry if included. This is the BYHOUR part from iCalendar.

byMinute: UnsignedInt[] (optional).

These are the minutes of the hour in which to repeat. Valid values are 0 to 59. The array MUST have at least one entry if included.

This is the BYMINUTE part from iCalendar.

bySecond: UnsignedInt[] (optional).

These are the seconds of the minute in which to repeat. Valid values are 0 to 60. The array MUST have at least one entry if included.

This is the BYSECOND part from iCalendar.

bySetPosition: Int[] (optional).

These are the occurrences within the recurrence interval to include in the final results. Negative values offset from the end of the list of occurrences. The array MUST have at least one entry if included. This is the BYSETPOS part from iCalendar.

count: `UnsignedInt` (optional).

This is the number of occurrences at which to range-bound the recurrence. This MUST NOT be included if an `until` property is specified.

This is the `COUNT` part from `iCalendar`.

until: `LocalDateTime` (optional).

This is the date-time at which to finish recurring. The last occurrence is on or before this date-time. This MUST NOT be included if a `count` property is specified. Note that if not specified otherwise for a specific `JSCalendar` object, this date is to be interpreted in the time zone specified in the `JSCalendar` object's `timeZone` property.

This is the `UNTIL` part from `iCalendar`.

3.3.3.1. Interpreting Recurrence Rules

A recurrence rule specifies a set of date-times for recurring calendar objects. A recurrence rule has the following semantics. Note that wherever "year", "month", or "day of month" is used, this is within the calendar system given by the `rscale` property, which defaults to "gregorian" if omitted.

1. A set of candidates is generated. This is every second within a period defined by the frequency property value:

yearly: every second from midnight on the first day of a year (inclusive) to midnight the first day of the following year (exclusive).

If `skip` is not "omit", the calendar system has leap months, and there is a `byMonth` property, generate candidates for the leap months, even if they don't occur in this year.

If `skip` is not "omit" and there is a `byMonthDay` property, presume each month has the maximum number of days any month may have in this calendar system when generating candidates, even if it's more than this month actually has.

monthly: every second from midnight on the first day of a month (inclusive) to midnight on the first of the following month (exclusive).

If skip is not "omit" and there is a byMonthDay property, presume the month has the maximum number of days any month may have in this calendar system when generating candidates, even if it's more than this month actually has.

weekly: every second from midnight (inclusive) on the first day of the week (as defined by the firstDayOfWeek property or Monday if omitted) to midnight seven days later (exclusive).

daily: every second from midnight at the start of the day (inclusive) to midnight at the end of the day (exclusive).

hourly: every second from the beginning of the hour (inclusive) to the beginning of the next hour (exclusive).

minutely: every second from the beginning of the minute (inclusive) to the beginning of the next minute (exclusive).

secondly: only the second itself.

2. Each date-time candidate is compared against all of the byX properties of the rule except bySetPosition. If any property in the rule does not match the date-time, the date-time is eliminated. Each byX property is an array; the date-time matches the property if it matches any of the values in the array. The properties have the following semantics:

byMonth: The date-time is in the given month.

byWeekNo: The date-time is in the nth week of the year. Negative numbers mean the nth last week of the year. This corresponds to weeks according to week numbering, as defined in ISO.8601.2004, with a week defined as a seven-day period, starting on the firstDayOfWeek property value or Monday if omitted. Week number one of the calendar year is the first week that contains at least four days in that calendar year.

If the date-time is not valid (this may happen when generating candidates with a skip property in effect), it is always eliminated by this property.

byYearDay: The date-time is on the nth day of year. Negative numbers mean the nth last day of the year.

If the date-time is not valid (this may happen when generating candidates with a skip property in effect), it is always eliminated by this property.

byMonthDay: The date-time is on the given day of the month.
Negative numbers mean the nth last day of the month.

byDay: The date-time is on the given day of the week. If an **nthOfPeriod** property is present, the date-time must be the nth occurrence of that day of the week within the year (if frequency is yearly AND no **byMonth** property exists on the rule) or month (otherwise). Negative numbers mean the nth last occurrence within that period.

byHour: The date-time has the given hour value.

byMinute: The date-time has the given minute value.

bySecond: The date-time has the given second value.

If a **skip** property is defined and is not "omit", there may be candidates that do not correspond to valid dates (e.g., February 31st in the Gregorian calendar). In this case, the properties MUST be considered in the order above, and:

1. After applying the **byMonth** filter, if the candidate's month is invalid for the given year, increment it (if **skip** is "forward") or decrement it (if **skip** is "backward") until a valid month is found, incrementing/decrementing the year as well if passing through the beginning/end of the year. This only applies to calendar systems with leap months.
2. After applying the **byMonthDay** filter, if the day of the month is invalid for the given month and year, change the date to the first day of the next month (if **skip** is "forward") or the last day of the current month (if **skip** is "backward").
3. If any valid date produced after applying the **skip** is already a candidate, eliminate the duplicate. (For example, after adjusting, February 30th and February 31st would both become the same "real" date, so one is eliminated as a duplicate.)
3. If a **bySetPosition** property is included, this is now applied to the ordered list of remaining dates. This property specifies the indexes of date-times to keep; all others should be eliminated. Negative numbers are indexed from the end of the list, with -1 being the last item, -2 the second from last, etc.
4. Any date-times before the start date of the event are eliminated (see below for why this might be needed).

5. If a skip property is included and is not "omit", eliminate any date-times that have already been produced by previous iterations of the algorithm. (This is not possible if skip is "omit".)
6. If further dates are required (we have not reached the until date or count limit), skip the next (interval - 1) sets of candidates, then continue from step 1.

When determining the set of occurrence dates for an event or task, the following extra rules must be applied:

1. The initial date-time to which the rule is applied (the start date-time for events or the start or due date-time for tasks) is always the first occurrence in the expansion (and is counted if the recurrence is limited by a count property), even if it would normally not match the rule.
2. The first set of candidates to consider is that which would contain the initial date-time. This means the first set may include candidates before the initial date-time; such candidates are eliminated from the results in step 4 of the list above.
3. The following properties MUST be implicitly added to the rule under the given conditions:
 - * If frequency is not "secondly" and there is no bySecond property, add a bySecond property with the sole value being the seconds value of the initial date-time.
 - * If frequency is not "secondly" or "minutely" and there is no byMinute property, add a byMinute property with the sole value being the minutes value of the initial date-time.
 - * If frequency is not "secondly", "minutely", or "hourly" and there is no byHour property, add a byHour property with the sole value being the hours value of the initial date-time.
 - * If frequency is "weekly" and there is no byDay property, add a byDay property with the sole value being the day of the week of the initial date-time.
 - * If frequency is "monthly" and there is no byDay property and no byMonthDay property, add a byMonthDay property with the sole value being the day of the month of the initial date-time.
 - * If frequency is "yearly" and there is no byYearDay property:

- If there are no `byMonth` or `byWeekNo` properties, and either there is a `byMonthDay` property or there is no `byDay` property, add a `byMonth` property with the sole value being the month of the initial date-time.
- If there are no `byMonthDay`, `byWeekNo`, or `byDay` properties, add a `byMonthDay` property with the sole value being the day of the month of the initial date-time.
- If there is a `byWeekNo` property and no `byMonthDay` or `byDay` properties, add a `byDay` property with the sole value being the day of the week of the initial date-time.

3.3.4. `recurrenceOverrides`

`recurrenceOverrides`: `LocalDateTime[PatchObject]` (optional). This maps recurrence ids (the date-time produced by the recurrence rule) to the overridden properties of the recurrence instance.

If the recurrence id does not match a date-time from the recurrence rule (or no rule is specified), it is to be treated as an additional occurrence (like an `RDATE` from `iCalendar`). The patch object may often be empty in this case.

If the occurrence generated by the recurrence id shall be omitted from the final set of recurrences (like an `EXDATE` from `iCalendar`), then the patch object **MUST** be a JSON object with a single member. The member name **MUST** be `"excluded"`, the member value **MUST** be `true`. The JSON object **MUST NOT** contain any other members.

By default, an occurrence inherits all properties from the main object except the start (or due) date-time, which is shifted to match the recurrence id `LocalDateTime`. However, individual properties of the occurrence can be modified by a patch or multiple patches. It is valid to patch the start property value, and this patch takes precedence over the value generated from the recurrence id. Both the recurrence id as well as the patched start date-time may occur before the original `JSCalendar` object's start or due date.

A pointer in the `PatchObject` **MUST** be ignored if it either exactly matches one of:

- * `@type`
- * `method`
- * `organizerCalendarAddress`

- * participants/*/calendarAddress
- * privacy
- * prodId
- * recurrenceId
- * recurrenceIdTimeZone
- * sentBy
- * uid

or if the first reference token of the pointer matches one of:

- * recurrenceOverrides
- * recurrenceRule
- * relatedTo

where the "*" character stands for a JSON pointer reference token having any value.

3.4. Sharing and Scheduling Properties

3.4.1. priority

priority: Int (optional; default: 0). This specifies a priority for the calendar object. This may be used as part of scheduling systems to help resolve conflicts for a time period.

The priority is specified as an integer in the range 0 to 9. A value of 0 specifies an undefined priority, for which the treatment will vary by situation. A value of 1 is the highest priority. A value of 2 is the second highest priority. Subsequent numbers specify a decreasing ordinal priority. A value of 9 is the lowest priority. Other integer values are reserved for future use.

3.4.2. freeBusyStatus

freeBusyStatus: String (optional; default: "busy"). This specifies how this calendar object should be treated when calculating free-busy state. This MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

free: The object should be ignored when calculating whether the user is busy.

busy: The object should be included when calculating whether the user is busy.

3.4.3. privacy

privacy: String (optional; default: "public"). Calendar objects are normally collected together and may be shared with other users. The privacy property allows the object owner to indicate that it should not be shared or should only have the time information shared but the details withheld. Enforcement of the restrictions indicated by this property is up to the API via which this object is accessed.

This property MUST NOT affect the information sent to scheduled participants; it is only interpreted by protocols that share the calendar objects belonging to one user with other users.

The value of the privacy property MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8). Any value the client or server doesn't understand should be preserved but treated as equivalent to private.

public: The full details of the object are visible to those whom the object's calendar is shared with.

private: The details of the object are hidden; only the basic time and metadata are shared. The following properties MAY be shared; any other properties MUST NOT be shared:

- * @type
- * created
- * due
- * duration
- * estimatedDuration
- * freeBusyStatus
- * privacy
- * recurrenceId

- * recurrenceIdTimeZone
- * recurrenceOverrides (Only patches that apply to another permissible property are allowed to be shared.)
- * recurrenceRule
- * sequence
- * showWithoutTime
- * start
- * timeZone
- * uid
- * updated
- * version

secret: The object is hidden completely (as though it did not exist) when the calendar this object is in is shared.

3.4.4. organizerCalendarAddress

organizerCalendarAddress: String (optional). This is a URI as defined by [RFC3986] or any other IANA-registered form for a URI. It is the same as the CAL-ADDRESS value of an iCalendar ORGANIZER property [RFC5545] (Section 3.8.4.3) — it globally identifies a particular organizer, even across different calendaring objects. If this property is set then at least one Participant object in the participants property MUST have the calendarAddress property set.

3.4.5. sentBy

Type: String (optional)

This is the email address in the "From" header of the email in which this calendar object was received. This is only relevant if the calendar object is received via iMIP or as an attachment to a message. The value MUST be a valid addr-spec value as defined in Section 3.4.1 of [RFC5322]. If this property is set, then the organizerCalendarAddress property MUST be set.

3.4.6. participants

participants: Id[Participant] (optional). This is a map of participant ids to participants, describing their participation in the calendar object. If this property is set and any participant has the calendarAddress property set, then the organizerCalendarAddress property of the calendar object MUST be set.

A Participant object has the following properties:

@type: String.

This specifies the type of this object. This MUST be "Participant", if set.

name: String (optional).

This is the display name of the participant (e.g., "Joe Bloggs").

email: String (optional).

This is the email address to use to contact the participant or, for example, match with an address book entry. If set, the value MUST be a valid "addr-spec" value as defined in Section 3.4.1 of [RFC5322] .

description: String (optional).

This is a description of this participant. For example, this may include more information about their role in the event or how best to contact them.

descriptionContentType: String (optional).

This describes the media type of the contents of the description property. Its requirements are specified in Section 3.2.3. If this property is set, then the description property MUST be set.

calendarAddress: String (optional).

This is a URI as defined by [RFC3986] or any other IANA-registered form for a URI. It is the same as the CAL-ADDRESS value of an iCalendar ATTENDEE property [RFC5545] (Section 3.8.4.1) or ORGANIZER property [RFC5545] (Section 3.8.4.3) — it globally identifies a particular participant, even across different calendaring objects.

kind: String (optional).

This is what kind of entity this participant is, if known. If this property is set, then the `calendarAddress` property MUST be set. The value MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8). Any value the client or server doesn't understand should be treated the same as if this property is omitted.

`individual`: a single person

`group`: a collection of people invited as a whole

`location`: a physical location that needs to be scheduled, e.g., a conference room

`resource`: a non-human resource other than a location, such as a projector

`roles`: `String[Boolean]` (optional).

This is a set of roles that this participant fulfills. If this property is set, then the `calendarAddress` property MUST be set and at least one role MUST be specified for the participant. The keys in the set MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

`owner`: The participant is an owner of the calendar object. This signifies they can make changes that affect all participants (for example, rescheduling the calendar object, adding and removing participants and roles). The presence of this role only is indicative, its semantics are subject to the calendaring exchange protocol being used. See [I-D.ietf-jmap-calendars] for an example for making use of this role.

`optional`: The participant's involvement with the event is optional.

`informational`: The participant is copied for informational reasons and is not expected to attend.

`chair`: The participant is in charge of the event/task when it occurs.

`required`: The participant is required to be present at the event.

The value for each key in the map MUST be true. It is expected that no more than one of the roles "required", "optional", "informational" and "chair" be present; if more than one are given, they take precedence as follows: "chair" over "required", either of them over "optional", all of them over "informational". Roles that are unknown to the implementation MUST be preserved.

participationStatus: String (optional; default: "needs-action").
This is the participation status, if any, of this participant. If this property is set, then the calendarAddress property MUST be set.

The value MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

needs-action: No status has yet been set by the participant.

accepted: The invited participant will participate.

declined: The invited participant will not participate.

tentative: The invited participant may participate.

delegated: The invited participant has delegated their attendance to another participant, as specified in the delegatedTo property.

expectReply: Boolean (optional; default: "false").
If true, the organizer is expecting the participant to notify them of their participation status. If this property is set, then the calendarAddress property MUST be set.

sentBy: String (optional).
This is the email address in the "From" header of the email that last updated this participant via iMIP. If this property is set, then the calendarAddress property MUST be set. This SHOULD only be set if the email address is different to that in the mailto URI of this participant's calendarAddress property (i.e., the response was received from a different address to that which the invitation was sent to). If set, the value MUST be a valid "addr-spec" value as defined in Section 3.4.1 of [RFC5322] .

delegatedTo: String[Boolean] (optional).
This is the set of participants that this participant has delegated their participation to. If this property is set, then the calendarAddress property MUST be set. Each key in the set MUST be a URI according to the definition of the calendarAddress

property. The value for each key in the map MUST be true. If there are no delegates, this MUST be omitted (rather than specified as an empty set).

delegatedFrom: String[Boolean] (optional).

This is a set of participants that this participant is acting as a delegate for. If this property is set, then the calendarAddress property MUST be set. Each key in the set MUST be a URI according to the definition of the calendarAddress property. The value for each key in the map MUST be true. If there are no delegators, this MUST be omitted (rather than specified as an empty set).

memberOf: Id[Boolean] (optional).

This is a set of group participants that were invited to this calendar object, which caused this participant to be invited due to their membership in the group(s). If this property is set, then the calendarAddress property MUST be set. Each key in the set MUST be a URI according to the definition of the calendarAddress property. The value for each key in the map MUST be true. If there are no groups, this MUST be omitted (rather than specified as an empty set).

links: Id[Link] (optional).

This is a map of link ids to Link objects, representing external resources associated with this participant, for example, an image. If there are no links, this MUST be omitted (rather than specified as an empty set).

progress: String (optional)

This property only is defined for Participant objects within a Task object, it otherwise MUST NOT be set. It represents the progress of the participant for this task. If this property is set, then the calendarAddress property MUST be set and the participationStatus of this participant MUST be "accepted". The property value MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

in-process: The participant is in process of contributing to the task.

completed: The participant successfully completed contributing to the task.

failed: The participant could not complete their contribution to the task.

percentComplete: UnsignedInt (optional; only allowed for participants of a Task).

This represents the percent completion of the participant for this task. The property value MUST be a positive integer between 0 and 100.

3.5. Alerts Properties

3.5.1. alerts

alerts: Id[Alert] (optional). This is a map of alert ids to Alert objects, representing alerts/reminders to display or send to the user for this calendar object.

An Alert object has the following properties:

@type: String.

This specifies the type of this object. This MUST be "Alert", if set.

trigger: OffsetTrigger|AbsoluteTrigger|UnknownTrigger (mandatory; defaultType: OffsetTrigger).

This defines when to trigger the alert. New types may be defined in future documents.

An OffsetTrigger object has the following properties:

@type: String.

This specifies the type of this object. This MUST be "OffsetTrigger", if set.

offset: SignedDuration (mandatory).

This defines the offset at which to trigger the alert relative to the time property defined in the relativeTo property of the alert. Negative durations signify alerts before the time property; positive durations signify alerts after the time property.

relativeTo: String (optional; default: "start").

This specifies the time property that the alert offset is relative to. The value MUST be one of the following:

start: triggers the alert relative to the start of the calendar object

end: triggers the alert relative to the end/due time of the calendar object

An AbsoluteTrigger object has the following properties:

@type: String.

This specifies the type of this object. This MUST be "AbsoluteTrigger".

when: UTCDateTime (mandatory).

This defines a specific UTC date-time when the alert is triggered.

An UnknownTrigger object is an object that contains an @type property whose value is not recognized (i.e., not OffsetTrigger or AbsoluteTrigger) plus zero or more other properties. This is for compatibility with client extensions and future specifications. Implementations SHOULD NOT trigger for trigger types they do not understand but MUST preserve them.

acknowledged: UTCDateTime (optional).

This records when an alert was last acknowledged. This is set when the user has dismissed the alert; other clients that sync this property SHOULD automatically dismiss or suppress duplicate alerts (alerts with the same alert id that triggered on or before this date-time).

For a recurring calendar object, setting the acknowledged property MUST NOT add a new override to the recurrenceOverrides property. If the alert is not already overridden, the acknowledged property MUST be set on the alert in the base event/task.

Certain kinds of alert action may not provide feedback as to when the user sees them, for example, email-based alerts. For those kinds of alerts, this property MUST be set immediately when the alert is triggered and the action is successfully carried out.

relatedTo: String[Relation] (optional).

This relates this alert to other alerts in the same JSCalendar object. Each key in the map is the key of an Alert object in the alerts property. The value defines the type of the relation. In addition to the relation values defined in Section 1.5.10, the following key is allowed:

snooze: The linked alert is snoozed by this alert.

If the user wishes to snooze an alert, the application MUST create an alert to trigger after snoozing. This new snooze alert MUST set a "snooze" relation to the identifier of the original alert.

action: String (optional; default: "display").

This describes how to alert the user.

The value MUST be at most one of the following values, a value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

display: The alert should be displayed as appropriate for the current device and user context.

email: The alert should trigger an email sent out to the user, notifying them of the alert. This action is typically only appropriate for server implementations.

3.6. Time Zone Properties

3.6.1. timeZone

timeZone: `TimeZoneId|null` (optional; default: `null`). This identifies the time zone the object is scheduled in or is `null` for floating time. If omitted, this MUST be presumed to be `null` (i.e., floating time).

4. Type-Specific JSCalendar Properties

4.1. Event Properties

In addition to the common JSCalendar object properties (Section 3), an Event has the following properties:

4.1.1. start

start: `LocalDateTime` (mandatory). This is the date/time the event starts in the event's time zone (as specified in the `timeZone` property, see Section 3.6.1).

4.1.2. duration

duration: `Duration` (optional; default: `"PT0S"`). This is the zero or positive duration of the event in the event's start time zone. The end time of an event can be found by adding the duration to the event's start time.

4.1.3. endTimeZone

endTimeZone: `TimeZoneId` (optional). This identifies the time zone in

which this event ends, for cases where the start and time zones of the event differ (e.g., a transcontinental flight). If this property is not set, then the event starts and ends in the same time zone. This property MUST NOT be set if the `timeZone` property value is null or not set.

4.1.4. `status`

`status`: String (optional; default: "confirmed"). This is the scheduling status (Section 3.4) of an Event. If set, it MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

`confirmed`: indicates the event is definitely happening

`cancelled`: indicates the event has been cancelled

`tentative`: indicates the event may happen

4.2. Task Properties

In addition to the common JSCalendar object properties (Section 3), a Task has the following properties.

If the `timeZone` property value is not null or the `showWithoutTime` property value is "true", then at least one of the `due` and `start` properties MUST be set.

4.2.1. `due`

`due`: `LocalDateTime` (optional). This is the date/time the task is due in the task's time zone.

4.2.2. `start`

`start`: `LocalDateTime` (optional). This the date/time the task should start in the task's time zone. This MUST be set if the `recurrenceRule` or `recurrenceId` properties are set.

4.2.3. `estimatedDuration`

`estimatedDuration`: `Duration` (optional). This specifies the estimated positive duration of time the task takes to complete.

4.2.4. `percentComplete`

`percentComplete`: `UnsignedInt` (optional). This represents the percent

completion of the task overall. The property value MUST be a positive integer between 0 and 100.

4.2.5. progress

progress: String (optional). This defines the progress of this task. If omitted, the default progress (Section 3.4) of a Task is defined as follows (in order of evaluation):

completed: if the progress property value of all participants is completed

failed: if at least one progress property value of a participant is failed

in-process: if at least one progress property value of a participant is in-process

needs-action: if none of the other criteria match

If set, it MUST be one of the following values, another value registered in the IANA "JSCalendar Enum Values" registry, or a vendor-specific value (see Section 1.8):

needs-action: indicates the task needs action

in-process: indicates the task is in process

completed: indicates the task is completed

failed: indicates the task failed

cancelled: indicates the task was cancelled

4.3. Group Properties

Group supports the following common JSCalendar properties (Section 3):

- * @type
- * categories
- * color
- * created
- * description

- * descriptionContentType
- * keywords
- * links
- * locale
- * prodId
- * title
- * uid
- * updated
- * version

In addition, the following Group-specific properties are supported:

4.3.1. entries

entries: (Task|Event)[] (mandatory). This is a collection of group members. Implementations MUST ignore entries of unknown type.

4.3.2. source

source: String (optional). This is the source from which updated versions of this group may be retrieved. The value MUST be a URI.

5. Examples

The following examples illustrate several aspects of the JSCalendar data model and format. The examples may omit mandatory or additional properties, which is indicated by a placeholder property with key "...". While most of the examples use calendar event objects, they are also illustrative for tasks.

5.1. Simple Event

This example illustrates a simple one-time event. It specifies a one-time event that begins on January 15, 2020 at 1 pm New York local time and ends after 1 hour.

```
{
  "@type": "Event",
  "version": "2.0",
  "uid": "a8df6573-0474-496d-8496-033ad45d7fea",
  "updated": "2020-01-02T18:23:04Z",
  "title": "Some event",
  "start": "2020-01-15T13:00:00",
  "timeZone": "America/New_York",
  "duration": "PT1H"
}
```

5.2. Simple Task

This example illustrates a simple task for a plain to-do item.

```
{
  "@type": "Task",
  "version": "2.0",
  "uid": "2a358cee-6489-4f14-a57f-c104db4dc2f2",
  "updated": "2020-01-09T14:32:01Z",
  "title": "Do something"
}
```

5.3. Simple Group

This example illustrates a simple calendar object group that contains an event and a task.

```
{
  "@type": "Group",
  "version": "2.0",
  "uid": "bf0ac22b-4989-4caf-9ebd-54301b4ee51a",
  "updated": "2020-01-15T18:00:00Z",
  "title": "A simple group",
  "entries": [{
    "@type": "Event",
    "uid": "a8df6573-0474-496d-8496-033ad45d7fea",
    "updated": "2020-01-02T18:23:04Z",
    "title": "Some event",
    "start": "2020-01-15T13:00:00",
    "timeZone": "America/New_York",
    "duration": "PT1H"
  },
  {
    "@type": "Task",
    "uid": "2a358cee-6489-4f14-a57f-c104db4dc2f2",
    "updated": "2020-01-09T14:32:01Z",
    "title": "Do something"
  }
]
```

5.4. All-Day Event

This example illustrates an event for an international holiday. It specifies an all-day event on April 1 that occurs every year since the year 1900.

```
{
  "...": "",
  "title": "April Fool's Day",
  "showWithoutTime": true,
  "start": "1900-04-01T00:00:00",
  "duration": "P1D",
  "recurrenceRule": {
    "frequency": "yearly"
  }
}
```

5.5. Task with a Due Date

This example illustrates a task with a due date. It is a reminder to buy groceries before 6 pm Vienna local time on January 19, 2020. The calendar user expects to need 1 hour for shopping.

```
{
  "...": "",
  "title": "Buy groceries",
  "due": "2020-01-19T18:00:00",
  "timeZone": "Europe/Vienna",
  "estimatedDuration": "PT1H"
}
```

5.6. Event with End Time Zone

This example illustrates the use of end time zones by use of an international flight. The flight starts on April 1, 2020 at 9 am in Berlin local time. The duration of the flight is scheduled at 10 hours 30 minutes. The time at the flight's destination is in the same time zone as Tokyo. Calendar clients could use the end time zone to display the arrival time in Tokyo local time and highlight the time zone difference of the flight. The location names can serve as input for navigation systems. The `mainLocationId` property indicates the start location.

```
{
  "...": "",
  "title": "Flight XY51 to Tokyo",
  "start": "2020-04-01T09:00:00",
  "timeZone": "Europe/Berlin",
  "endTimeZone": "Asia/Tokyo",
  "duration": "PT10H30M",
  "mainLocationId": "1",
  "locations": {
    "1": {
      "name": "Frankfurt Airport (FRA)"
    },
    "2": {
      "name": "Narita International Airport (NRT)"
    }
  }
}
```

5.7. Floating-Time Event (with Recurrence)

This example illustrates the use of floating time. Since January 1, 2020, a calendar user blocks 30 minutes every day to practice yoga at 7 am local time in whatever time zone the user is located on that date.

```
{
  "...": "",
  "title": "Yoga",
  "start": "2020-01-01T07:00:00",
  "duration": "PT30M",
  "recurrenceRule": {
    "frequency": "daily"
  }
}
```

5.8. Event with Physical and Virtual Location

This example illustrates an event that happens at both a physical and a virtual location. Fans can see a live concert on premises or online. In addition to the main event location, the event contains an additional location for a nearby parking garage.

```
{
  "...": "",
  "title": "Live from Music Bowl: The Band",
  "description": "Go see the biggest music event ever!",
  "locale": "en",
  "start": "2020-07-04T17:00:00",
  "timeZone": "America/New_York",
  "duration": "PT3H",
  "mainLocationId": "c0503d30-8c50-4372-87b5-7657e8e0fedd",
  "locations": {
    "c0503d30-8c50-4372-87b5-7657e8e0fedd": {
      "name": "The Music Bowl",
      "description": "Music Bowl, Central Park, New York",
      "coordinates": "geo:40.7829,-73.9654"
    },
    "ee42e41e-1046-4489-9760-c0b85f0dc176": {
      "name": "BAZ Parking, 9 West 57th Street, New York",
      "coordinates": "geo:40.7637,-73.9748",
      "locationTypes": {
        "parking": true
      }
    }
  },
  "virtualLocations": {
    "vloc1": {
      "name": "Free live Stream from Music Bowl",
      "uri": "https://stream.example.com/the_band_2020"
    }
  }
}
```

5.9. Recurring Event with Overrides

This example illustrates the use of recurrence overrides. A math course at a university is held for the first time on January 8, 2020 at 9 am London time and occurs every week until June 24, 2020. Each lecture lasts for one hour and 30 minutes and is located at the Mathematics department. This event has exceptional occurrences: at the last occurrence of the course is an exam, which lasts for 2 hours and starts at 10 am. Also, the location of the exam differs from the usual location. On April 1, no course is held. On January 7 at 2 pm, there is an optional introduction course, which occurs before the first regular lecture.

```

{
  "...": "",
  "title": "Calculus I",
  "start": "2020-01-08T09:00:00",
  "timeZone": "Europe/London",
  "duration": "PT1H30M",
  "locations": {
    "mlab": {
      "name": "Math lab room 1",
      "description": "Math Lab I, Department of Mathematics"
    }
  },
  "recurrenceRule": {
    "frequency": "weekly",
    "until": "2020-06-24T09:00:00"
  },
  "recurrenceOverrides": {
    "2020-01-07T14:00:00": {
      "title": "Introduction to Calculus I (optional)"
    },
    "2020-04-01T09:00:00": {
      "excluded": true
    },
    "2020-06-25T09:00:00": {
      "title": "Calculus I Exam",
      "start": "2020-06-25T10:00:00",
      "duration": "PT2H",
      "locations": {
        "auditorium": {
          "name": "Big Auditorium",
          "description": "Big Auditorium, Other Road"
        }
      }
    }
  }
}

```

5.10. Making a "This and Future" Change

Sometimes, you may want to make a change to a recurring event that applies from a specific instance onwards. This cannot be represented as a single JSCalendar object. Instead, you must duplicate the event, modifying the recurrence rule of the original so it finishes before the split point, and the duplicate so it starts at the split point. A "next" and "first" relation must be set on the new objects respectively, as per Section 3.1.3.

This example shows two JSCalendar objects, representing an event that used to happen at 2pm on a Tuesday in Room 101, but moved in March to 3pm on a Wednesday in Room 202.

```
{
  "...": "",
  "uid": "715ed4c5-3cf5-427f-927c-db40cdd63894",
  "relatedTo": {
    "32859916-af7a-4599-82ed-32a4315b4fe7": {
      "relation": {
        "next": true
      }
    }
  },
  "title": "Departmental meeting",
  "start": "2025-01-07T14:00:00",
  "timeZone": "Australia/Melbourne",
  "duration": "PT1H",
  "locations": {
    "room": {
      "name": "Room 101"
    }
  },
  "recurrenceRule": {
    "frequency": "weekly",
    "until": "2025-02-25T14:00:00"
  }
}
{
  "...": "",
  "uid": "32859916-af7a-4599-82ed-32a4315b4fe7",
  "relatedTo": {
    "715ed4c5-3cf5-427f-927c-db40cdd63894": {
      "relation": {
        "first": true
      }
    }
  },
  "title": "Departmental meeting",
  "start": "2025-03-05T15:00:00",
  "timeZone": "Australia/Melbourne",
  "duration": "PT1H",
  "locations": {
    "room": {
      "name": "Room 202"
    }
  },
  "recurrenceRule": {
    "frequency": "weekly"
  }
}
```

5.11. Recurring Event with Participants

This example illustrates scheduled events. A team meeting occurs every week since January 8, 2020 at 9 am Johannesburg time. The event owner also chairs the event. Participants meet in a virtual meeting room. A participant has accepted the invitation, but, on March 4, 2020, they are unavailable and declined participation for this occurrence.

```
{
  "...": "",
  "title": "FooBar team meeting",
  "start": "2020-01-08T09:00:00",
  "timeZone": "Africa/Johannesburg",
  "duration": "PT1H",
  "virtualLocations": {
    "0": {
      "name": "ChatMe meeting room",
      "uri": "https://chatme.example.com?id=1234567&pw=a8a24627b63d"
    }
  },
  "recurrenceRule": {
    "frequency": "weekly"
  },
  "organizerCalendarAddress":
    "mailto:f245f875-7f63-4a5e-a2c8@schedule.example.com",
  "participants": {
    "dG9tQGZvb2Jhci5x1LmNvbQ": {
      "name": "Tom Tool",
      "email": "tom@foobar.example.com",
      "calendarAddress": "mailto:tom@calendar.example.com",
      "participationStatus": "accepted",
    },
    "em9lQGZvb2GFtcGx1LmNvbQ": {
      "name": "Zoe Zelda",
      "calendarAddress": "mailto:zoe@foobar.example.com",
      "participationStatus": "accepted",
      "roles": {
        "owner": true,
        "chair": true
      }
    }
  },
  "recurrenceOverrides": {
    "2020-03-04T09:00:00": {
      "participants/dG9tQGZvb2Jhci5x1LmNvbQ/participationStatus":
        "declined"
    }
  }
}
```

6. Security Considerations

Calendaring and scheduling information is very privacy sensitive. It can reveal the social network of a user, location information of this user and those in their social network, identity and credentials information, and patterns of behavior of the user in both the physical and cyber realm. Additionally, calendar events and tasks can influence the physical location of a user or their cyber behavior within a known time window. Its transmission and storage must be done carefully to protect it from possible threats, such as eavesdropping, replay, message insertion, deletion, modification, and on-path attacks.

The data being stored and transmitted may be used in systems with real-world consequences. For example, a home automation system may turn an alarm on and off or a coworking space may charge money to the organizer of an event that books one of their meeting rooms. Such systems must be careful to authenticate all data they receive to prevent them from being subverted and ensure the change comes from an authorized entity.

This document only defines the data format; such considerations are primarily the concern of the API or method of storage and transmission of such files.

6.1. Expanding Recurrences

A recurrence rule may produce infinite occurrences of an event. Implementations **MUST** handle expansions carefully to prevent accidental or deliberate resource exhaustion.

Conversely, a recurrence rule may be specified that does not expand to anything. It is not always possible to tell this through static analysis of the rule, so implementations **MUST** be careful to avoid getting stuck in infinite loops or otherwise exhausting resources while searching for the next occurrence.

Events recur in the event's time zone. If the user is in a different time zone, daylight saving transitions may cause an event that normally occurs at, for example, 9 am to suddenly shift an hour earlier. This may be used in an attempt to cause a participant to miss an important meeting. User agents must be careful to translate date-times correctly between time zones and may wish to call out unexpected changes in the time of a recurring event.

6.2. JSON Parsing

The security considerations of [RFC8259] apply to the use of JSON as the data interchange format.

As for any serialization format, parsers need to thoroughly check the syntax of the supplied data. JSON uses opening and closing tags for several types and structures, and it is possible that the end of the supplied data will be reached when scanning for a matching closing tag; this is an error condition, and implementations need to stop scanning at the end of the supplied data.

JSON also uses a string encoding with some escape sequences to encode special characters within a string. Care is needed when processing these escape sequences to ensure that they are fully formed before the special processing is triggered, with special care taken when the escape sequences appear adjacent to other (non-escaped) special characters or adjacent to the end of data (as in the previous paragraph).

If parsing JSON into a non-textual structured data format, implementations may need to allocate storage to hold JSON string elements. Since JSON does not use explicit string lengths, the risk of denial of service due to resource exhaustion is small, but implementations may still wish to place limits on the size of allocations they are willing to make in any given context, to avoid untrusted data causing excessive memory allocation.

6.3. URI Values

Several JSCalendar properties contain URIs as values, and processing these properties requires extra care. Section 7 of [RFC3986] discusses security risks related to URIs.

Fetching remote resources carries inherent risks. Connections must only be allowed on well-known ports, using allowed protocols (generally, just HTTP/HTTPS on their default ports). The URL must be resolved externally and not allowed to access internal resources. Connecting to an external source reveals IP (and therefore often location) information.

A maliciously constructed JSCalendar object may contain a very large number of URIs. In the case of published calendars with a large number of subscribers, such objects could be widely distributed. Implementations should be careful to limit the automatic fetching of linked resources to reduce the risk of this being an amplification vector for a denial-of-service attack.

6.4. Spam

Calendar systems may receive JSCalendar files from untrusted sources, in particular, as attachments to emails. This can be a vector for an attacker to inject spam into a user's calendar. This may confuse, annoy, and mislead users or overwhelm their calendar with bogus events, preventing them from seeing legitimate ones.

Heuristic, statistical, or machine-learning-based filters can be effective in filtering out spam. Authentication mechanisms, such as DomainKeys Identified Mail (DKIM) [RFC6376], can help establish the source of messages and associate the data with existing relationships (such as an address book contact). However, misclassifications are always possible and providing a mechanism for users to quickly correct this is advised.

Confusable unicode characters may be used to trick a user into trusting a JSCalendar file that appears to come from a known contact but is actually from a similar-looking source controlled by an attacker.

6.5. Duplication

It is important for calendar systems to maintain the UID of an event when updating it to avoid an unexpected duplication of events. Consumers of the data may not remove the previous version of the event if it has a different UID. This can lead to a confusing situation for the user, with many variations of the event and no indication of which one is correct. Care must be taken by consumers of the data to remove old events where possible to avoid an accidental denial-of-service attack due to the volume of data.

6.6. Time Zones

Events recur in a particular time zone. When this differs from the user's current time zone, it may unexpectedly cause an occurrence to shift in time for that user due to a daylight savings change in the event's time zone. A maliciously crafted event could attempt to confuse users with such an event to ensure a meeting is missed.

7. IANA Considerations

IANA has created the "JSCalendar Properties", "JSCalendar Types" and "JSCalendar Enum Values" registries, originally defined in [RFC8984]. This document updates some of the registry definitions and registry contents. The following sections redefine all IANA considerations, even if they are unchanged.

7.1. Media Type Registration

[RFC8984] defined a media type for use with JSCalendar data formatted in JSON. This section restates the original definition unchanged.

Type name: application

Subtype name: jscalendar+json

Required parameters: type

The "type" parameter conveys the type of the JSCalendar data in the body part. The allowed parameter values correspond to the @type property of the JSON-formatted JSCalendar object in the body:

event: The @type property value MUST be "Event".

task: The @type property value MUST be "Task".

group: The @type property value MUST be "Group".

No other parameter values are allowed. The parameter MUST NOT occur more than once.

Optional parameters: version

This parameter conveys the version of the JSCalendar data in the body part. It MUST NOT occur more than once. If this parameter is set, then the values of all JSCalendar version (Section 7.4.2.4, Paragraph 11) properties in the body part MUST match the parameter value.

Encoding considerations: This is the same as the encoding considerations of application/json, as specified in Section 11 of [RFC8259].

Security considerations: See Section 6 of this document.

Interoperability considerations: While JSCalendar is designed to avoid ambiguities as much as possible, when converting objects from other calendar formats to/from JSCalendar, it is possible that differing representations for the same logical data or ambiguities in interpretation might arise. The semantic equivalence of two JSCalendar objects may be determined differently by different applications, for example, where URL values differ in case between the two objects.

Published specification: draft-ietf-calext-jscalendarbis

Applications that use this media type: Applications that currently make use of the text/calendar and application/calendar+json media types can use this as an alternative. Similarly, applications that use the application/json media type to transfer calendaring data can use this to further specify the content.

Fragment identifier considerations: A JSON Pointer fragment identifier may be used, as defined in [RFC6901], Section 6.

Additional information: Magic number(s): N/A

File extensions(s): N/A

Macintosh file type code(s): N/A

Person & email address to contact for further information:
calsify@ietf.org

Intended usage: COMMON

Restrictions on usage: N/A

Author: See the "Author's Address" section of this document.

Change controller: IETF

7.2. Registry Policy and Change Procedures

Registry assignments that introduce backwards-incompatible (Section 1.9) changes require the JSCalendar major version to change; other changes only require a change to the minor version. The registry policy for assignments that require the JSCalendar major version to change is Standards Action ([RFC8126], Section 4.9). The registry policy for other assignments is Specification Required ([RFC8126], Section 4.6).

The designated expert (DE) decides if a major or minor version change is required and assigns the new version to the "JSCalendar Version" registry (Section 7.3). Version numbers increment by one, and a major version change resets the minor version to zero. An assignment may apply multiple changes and to more than one registry at once, in which case a single version change is sufficient. If the registry policy is Specification Required, then the DE may decide that it is enough to document the new assignment in the Description item of the respective registry.

A registration MUST have an intended usage of "common", "reserved", or "obsolete".

- * A "common" usage denotes an item with shared semantics and syntax across systems. Up-to-date systems MUST expect such items to occur in JSCalendar data.
- * A "reserved" usage reserves an item in the registry without assigning semantics to avoid name collisions with future extensions or protocol use. Implementations MUST NOT expect or add items with such names outside the protocols or extensions that use them; otherwise, any such JSCalendar data is invalid.
- * An "obsolete" usage denotes an item that is no longer expected to be added by up-to-date systems. A new assignment has probably been defined, covering the obsolete item's semantics. Implementations MUST expect such items to occur in JSCalendar data up to the "Until Version" registry field, inclusively. They MUST NOT add such items for any version after which the item got obsolete; otherwise, any such JSCalendar data is invalid.

The intended usage of registry items may change between versions, but the DE must carefully consider the impact on existing implementations and standards before doing so.

The registration procedure is not a formal standards process but rather an administrative procedure intended to allow community comments and to check whether it is coherent without excessive time delay. It is designed to encourage vendors to document and register new items they add for use cases not covered by the original specification, leading to increased interoperability.

7.2.1. Preliminary Community Review

Notice of a potential new registration MUST be sent to the Calext WG mailing list <calsify@ietf.org> for review. This mailing list is appropriate for soliciting community feedback on a proposed registry assignment.

The intent of the public posting to this list is to solicit comments and feedback on the choice of the item name or value, the unambiguity of its description, and a review of any interoperability or security considerations. The submitter may submit a revised registration proposal or abandon the registration completely at any time.

7.2.2. Submit Request to IANA

Registration requests can be sent to IANA <iana@iana.org>.

7.2.3. Designated Expert Review

The primary concern of the DE is preventing name collisions and encouraging the submitter to document security and privacy considerations.

A new type name, property name, or enumerated value MUST NOT differ only in case from an already-registered name or value.

For a common-use registration, the DE is expected to confirm that suitable documentation is available to ensure interoperability. The DE should also verify that the new assignment does not conflict with work that is active or already published within the IETF.

The DE will either approve or deny the registration request and publish a notice of the decision to the Calext WG mailing list or its successor, as well as inform IANA. A denial notice must be justified by an explanation, and in the cases where it is possible, concrete suggestions on how the request can be modified to become acceptable should be provided.

7.2.4. Change Procedures

Once a JSCalendar registry group item has been published by IANA, the Change Controller may request a change to its definition. The same procedure that would be appropriate for the original registration request is used to process a change request.

JSCalendar registrations do not get deleted; instead, items that are no longer believed appropriate for use are declared obsolete by a change to their "Intended Usage" field; such items will be clearly marked in the IANA registry.

Significant changes to a JSCalendar registry item's definition should be requested only when there are serious omissions or errors in the published specification, as such changes may cause interoperability issues. When review is required, a change request may be denied if it renders entities that were valid under the previous definition invalid under the new definition.

7.3. "JSCalendar Version" Registry

IANA will add the "JSCalendar Version" registry to the "JSCalendar" registry group. The purpose of this new registry is to define the allowed value range of JSCalendar major and minor version numbers.

The registry entries sort numerically in ascending order by the "Major Version" column, entries with equal "Major Version" sort numerically in ascending order by the "Minor Version" column.

The registry process is defined in Section 7.2.

7.3.1. "JSCalendar Version" Registry Template

Major Version: The numeric value of a JSCalendar major version number. It MUST be a positive integer.

Highest Minor Version: The maximum numeric value of a JSCalendar minor version for the given major version. It MUST be zero or a positive integer. All numbers less than or equal to this value are valid minor version values for the given major version.

7.3.2. Initial Contents of the JSCalendar Version Registry

The following table lists the initial valid major and minor version number ranges.

| Major Version | Highest Minor Version | Reference |
|---------------|-----------------------|---------------------------------|
| 1 | 0 | [RFC8984] |
| 2 | 0 | draft-ietf-calext-jscalendarbis |

Table 1: JSCalendar Version Registry

7.4. "JSCalendar Properties" Registry

IANA has created the "JSCalendar Properties" registry to allow interoperability of extensions to JSCalendar objects. IANA will set the Reference of the registry to this document, rather than obsoleted [RFC8984].

7.4.1. "JSCalendar Properties" Registry Template

Property Name: This is the name of the property. The property name

MUST NOT already be registered for any of the object types listed in the "Property Context" field of this registration. Other object types MAY already have registered a different property with the same name; however, the same name SHOULD only be used when the semantics are analogous.

Property Type: This is the type of this property, using type signatures, as specified in Section 1.4.2. The property type MUST be registered in the "JSCalendar Types" registry.

Property Context: This is a comma-separated list of JSCalendar object types this property is allowed on.

Reference or Description: This is a brief description or RFC number and section reference where the property is specified (omitted for "reserved" property names).

Intended Usage: This may be "common", "reserved", or "obsolete".

Since Version: The JSCalendar version on which the property definition is based. The version MUST be one of the allowed values of the version property in the "JSCalendar Version" registry (see Table 1).

Until Version: The JSCalendar version after which the property was obsoleted; therefore, it MUST NOT be used in later versions. The Until Version value either MUST NOT be set or MUST be one of the allowed values of the version property in the "JSCalendar Version" registry (see Table 1).

Change Controller: This is who may request a change to this entry's definition ("IETF" for RFCs from the IETF stream).

7.4.2. Changes to the "JSCalendar Properties" Registry

7.4.2.1. Obsoleted Properties

IANA will change the Intended Usage from "common" to "obsolete" for the following entries in the JSCalendar Properties Registry. For each entry, the Property Name and its changed fields are listed.

Property Name aliases
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name cid

Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name comments
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name daylight
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name excludedRecurrenceRules
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name language
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name locationId
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name names
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name offsetFrom
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name offsetTo

Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name progressUpdated
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name recurrenceRules
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name standard
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name timeZones
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name tzId
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name url
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

Property Name validUntil
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

The following change only applies for the property entry where the Property Name is "start" and the Property Context is "TimeZoneRule":

```
Property Name  start
Property Context  TimeZoneRule
Reference/Description  Appendix A.2.1
Intended Usage  obsolete
Since Version  1.0
Until Version  1.0
```

7.4.2.2. Reserved Properties

IANA will change the Intended Usage from "common" to "reserved" for the following entries in the JSCalendar Properties Registry. For each entry, the Property Name and its changed fields are listed.

```
Property Name  excluded
Reference/Description  Appendix A.2.2
Intended Usage  reserved
Since Version  1.0
Until Version  1.0
```

```
Property Name  invitedBy
Reference/Description  Appendix A.2.2
Intended Usage  reserved
Since Version  1.0
Until Version  1.0
```

```
Property Name  localizations
Reference/Description  Appendix A.2.2
Intended Usage  reserved
Since Version  1.0
Until Version  1.0
```

```
Property Name  participationComment
Reference/Description  Appendix A.2.2
Intended Usage  reserved
Since Version  1.0
Until Version  1.0
```

```
Property Name  replyTo
Reference/Description  Appendix A.2.2
Intended Usage  reserved
Since Version  1.0
Until Version  1.0
```

```
Property Name  requestStatus
Reference/Description  Appendix A.2.2
```

Intended Usage reserved
Since Version 1.0
Until Version 1.0

Property Name scheduleAgent
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

Property Name scheduleForceSend
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

Property Name scheduleSequence
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

Property Name scheduleStatus
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

Property Name scheduleUpdated
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

Property Name sendTo
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

Property Name useDefaultAlerts
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

7.4.2.3. Updated Properties

IANA will update the following entries in the JSCalendar Properties Registry. For each entry, the Property Name and its changed fields are listed. Unchanged fields are omitted. Referenced section numbers refer to this document, unless otherwise noted.

Property Name @type
Property Context Event, Task, Group, AbsoluteTrigger, Alert, Link,
Location, NDay, OffsetTrigger, Participant, RecurrenceRule,
Relation, VirtualLocation
Reference/Description Section 1.4.4
Since Version 1.0

Property Name acknowledged
Reference/Description Section 3.5.1
Since Version 1.0

Property Name action
Reference/Description Section 3.5.1
Since Version 1.0

Property Name alerts
Reference/Description Section 3.5.1
Since Version 1.0

Property Name byDay
Reference/Description Section 3.3.3
Since Version 1.0

Property Name byHour
Reference/Description Section 3.3.3
Since Version 1.0

Property Name byMinute
Reference/Description Section 3.3.3
Since Version 1.0

Property Name byMonth
Reference/Description Section 3.3.3
Since Version 1.0

Property Name byMonthDay
Reference/Description Section 3.3.3
Since Version 1.0

Property Name bySecond
Reference/Description Section 3.3.3

Since Version 1.0

Property Name bySetPosition
Reference/Description Section 3.3.3
Since Version 1.0

Property Name byWeekNo
Reference/Description Section 3.3.3
Since Version 1.0

Property Name byYearDay
Reference/Description Section 3.3.3
Since Version 1.0

Property Name calendarAddress
Reference/Description Section 3.4.6
Since Version 1.0

Property Name categories
Reference/Description Section 3.2.11
Since Version 1.0

Property Name color
Reference/Description Section 3.2.12
Since Version 1.0

Property Name contentType
Reference/Description Section 1.5.11
Since Version 1.0

Property Name coordinates
Reference/Description Section 3.2.5
Since Version 1.0

Property Name count
Reference/Description Section 3.3.3
Since Version 1.0

Property Name created
Reference/Description Section 3.1.5
Since Version 1.0

Property Name day
Reference/Description Section 3.3.3
Since Version 1.0

Property Name delegatedFrom
Reference/Description Section 3.4.6

Since Version 1.0

Property Name delegatedTo
Reference/Description Section 3.4.6
Since Version 1.0

Property Name description
Property Context Event, Task, Participant
Reference/Description Section 3.2.2, Section 3.4.6
Since Version 1.0

Property Name descriptionContentType
Property Context Event, Task, Participant
Reference/Description Section 3.2.2, Section 3.4.6
Since Version 1.0

Property Name display
Reference/Description Section 1.5.11
Since Version 1.0

Property Name due
Reference/Description Section 4.2.1
Since Version 1.0

Property Name duration
Reference/Description Section 4.1.2
Since Version 1.0

Property Name email
Reference/Description Section 3.4.6
Since Version 1.0

Property Name entries
Reference/Description Section 4.3.1
Since Version 1.0

Property Name estimatedDuration
Reference/Description Section 4.2.3
Since Version 1.0

Property Name expectReply
Reference/Description Section 3.4.6
Since Version 1.0

Property Name features
Reference/Description Section 3.2.7
Since Version 1.0

Property Name firstDayOfWeek
Reference/Description Section 3.3.3
Since Version 1.0

Property Name freeBusyStatus
Reference/Description Section 3.4.2
Since Version 1.0

Property Name frequency
Reference/Description Section 3.3.3
Since Version 1.0

Property Name href
Reference/Description Section 1.5.11
Since Version 1.0

Property Name interval
Reference/Description Section 3.3.3
Since Version 1.0

Property Name keywords
Reference/Description Section 3.2.10
Since Version 1.0

Property Name kind
Reference/Description Section 3.4.6
Since Version 1.0

Property Name links
Reference/Description Section 3.2.8, Section 3.2.5, Section 3.4.6
Since Version 1.0

Property Name locale
Reference/Description Section 3.2.9
Since Version 1.0

Property Name locationTypes
Reference/Description Section 3.2.5
Since Version 1.0

Property Name locations
Reference/Description Section 3.2.5
Since Version 1.0

Property Name memberOf
Reference/Description Section 3.4.6
Since Version 1.0

Property Name method
Reference/Description Section 3.1.8
Since Version 1.0

Property Name name
Reference/Description Section 3.2.5, Section 3.2.7, Section 3.4.6
Since Version 1.0

Property Name nthOfPeriod
Reference/Description Section 3.3.3
Since Version 1.0

Property Name offset
Reference/Description Section 3.5.1
Since Version 1.0

Property Name participants
Reference/Description Section 3.4.6
Since Version 1.0

Property Name participationStatus
Reference/Description Section 3.4.6
Since Version 1.0

Property Name percentComplete
Reference/Description Section 4.2.4, Section 3.4.6
Since Version 1.0

Property Name priority
Reference/Description Section 3.4.1
Since Version 1.0

Property Name privacy
Reference/Description Section 3.4.3
Since Version 1.0

Property Name prodId
Reference/Description Section 3.1.4
Since Version 1.0

Property Name progress
Reference/Description Section 4.2.5, Section 3.4.6
Since Version 1.0

Property Name recurrenceId
Reference/Description Section 3.3.1
Since Version 1.0

Property Name recurrenceIdTimeZone
Reference/Description Section 3.3.2
Since Version 1.0

Property Name recurrenceOverrides
Property Content Event, Task
Reference/Description Section 3.3.4
Since Version 1.0

Property Name rel
Reference/Description Section 1.5.11
Since Version 1.0

Property Name relatedTo
Reference/Description Section 3.1.3, Section 3.5.1
Since Version 1.0

Property Name relation
Reference/Description Section 1.5.10
Since Version 1.0

Property Name relativeTo
Property Context OffsetTrigger
Reference/Description Section 3.5.1
Since Version 1.0

Property Name roles
Reference/Description Section 3.4.6
Since Version 1.0

Property Name rscale
Reference/Description Section 3.3.3
Since Version 1.0

Property Name sentBy
Property Context Event, Task, Participant
Reference/Description Section 3.4.6, Section 3.4.5
Since Version 1.0

Property Name sequence
Reference/Description Section 3.1.7
Since Version 1.0

Property Name showWithoutTime
Reference/Description Section 3.2.4
Since Version 1.0

Property Name size

Reference/Description Section 1.5.11
Since Version 1.0

Property Name skip
Reference/Description Section 3.3.3
Since Version 1.0

Property Name source
Reference/Description Section 4.3.2
Since Version 1.0

Property Name start
Property Context Event, Task
Reference/Description Section 4.1.1, Section 4.2.2
Since Version 1.0

Property Name status
Reference/Description Section 4.1.4
Since Version 1.0

Property Name timeZone
Property Context Event, Task
Reference/Description Section 3.6.1
Since Version 1.0

Property Name title
Reference/Description Section 3.2.1
Since Version 1.0

Property Name trigger
Reference/Description Section 3.5.1
Since Version 1.0

Property Name uid
Reference/Description Section 3.1.1
Since Version 1.0

Property Name until
Reference/Description Section 3.3.3
Since Version 1.0

Property Name updated
Reference/Description Section 3.1.6
Since Version 1.0

Property Name uri
Reference/Description Section 3.2.7
Since Version 1.0

Property Name virtualLocations
Reference/Description Section 3.2.7
Since Version 1.0

Property Name when
Reference/Description Section 3.5.1
Since Version 1.0

7.4.2.4. Added Properties

IANA will add the following entries in the JSCalendar Properties Registry. Referenced section numbers refer to this document, unless otherwise noted.

Property Name calendarAddress
Property Type String
Property Context Participant
Reference/Description Section 3.4.6
Intended Usage common
Since Version 2.0
Is Per-User No

Property Name description
Property Type not applicable
Property Context Location, VirtualLocation
Reference/Description Appendix A.2.2
Intended Usage reserved
Since Version 2.0
Is Per-User No

Property Name endTimeZone
Property Type String
Property Context Event
Reference/Description Section 4.1.3
Intended Usage common
Since Version 2.0
Is Per-User No

Property Name extra
Property Type not applicable
Property Context not applicable
Reference/Description Section 1.7.3.1
Intended Usage reserved
Since Version 2.0
Is Per-User No

Property Name mainLocationId
Property Type String

Property Context Event, Task
Reference/Description Section 3.2.6
Intended Usage common
Since Version 2.0
Is Per-User No

Property Name organizerCalendarAddress
Property Type String
Property Context Event, Task
Reference/Description Section 3.4.4
Intended Usage common
Since Version 2.0
Is Per-User No

Property Name recurrenceRule
Property Type RecurrenceRule
Property Context Event, Task
Reference/Description Section 3.3.3
Intended Usage common
Since Version 2.0
Is Per-User No

Property Name relativeTo
Property Context Location
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 2.0
Is Per-User No

Property Name timeZone
Property Context Location
Reference/Description Appendix A.2.1
Intended Usage obsolete
Since Version 2.0
Is Per-User No

Property Name version
Property Type String
Property Context Group, Event, Task
Reference/Description Section 3.1.2
Intended Usage common
Since Version 2.0
Is Per-User No

7.5. "JSCalendar Types" Registry

IANA has created the "JSCalendar Types" registry to avoid name collisions and provide a complete reference for all data types used for JSCalendar property values. IANA will set the Reference of the registry to this document, rather than obsoleted [RFC8984].

The registry policy is defined in Section 7.2.

7.5.1. "JSCalendar Types" Registry Template

Type Name: This is the name of the type.

Reference or Description: This is a brief description or RFC number and section reference where the Type is specified (may be omitted for "reserved" type names).

Intended Usage: This may be "common", "reserved", or "obsolete".

Since Version: The JSCalendar version on which the type definition is based. The version MUST be one of the allowed values of the version type in the "JSCalendar Version" registry (see Table 1).

Until Version: The JSCalendar version after which the type was obsoleted; therefore, it MUST NOT be used in later versions. The Until Version value either MUST NOT be set or MUST be one of the allowed values of the version type in the "JSCalendar Version" registry (see Table 1).

Change Controller: This is who may request a change to this entry's definition ("IETF" for RFCs from the IETF stream)

7.5.2. Changes to the "JSCalendar Types" Registry

7.5.2.1. Obsoleted Types

IANA will change the Intended Usage from "common" to "obsolete" for the following entries in the JSCalendar Types Registry. For each entry, the Type Name and its changed fields are listed.

| | |
|-----------------------|----------------|
| Type Name | TimeZone |
| Reference/Description | Appendix A.3.1 |
| Intended Usage | obsolete |
| Since Version | 1.0 |
| Until Version | 1.0 |

| | |
|-----------------------|----------------|
| Type Name | TimeZoneRule |
| Reference/Description | Appendix A.3.1 |

Intended Usage obsolete
Since Version 1.0
Until Version 1.0

7.5.2.2. Updated Types

IANA will update the following entries in the JSCalendar Types Registry. For each entry, the Type Name and its changed fields are listed. Unchanged fields are omitted. Referenced section numbers refer to this document, unless otherwise noted.

Type Name Alert
Reference/Description Section 3.5.1
Since Version 1.0

Type Name Boolean
Reference/Description Section 1.4.2
Since Version 1.0

Type Name Duration
Reference/Description Section 1.5.6
Since Version 1.0

Type Name Id
Reference/Description Section 1.5.1
Since Version 1.0

Type Name Int
Reference/Description Section 1.5.2
Since Version 1.0

Type Name LocalDateTime
Reference/Description Section 1.5.5
Since Version 1.0

Type Name Link
Reference/Description Section 1.5.11
Since Version 1.0

Type Name Location
Reference/Description Section 3.2.5
Since Version 1.0

Type Name NDay
Reference/Description Section 3.3.3
Since Version 1.0

Type Name Number

Reference/Description Section 1.4.2
Since Version 1.0

Type Name Participant
Reference/Description Section 3.4.6
Since Version 1.0

Type Name PatchObject
Reference/Description Section 1.5.9
Since Version 1.0

Type Name RecurrenceRule
Reference/Description Section 3.3.3
Since Version 1.0

Type Name Relation
Reference/Description Section 1.5.10
Since Version 1.0

Type Name SignedDuration
Reference/Description Section 1.5.7
Since Version 1.0

Type Name String
Reference/Description Section 1.4.2
Since Version 1.0

Type Name TimeZoneId
Reference/Description Section 1.5.8
Since Version 1.0

Type Name UnsignedInt
Reference/Description Section 1.5.3
Since Version 1.0

Type Name UTCDateTime
Reference/Description Section 1.5.4
Since Version 1.0

7.5.2.3. Added Types

IANA will add the following entries in the JSCalendar Types Registry. Referenced section numbers refer to this document, unless otherwise noted.

Type Name Event
Reference/Description Section 2.1
Intended Usage common

Since Version 1.0
Change Controller IETF

Type Name Group
Reference/Description Section 2.3
Intended Usage common
Since Version 1.0
Change Controller IETF

Type Name Task
Reference/Description Section 2.2
Intended Usage common
Since Version 1.0
Change Controller IETF

Type Name OffsetTrigger
Reference/Description Section 3.5.1
Intended Usage common
Since Version 1.0
Change Controller IETF

Type Name AbsoluteTrigger
Reference/Description Section 3.5.1
Intended Usage common
Since Version 1.0
Change Controller IETF

Type Name UnknownTrigger
Reference/Description Section 3.5.1
Intended Usage common
Since Version 1.0
Change Controller IETF

7.6. "JSCalendar Enum Values" Registry

IANA has created the "JSCalendar Enum Values" registry to allow interoperable extension of semantics for properties with enumerable values. Each such property has a subregistry of allowed values. IANA will set the Reference of the registry to this document, rather than obsoleted [RFC8984].

The registry policy is defined in Section 7.2.

7.6.1. "JSCalendar Enum Values" Registry Property Template

This template is for adding a subregistry for a new enumerable property to the "JSCalendar Enum" registry. To add or amend enumerated values for a new or existing subregistry use the template in Section 7.6.2.

Property Name: These are the name(s) of the property or properties where these values may be used. This MUST be registered in the "JSCalendar Properties" registry.

Context: This is the list of allowed object types where the property or properties may appear, as registered in the "JSCalendar Properties" registry. This disambiguates where there may be two distinct properties with the same name in different contexts.

Change Controller: ("IETF" for properties defined in RFCs from the IETF stream).

Initial Contents: This is the initial list of defined values for this enum, using the template defined in Section 7.6.2. A subregistry will be created with these values for this property name/context tuple.

7.6.2. "JSCalendar Enum Values" Registry Value Template

This template is for adding a new enum value to a subregistry in the JSCalendar Enum registry.

Enum Value: This is the verbatim value of the enum.

Reference or Description: This is a brief description or RFC number and section reference for the semantics of this value.

Intended Usage: This may be "common", "reserved", or "obsolete".

Since Version: The JSCalendar version on which the enum value definition is based. The version MUST be one of the allowed values of the version type in the "JSCalendar Version" registry (see Table 1).

Until Version: The JSCalendar version after which the enum value was obsoleted; therefore, it MUST NOT be used in later versions. The Until Version value either MUST NOT be set or MUST be one of the allowed values of the version type in the "JSCalendar Version" registry (see Table 1).

7.6.3. Changes to the "JSCalendar Enum Values" Registry

IANA will update the following entries. For each entry, the Property Name and its changed fields are listed. Unchanged fields are omitted.

Property Name progress
Context Task
Reference draft-ietf-calex-jscalendarbis

Property Name relativeTo
Context OffsetTrigger
Reference draft-ietf-calex-jscalendarbis

For every other existing entry, IANA will replace the contents of the "Reference" column with a reference to this document.

7.6.4. Additions to the "JSCalendar Enum Values" Registry

IANA will add the following entry to the "JSCalendar Enum Values" registry entry:

Property Name progress
Context Participant
Reference draft-ietf-calex-jscalendarbis
Change Controller IETF

IANA will add the following enumerated values in the newly created subregistry:

Enum Value in-process
Reference/Description Section 3.4.6
Intended Usage common
Since Version 2.0
Until Version
Change Controller IETF

Enum Value completed
Reference/Description Section 3.4.6
Intended Usage common
Since Version 2.0
Until Version
Change Controller IETF

Enum Value failed
Reference/Description Section 3.4.6
Intended Usage common
Since Version 2.0

Until Version
Change Controller IETF

7.6.5. Changes to the "JSCalendar Enum Values for action (Context:
Alert)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 3.5.1
Intended Usage common
Since Version 1.0
Until Version

7.6.6. Changes to the "JSCalendar Enum Values for display (Context:
Link)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 1.5.11
Intended Usage common
Since Version 1.0
Until Version

7.6.7. Changes to the "JSCalendar Enum Values for features (Context:
VirtualLocation)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 3.2.7
Intended Usage common
Since Version 1.0
Until Version

7.6.8. Changes to the "JSCalendar Enum Values for freeBusyStatus
(Context: Event, Task)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 3.4.2
Intended Usage common
Since Version 1.0
Until Version

7.6.9. Changes to the "JSCalendar Enum Values for kind (Context: Participant)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 3.4.6
Intended Usage common
Since Version 1.0
Until Version

7.6.10. Changes to the "JSCalendar Enum Values for participationStatus (Context: Participant)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 3.4.6
Intended Usage common
Since Version 1.0
Until Version

7.6.11. Changes to the "JSCalendar Enum Values for privacy (Context: Event, Task)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 3.4.3
Intended Usage common
Since Version 1.0
Until Version

7.6.12. Changes to the "JSCalendar Enum Values for progress (Context: Task, Participant)" Registry

IANA will rename the sub-registry to "JSCalendar Enum Values for progress (Context: Task)".

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 4.2.5
Intended Usage common
Since Version 1.0
Until Version

7.6.13. Changes to the "JSCalendar Enum Values for relation (Context: Relation)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 1.5.10
Intended Usage common
Since Version 1.0
Until Version

IANA will add the following entry:

Enum Value snooze
Reference/Description Section 3.5.1
Intended Usage common
Since Version 2.0
Until Version
Change Controller IETF

7.6.14. Changes to the "JSCalendar Enum Values for relativeTo (Context: OffsetTrigger, Location)" Registry

IANA will rename the sub-registry to "JSCalendar Enum Values for relativeTo (Context: OffsetTrigger)".

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 3.5.1
Intended Usage common
Since Version 1.0
Until Version

7.6.15. Changes to the "JSCalendar Enum Values for roles (Context: Participant)" Registry

For the entry with enum value "attendee", IANA will set the following fields:

Reference Appendix A.2.3
Intended Usage obsolete
Since Version 1.0
Until Version 1.0

For every other existing entry, IANA will set the following fields:

Reference Section 3.4.6

Intended Usage common
Since Version 1.0
Until Version

7.6.16. Changes to the "JSCalendar Enum Values for scheduleAgent (Context: Participant)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Appendix A.2.2
Intended Usage reserved
Since Version 1.0
Until Version 1.0

7.6.17. Changes to the "JSCalendar Enum Values for status (Context: Event)" Registry

For every existing entry, IANA will set the following fields.
Unchanged fields are omitted.

Reference Section 4.1.4
Intended Usage common
Since Version 1.0
Until Version

8. References

8.1. Normative References

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Appendix A. Differences from RFC 8984

This section documents all significant differences from RFC 8984. Insignificant differences, such as formatting, grammar or typos are not documented.

A.1. Applied Errata

All verified errata of RFC 8984 was applied to this document:

- * Errata 6872 (<https://www.rfc-editor.org/errata/eid6872>)
- * Errata 6873 (<https://www.rfc-editor.org/errata/eid6873>)
- * Errata 8028 (<https://www.rfc-editor.org/errata/eid8028>)

A.2. Changed Property Definitions

This section summarizes the differences from the JSCalendar property definitions of [RFC8984].

A.2.1. Obsoleted Properties

The following properties became obsolete:

***excludedRecurrenceRules*:**

This is incompatible with iCalendar, which deprecated the EXRULE property in [RFC5545].

See Section 4.3.4 of [RFC8984].

***recurrenceRules*:**

This is incompatible with the following definitions of the iCalendar RRULE property [RFC5545] (Section 3.8.5.3):

- * The RRULE property SHOULD NOT be specified more than once.
- * The recurrence set generated with multiple RRULE properties is undefined.

The newly defined single-valued recurrenceRule property (Section 3.3.3) replaces it.

See Section 4.3.3 of [RFC8984].

***timeZones*:**

This property was obsoleted for the following reasons:

- * Custom time zones in calendaring data increase implementation complexity, introduce inefficiencies and are error-prone, as described for CalDAV and iCalendar in [RFC7809].
- * In practice, the only non-IANA time zone identifiers are Microsoft time zone names. These can be converted to IANA time zones, e.g. using the International Components for Unicode (<https://icu.unicode.org/>) software library.
- * The property contradicts the stated goal of JSCalendar to avoid ambiguities and pitfalls of iCalendar, defined in Section 1.1 of [RFC8984].

See Section 4.7.2 of [RFC8984].

***Link.cid*:**

This property was obsoleted for the following reasons:

- * It only is relevant for rich-text descriptions, but the related iCalendar STYLED-DESCRIPTION property [RFC9073] (Section 6.5) does not support referring to attached media.
- * It only is applicable for Link objects having a "data:" URI as href property value. But even the definition of the Link object recommends not to use "data:" URIs as values in the href property.

- * A Link with "data:" URI converts to an iCalendar BINARY value [RFC5545] (Section 3.3.1). But these are marginally supported by CalDAV clients, which tend to prefer using WebDAV managed attachments [RFC8607].

See Section 1.4.11 of [RFC8984].

Location.{relativeTo|timeZone}:

These got replaced with the newly defined Event.endTimeZone property (Section 4.1.3):

- * They were meant to be equivalent to the iCalendar DTEND property [RFC5545] (Section 3.8.2.2). But the semantics were undefined if multiple Location objects had "relativeTo=end" and the "timeZone" property set.
- * Their semantics were undefined for Task objects.
- * They were incompatible with the iCalendar VLOCATION component [RFC9073] (Section 7.2), which neither defines how to set a time zone identifier or how the VLOCATION relates to start and end.

See Section 4.2.5 of [RFC8984].

Participant.locationId:

This is incompatible with the iCalendar PARTICIPANT component [RFC9073] (Section 7.1):

- * The PARTICIPANT component may contain multiple VLOCATION components and LOCATION properties.
- * The PARTICIPANT component does not support referring to other VLOCATION components or LOCATION properties

The description of the Event object type in Section 2.1 reflects this:

- * It stated: "Multiple participants may partake in the event at multiple locations."
- * It now states: "Multiple participants may partake in the event."

See Section 4.4.6 of [RFC8984].

Participant.language:

No equivalent element exists in iCalendar and its current single-valued definition is likely to conflict with any related future extension of the PARTICIPANT component [RFC9073] (Section 7.1).

See Section 4.4.6 of [RFC8984].

***{Participant|Task}.progressUpdated*:**

This became obsolete for the following reasons:

- * It is incompatible with the newly introduced iCalendar VSTATUS component [I-D.ietf-calext-ical-tasks] (Section 12.1), which may occur multiple times in the PARTICIPANT and VTOD components.
- * The VSTATUS component introduces new semantics to a task's progress and status, which better be defined by a future JSCalendar extension for tasks.

See Section 4.4.6 of [RFC8984] and Section 5.2.6 of [RFC8984].

***{TimeZone|TimeZoneRule}.*:**

All properties defined solely for the TimeZone and TimeZoneRule object types became obsolete, because the "timeZones" property became obsolete.

See Section 4.7.2 of [RFC8984].

A.2.2. Reserved Properties

A.2.2.1. JMAP for Calendars

The following common use properties became reserved for JMAP for Calendars [I-D.ietf-jmap-calendars]:

***useDefaultAlerts*:**

No equivalent element exists in iCalendar and no consensus for default alarms in CalDAV and iCalendar was found at IETF as part of [RFC9074].

See Section 4.4.1 of [RFC8984].

***Participant.scheduleSequence*:**

This requires further work by IETF to update iTIP [RFC5546] with the PARTICIPANT component and JSCalendar. This property may later be redefined for common use.

See Section 4.4.6 of [RFC8984].

***Participant.scheduleUpdated*:**

This requires further work by IETF to update iTIP [RFC5546] with the PARTICIPANT component and JSCalendar. This property may later be redefined for common use.

See Section 4.4.6 of [RFC8984].

A.2.2.2. Scheduling Extensions for CalDAV and iTIP

The following common use properties became reserved for future JSCalendar extensions of Scheduling Extensions for CalDAV [RFC6638] and iTIP [RFC5546]:

***replyTo*:**

This requires further work by IETF. For compatibility with iCalendar, the newly introduced organizerCalendarAddress property (Section 3.4.4) replaces it.

See Section 4.4.4 of [RFC8984].

***requestStatus*:**

This mainly is applicable in scheduling over CalDAV.

See Section 4.4.7 of [RFC8984].

***Participant.invitedBy*:**

This requires further work by IETF. Specifically, the iTIP definitions of the REPLY method [RFC5546] (Section 3.2.3) and how to forward invitation requests (Section 4.2.8 of [RFC5546]) must be updated.

See Section 4.4.6 of [RFC8984].

***Participant.participationComment*:**

This requires further work by IETF to update iTIP [RFC5546] with the PARTICIPANT component or JSCalendar. This property may later be redefined for common use.

See Section 4.4.6 of [RFC8984].

***Participant.scheduleAgent*:**

This only is applicable in scheduling over CalDAV.

See Section 4.4.6 of [RFC8984].

***Participant.scheduleForceSend*:**

This only is applicable in scheduling over CalDAV.

See Section 4.4.6 of [RFC8984].

***Participant.scheduleStatus*:**

This only is applicable in scheduling over CalDAV.

See Section 4.4.6 of [RFC8984].

***Participant.sendTo*:**

This requires further work by IETF. For compatibility with iCalendar, the newly introduced Participant.calendarAddress property (Section 3.4.6) replaces it.

See Section 4.4.6 of [RFC8984].

A.2.2.3. Localization Extensions for iCalendar and JSCalendar

The following properties became reserved for future JSCalendar and iCalendar extensions for multi-lingual calendar data:

***localizations*:**

This requires further work by IETF. The "localizations" property primarily was introduced in JSCalendar for event publishing, but neither the Event Publishing extensions for iCalendar [RFC9073] nor other iCalendar extensions define how to localize iCalendar data. This property may later be redefined for common use.

See Section 4.6.1 of [RFC8984].

A.2.2.4. Reserved for Future RFCs

The following properties became reserved for some future JSCalendar extension RFCs:

***Location.description, VirtualLocation.description*:**

This requires further work by IETF. The VirtualLocation "description" property does not convert to any parameter of the CONFERENCE property. It would require to define a new parameter or to introduce a new component to augment the CONFERENCE property with a DESCRIPTION or STYLED-DESCRIPTION property. For consistency, the Location "description" property became reserved, too.

See Section 4.2.5 of [RFC8984] and Section 4.2.6 of [RFC8984].

A.2.2.5. Reserved for Internal Use

The following properties became reserved for internal use by JSCalendar:

***excluded*:**

This property name already was defined for internal use only in the recurrenceOverrides property, but registering it for common use had made it appear as being a regular property. Making this a reserved property is to help clarify its purpose. Section 3.3.4 has been updated accordingly.

See Section 4.3.4 of [RFC8984].

A.2.3. Updated Properties

The following property definitions were updated:

***@type*:**

The original definition required this property be set on every object type. The type and property notation in Section 1.4 now matches the one in JSContact, and the @type property is optional in the majority of cases.

***Alert.relatedTo*:**

The original definition instructed to set the "parent" relation on a snooze alert. It now instructs to set the newly defined "snooze" relation, for compatibility with the VALARM "SNOOZE" relationship type (Section 7 of [RFC9074]).

The original definition did not define that the map keys represent keys of Alert objects in the "alerts" property.

See Section 3.5.1.

***Alert.trigger*:**

JSCalendar now supports default types for properties of type "A|B". The default type of this property now is OffsetTrigger.

See Section 3.5.1.

***{Event|Task|Group}.color*:**

The original definition allowed hexadecimal RGB values, which CSS3 specifies to be either in three-digit or six-digit form. The updated definition only allows them in six-digit form to match the proposed update of the iCalendar COLOR property. It also explicitly defines that values are case-insensitive.

See Section 3.2.12.

***Link.display*:**

The original definition only allowed one purpose to be set, which is incompatible with the multi-valued iCalendar DISPLAY parameter [RFC7986] (Section 6.1). It now supports setting multiple purposes.

Setting this property does not anymore require the "rel" property of the Link object be set to "icon".

See Section 1.5.11.

***Link.rel*:**

The original definition restricted the value of this property to registered link types. It now also allows extension relation types for compatibility with the LINKREL parameter [RFC9253] (Section 6.1).

See Section 1.5.11.

***Participant.delegatedFrom*, *Participant.delegatedTo*,
Participant.memberOf,**

The original definitions required their values to identify Participant objects. This was incompatible with iCalendar when the DELEGATED-TO, DELEGATED-FROM or MEMBER parameters contained a calendar address but no ATTENDEE property with that same calendar address. The new definition now requires the property values to be calendar addresses.

Also, they now require the calendarAddress property to be set.

See Section 3.4.6.

***Participant.expectReply*, *Participant.invitedBy*,
Participant.kind, *Participant.participationStatus*,
Participant.progress, *Participant.sentBy*:**

The original definitions were incompatible with iCalendar: they did not require the (now reserved) sendTo property to be set, but their equivalent iCalendar parameters require an ATTENDEE property. They now require the calendarAddress property to be set.

See Section 3.4.6.

***Participant.progress*:**

The original definition was incompatible with iCalendar. It allowed the progress value to be "cancelled", but this is not a supported PARTSTAT parameter value of an ATTENDEE property in a VTODO component. The new definition only supports the progress property values "in-process", "completed" and "failed".

See Section 3.4.6.

***Participant.roles*:**

The original definition was incompatible with iCalendar:

- * It did not cover the "REQ-PARTICIPANT" value of the ROLE parameter [RFC5545] (Section 3.2.16). It now defines the new "required" role.
- * The "roles" property is multi-valued but the ROLE parameter is single-valued and only allowed to be set once on an ATTENDEE. For compatibility, a precedence of Participant roles got defined for converting roles to iCalendar.
- * It was mandatory for a Participant, but the (now reserved) sendTo property was not. This was incompatible with iCalendar, which required an ATTENDEE property to set the ROLE parameter. It now is optional, but requires the calendarAddress property to be set.
- * It defined a "contact" role, but this role later got redefined as an enumerated value of the PARTICIPANT-TYPE property [RFC9073] (Section 6.2). It now removed this role and leaves defining participant types to a future JSCalendar extension.
- * The "attendee" role got removed. There is no equivalent ROLE value in iCalendar and any Participant with a calendarAddress by definition is an ATTENDEE in iCalendar.
- * The "owner" role got redefined. It now makes clear that the semantics of the role depend on the calendaring exchange protocol.

See Section 3.4.6.

***Relation.relation*:**

The original definition specified the empty relation to represent an unspecified relationship. It now defines the empty relation to default to "parent", unless overridden, for compatibility with the RELATED-TO property [RFC5545] (Section 3.8.4.5).

See Section 1.5.10.

***{Event|Task}.sentBy*:**

The property now requires the organizerCalendarAddress property to be set.

See Section 3.4.5.

***Task.{due|start}*:**

The original definition defined these as optional, but this is incompatible with iCalendar: if the Task object's timeZone property is set, then it requires the DUE property [RFC5545] (Section 3.8.2.3) or DTSTART property [RFC5545] (Section 3.8.2.4) be set in the VTOD component. It now requires at least one of the "due" or "start" properties be set, if the "timeZone" property is set.

The original definition did not require the "start" property be set if the "recurrenceRule" property is set. But this is incompatible with the RRULE property [RFC5545] (Section 3.8.5.3), which requires the DTSTART property be set in the VTOD component. The "start" property now is required if the "recurrenceRule" or "recurrenceId" properties are set.

The "showWithoutTime" property having value "true" now requires at least one of the "due" or "start" properties be set.

See Section 4.2.

A.2.4. New Properties

The following new properties were defined:

***mainLocationId*:**

This got introduced for better interoperability with iCalendar, where the VEVENT and VTOD components allow at most one LOCATION property to be present. While VLOCATION components [RFC9073] (Section 7.2) may occur multiple times, implementations need to know which Location to choose for the LOCATION property.

See Section 3.2.6.

***organizerCalendarAddress*:**

This replaces the reserved replyTo property.

See Section 3.4.4.

***recurrenceRule*:**

This replaces the obsoleted recurrenceRules property.

See Section 3.3.3.

***version*:**

This adds versioning (Section 1.9) to JSCalendar, as defined for JSContact [RFC9553].

See Section 3.1.2.

***Event.endTimeZone*:**

This replaces the obsoleted `Location.relativeTo` and `Location.timeZone` properties.

See Section 4.1.3.

***Location.descriptionContentType*:**

This is for compatibility with the iCalendar `STYLED-DESCRIPTION` property [RFC9073] (Section 6.5) of the `VLOCATION` component.

See Section 3.2.5.

***Participant.calendarAddress*:**

This replaces the reserved `Participant.sendTo` property.

See Section 3.4.6.

***Participant.descriptionContentType*:**

This is for compatibility with the iCalendar `STYLED-DESCRIPTION` property [RFC9073] (Section 6.5) of the `PARTICIPANT` component.

See Section 3.2.5.

***VirtualLocation.descriptionContentType*:**

This is for consistency with the definition of the `Location` object type. The newly defined `VCONFERENCE` component will be allowed to contain the `STYLED-DESCRIPTION` property [RFC9073] (Section 6.5).

See Section 3.2.7.

A.3. Changed Type Definitions

This section summarizes the differences from the JSCalendar type definitions of [RFC8984].

A.3.1. Obsoleted Types

The following type definitions became obsolete:

***TimeZone, TimeZoneRule*:**

The `"timeZones"` property became obsolete.

See Section 4.7.2 of [RFC8984].

A.3.2. Updated Types

The following type definitions were updated:

***Duration, LocalDateTime, UTCDateTime*:**

The original definitions supported fractional seconds. This is incompatible with the iCalendar DATE-TIME and DURATION types defined in Section 3.3.5 of [RFC5545] and Section 3.3.6 of [RFC5545].

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