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Toby Considine

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- IETF RFC5545, ICalendar
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-

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Abstract:

WS-Calendar describes a limited set of message components and interactions providing a common basis for specifying schedules and intervals to coordinate activities between services. The specification includes service definitions consistent with the OASIS SOA Reference Model and XML vocabularies for the interoperable and standard exchange of:

- Schedules, including sequences of schedules
- Intervals, including sequences of intervals

These message components describe schedules and intervals future, present, or past (historical). The definition of the services performed to meet a schedule or interval depends on the market context in which that service exists. It is not in scope for this TC to define those markets or services.

Status:

This document was last revised or approved by the WS-Calendar Technical Committee on the above date. The level of approval is also listed above. Check the “Latest Version” or “Latest Approved Version” location noted above for possible later revisions of this document.

Technical Committee members should send comments on this specification to the Technical Committee’s email list. Others should send comments to the Technical Committee by using the “Send A Comment” button on the Technical Committee’s web page at http://www.oasis-open.org/committees/ws-calendar/.

For information on whether any patents have been disclosed that may be essential to implementing this specification, and any offers of patent licensing terms, please refer to the Intellectual Property Rights section of the Technical Committee web page (http://www.oasis-open.org/committees/ws-calendar/ipr.php.

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1 Introduction

One of the most fundamental components of negotiating services is agreeing when something should occur, and in auditing when they did occur. Short running services traditionally have been handled as if they were instantaneous, and have handled scheduling through just-in-time requests. Longer running processes, including physical processes, may require significant lead times. When multiple long-running services participate in the same business process, it may be more important to negotiate a common completion time than a common start time. Pre-existing approaches that rely on direct control of such services by a central system increases integration costs and reduce interoperability as they require the controlling agent to know and manage multiple lead times.

Not all services are requested one time as needed. Processes may have multiple and periodic occurrences. An agent may need to request identical processes on multiple schedules. An agent may request services to coincide with or to avoid human interactions. Service performance be required on the first Tuesday of every month, or in weeks in which there is no payroll, to coordinate with existing business processes. Service performance requirements may vary by local time zone. A common schedule communication must support diverse requirements.

Physical processes are already being coordinated by web services. Building systems and industrial processes are operated using oBIX, BACnet/WS, LON-WS, OPC XML, and a number of proprietary specifications including TAC-WS, Gridlogix EnNet, and MODBUS.NET. In particular, if building systems coordinate with the schedules of the building's occupants, they can reduce energy use while improving performance.

An increasing number of specifications envision synchronization of processes through mechanisms including broadcast scheduling. Efforts to build an intelligent power grid (or smart grid) rely on coordinating processes in homes, offices, and industry with projected and actual power availability; mechanisms proposed include communicating different prices at different times. Several active OASIS Technical Committees require a common means to specify schedule and interval: Energy Interoperation (EITC) and Energy Market Information Exchange (EMIX). Emergency management coordinators wish to inform geographic regions of future events, such as a projected tornado touchdown, using EDXL. The open Building Information Exchange specification **[oBIX]** lacks a common schedule communications for interaction with enterprise activities. These and other efforts would benefit from a common cross-domain, cross specification standard for communicating schedule and interval.

For human interactions and human scheduling, the well-known iCalendar format is used to address these problems. Prior to WS-Calendar, there has been no comparable standard for web services. As an increasing number of physical processes become managed by web services, the lack of a similar standard for scheduling and coordination of services becomes critical.

The intent of the WS-Calendar technical committee was to adapt the existing specifications for calendaring and apply them to develop a standard for how schedule and event information is passed between and within services. The standard adopts the semantics and vocabulary of iCalendar for application to the completion of web service contracts. WS Calendar builds on work done and ongoing in The Calendaring and Scheduling Consortium (CalConnect), which works to increase interoperation between calendaring systems.

Everything with the exception of all examples, all appendices, and the introduction is normative.

1.1 Terminology

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

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1.3 Non-Normative References

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1.4 Naming Conventions

This specification follows some naming conventions for artifacts defined by the specification, as follows:

For the names of elements and the names of attributes within XSD files, the names follow the camelCase[1] convention, with all names starting with a lower case letter, eg

```
<element name="componentType" type="WS-Calendar:ComponentType"/>
```

For the names of types within XSD files, the names follow the CamelCase convention with all names starting with an upper case letter, e.g.,

```
<complexType name="ComponentService">
```

For the names of intents, the names follow the CamelCase convention, with all names starting with a lower case letter, EXCEPT for cases where the intent is to represent an established acronym, in which case the entire name follows the usage of the established acronym.

An example of an intent which references an acronym is the "SOAP" intent.

1.5 Architectural References

WS-Calendar assumes incorporation into services. Accordingly it assumes a certain amount of definitions of roles, names, and interaction patterns. This document relies heavily on roles and interactions as defined in the OASIS Standard *Reference Model for Service Oriented Architecture* ***[SOA-RM]***.

[1] Common term - see Wikipedia for explanation.

2 Overview of WS-Calendar

A calendar communication without a real world effect[2] is of little interest. That real world effect is the result of a services execution context within a policy context. Practitioners can use WS-Calendar to add communication of schedule and interval to the execution context of a service. Use of WS-Calendar will align the performance expectations between execution contexts in different domains. The Technical Committee intends for other specifications and standards to incorporate WS-Calendar, bringing a common scheduling context to diverse interactions in different domains

2.1 Approach taken by the WS-Calendar Technical Committee

The Technical Committee (TC) based its work upon the iCalendar specification as updated in 2009 (IETF **[RFC5545]** and its the XML serialization **[XCAL]**, currently (2010-07) on a standards track in the IETF. Members of the Calendaring and Scheduling Consortium (CalConnect.org) developed both updates to IETF specifications and provided advice to this TC. This work provides the vocabulary for use in this specification.

The committee solicited requirements from a range of interests, notably the NIST Smart Grid Roadmap and the requirements of the Smart Grid Interoperability Panel (SGIP) as developed by the North American Energy Standards Board (NAESB). Others submitting requirements included members of the oBIX technical committee and representative of the FIX Protocol Association. These requirements are reflected in the semantic elements described in Chapters 3 and 4.

In a parallel effort, the CalConnect TC-XML committee developed a number of schedule and calendar-related services. CalConnect drew on its experience in interoperability between enterprise calendaring systems as well as interactions with web-based calendars and personal digital assistants (PDAs). These services were developed as RESTfull (using **[REST]**)services by CalConnect and contributed to the WS-Calendar TC.

2.2 Scheduling Service Performance

Time semantics are critical to WS-Calendar. Services requested differently can have different effects on performance even though they appear to request the same time interval. This is inherent in the in the concept of a service oriented architecture.

As defined in the OASIS Reference Model for Service Oriented Architecture 1.0[3], service requests access the capability of a remote system.

> *The purpose of using a capability is to realize one or more real world effects. At its core, an interaction is "an act" as opposed to "an object" and the result of an interaction is an effect (or a set/series of effects). This effect may be the return of information or the change in the state of entities (known or unknown) that are involved in the interaction.*
>
> *We are careful to distinguish between public actions and private actions; private actions are inherently unknowable by other parties. On the other hand, public actions result in changes to the state that is shared between at least those involved in the current execution context and possibly shared by others. Real world effects are, then, couched in terms of changes to this shared state*

A request for remote service performance is a request for specific real world effects. Consider two service providers that offer the same service. One must start planning an hour or more in advance. The second may be able to achieve the service in five minutes. The service start time is the time when that service

[2] This paragraph includes a number of terms of art used in service oriented architecture (SOA). In all cases, the terms are as defined in the *Reference Model for Service Oriented Architecture,* found in the normative references.

[3] See normative references in section 1.2

becomes available. If we do not distinguish these circumstances, then the customer would receive quite different quite different services with no distinctions in the service contract.

The complement of this is the scheduled end time. The party offering the service may need to ramp down long running processes. Using for example energy demand response, if a system contracts to end energy use by 3:00, it assumes the onus of turning everything off before 3:00.

Duration is how long a behavior is continued. If a service contracts to provide shed load for an hour, it is not necessary for it to stop shedding load 65 minutes later (which may be the end of the work day). It must, however, shed the agreed upon load during all of the 60 minutes.

In this way, the service scheduled to shed load from 4:00 ending at 5:00 may be quite different than the one scheduled to shed load for an hour beginning at 4:00.

2.2.1 Which Time? UCT vs. Local Time

When 2 or more parties attempt to agree on a time - e.g., for a meeting, or when to provide a service, they agree to start at a particular instant of time UTC. They agree on that instant in time by converting from local time, e.g., they want a meeting to start at 13:00 Eastern, 18:00 UK. Our lives and the use of services are bound by local time not by UTC. To humans local time is the invariant and UTC is mapped on to it. If a government modifies the rules we adjust the mappings and we shift the UTC time. We still want to meet at 13:00 local or have the heating start at 07:00.

As long as the rules never change this causes no confusion—but they do. Recent experience has included considerable efforts when the rules for the start of Daylight Savings Time (DST) have changed. If all information is in UTC, and no record of the events basis in the local time and time zone remains, there is no way to re-compute existing contracts. We don't know if that UTC was calculated based on an old or new rule.

A triplet of Local time + timezoneid + (UTC or offset) always allows you to determine if the time is valid. If a recalculation of UTC for that local time + tzid results in a different value from that stored then presumably the DST rules have changed since the data was stored. If you can detect that the scheduled time is no longer valid you can take corrective action.

For simplicity, all examples and discussion in this document are based on Greenwich Mean Time also known as Coordinated Universal Time (UTC). The Technical Committee makes no representation as whether UTC or local time are more appropriate for a given interaction. Because WS-Calendar is based on **[iCalendar]**, business practices built upon WS-Calendar can support either.

Practitioners should consult **[Time Service Recommendations]** and **[Time Zone Service]** in the non-normative references.

2.3 Overview of This Document

The specification consists of a standard schema and semantics for schedule and interval information. Often the most important service schedule communications involve series of related services over time, which WS-Calendar defines as a Sequence. These semantic elements are defined and discussed in Section 3.

Section 4 introduces notions of performance, i.e. what does it mean to be “on time”. This section also describes the different ways to association a service request with each Interval in a Sequence.

Managing information exchanges about a Sequence of events can easily become cumbersome, or prone to error. WS-Calendar defines the Calendar Gluon, a mechanism for making assertions about all or most of the intervals in a sequence. Intervals can inherit from a Calendar Gluon, or they can override locally assertions inherited from the Calendar Gluon. Section 5 discusses inheritance and parsimony of communication and introduces contract scheduling.

In Sections 7-15, this document describes **[REST]**-based, (RESTfull) web services for interacting with remote calendars. These interactions are based upon the larger iCalendar message. The specification defines services for calendar inquiries, event scheduling, event updating, and event cancelation.

3 Intervals, Temporal Relations, and Sequences

WS-Calendar Elements are semantic elements derived from the [XCAL] specification. These elements are smaller than a full schedule interaction, and describe the intervals, durations, and time-related events that are relevant to service interactions. The Elements are used to build a precise vocabulary of time, duration, sequence, and schedule.

WS-Calendar elements elaborate the objects defined in iCalendar, to make interaction requirements explicit. For example, in human schedule interactions, different organizations have their own expectations. Meetings may start on the hour or within 5 minutes of the hour. As agents scheduled in those organizations, people learn the expected precision. In WS-Calendar, that precision must be explicit to prevent interoperation problems. WS-Calendar defines a performance element to elaborate the simple specification of **[XCAL]** to make explicit the performance expectations within a scheduled event.

WS-Calendar defines common semantics for recording and exchanging event information.

3.1 Core Semantics derived from [XCAL]

The iCalendar data format **[RFC5545]** is a widely deployed interchange format for calendaring and scheduling data. The **[XCAL]** specification (in process) standardizes the XML representation of iCalendar information. WS-Calendar relies on **[XCAL]** standards and data representation to develop its semantic components.

http://ietfreport.isoc.org/idref/draft-daboo-et-al-icalendar-in-xml/

3.1.1 Time

Time is an ISO 8601 compliant time string with the optional accompaniment of a duration interval to define times of less than 1 second. Examples of the from the ISO 8601 standard include:

```
Year:
    YYYY (eg 1997)
Year and month:
    YYYY-MM (eg 1997-07)
Complete date:
    YYYY-MM-DD (eg 1997-07-16)
Complete date plus hours and minutes:
    YYYY-MM-DDThh:mmTZD (eg 1997-07-16T19:20+01:00)
Complete date plus hours, minutes and seconds:
    YYYY-MM-DDThh:mm:ssTZD (eg 1997-07-16T19:20:30+01:00)
Complete date plus hours, minutes, seconds and a decimal fraction of a second
    YYYY-MM-DDThh:mm:ss.sTZD (eg 1997-07-16T19:20:30.45+01:00)
```

Normative information on **[ISO 8601]** is found in section 1.2.

The iCalendar Components (VComponents)

iCalendar and **[XCAL]** have a number of long defined component objects that comprise the payload inside of an iCalendar message. These include the VTODO, the VALARM, the VEVENT. These element names begin with “V” for historic reasons. The definitions and use of each of the vObjects is described in **[RFC5545]**.

Because of its flexibility, the VTODO object is the basis for WS-Calendar objects for service performance. Because WS-Calendar services support all traditional iCalendar-based interactions (CalDAV, et al.), all VComponents SHALL be supported.

3.2 Intervals

Time Segments, i.e., increments of continuous passage of time, are a critical component of service alignment using WS-Calendar. There are many overloaded uses of terms about time, and within a

particular time segment, there may be many of them. Within this document, we use the term Time Segments to encompass all the terms in Table 3-1, below.

The base data type for time segments is the Interval. The Interval is a time segment defined by the Duration element as defined in **[XCAL]**. The **[XCAL]** duration is a data type based upon the string representation in the iCalendar duration. The Committee listened to arguments that we should redefine the use and meaning of Duration. Whatever their merit, the iCalendar Duration has a pre-existing meaning of the length of time of scheduled within an event. In this section, the Duration is enumerated as one of several time segments.

Table 3-1: Defining Time Segments for WS-Calendar

Time Segment	Definition
Duration	Well-known element from iCalendar and **[XCAL]**, Duration is the length of an event scheduled using iCalendar or any of its derivatives. The **[XCAL]** duration is a data type using the string representation defined in the iCalendar duration. The Duration is the sole descriptive element of the VTODO object that is mandatory in the Interval.
Interval	The Interval is a single duration supported by the full information set of the VTODO object as defined in iCalendar (**[RFC5545]**) and refined in **[XCAL]**. A WS-Calendar interval must include a Duration.
Sequence	A Sequence is a set of Intervals with defined temporal relationships. Sequences may have gaps between Intervals, or even simultaneous activities. A sequence is re-locatable, i.e., it does not have a specific date and time. A Sequence may consist of a single interval.
Scheduled Sequence	A Scheduled Sequence is a Sequence that is anchored by a specific date and time, that is, it is a Sequence with a start date and time. Specific performance of a Sequence against a service contract always occurs in a Scheduled Sequence.
Partition	A Partition is a set of consecutive intervals. A Partition includes the trivial case of a single Interval. A Partition is used to define a single service or behavior which varies over time. Examples include energy prices over time and or energy usage over time. A Partition is re-locatable, i.e., it does not have a specific date and time.
Scheduled Partition	A Scheduled Partition is a Partition that is anchored by a specific date and time, that is, it is a Partition with a start date and time. The Performance of a Partition against an executed service contract always occurs in a Scheduled Partition.

1.1.1 Intervals: the Basic Time Segment

An interval specifies how long an activity lasts. An Unscheduled Interval is not linked to a specific date and time. Intervals are derived from the **[iCalendar]** Component VTODO. For ease of reference, the required elements from the VTODO object are summarized here. Nothing in this section supersedes **[RFC5545]** or the **[XCAL]** specification. Implementers SHALL refer to those respective specifications **[RFC5545]** and the **[XCAL]** specifications for the normative description and definitions.

While all elements of the VTODO component are legal in WS-Calendar, certain elements are critical when invoking services. These elements and their definitions within WS-Calendar are listed in *Table 3-2: VTODO properties in* Intervals.

Table 3-2: VTODO properties in Intervals

Elements	Use	Use in WS-Calendar
dtstamp	Mandatory	

Elements	Use	Use in WS-Calendar
x-wscalendarType	Mandatory xs:string, value always “Interval”	Added vtodo attribute, ignored by iCalendar processors
uid	Mandatory	Used to enable unambiguous referencing by other components
dtstamp	xcal:dtstamp Optional	Identifies when Interval object was created
duration	xcal:duration Optional	Identifies length of time for Interval
dtStart	Optional	Scheduled start date and time for interval
dtEnd	Ignored	Legal for compatibility only. WS-Calendar does not use dtend.
attach	Mandatory, Multipleoccurs	In [xCal], any attachment. In WS-Calendar, restricted to the Attachment object as defined in section 4.
x-wscalendarrelation	temporalRelation. Optional compound element	Defines temporal relations to other components. Temporal Relations and their use to define Sequences are described in section 3.3.

An interval specifies how long an activity lasts. An Unscheduled Interval is not linked to a specific date and time. The example below shows the components section of a WS-Calendar event containing a single interval

Example 1: An Interval

```
<components>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <uid>
            <text>00959BC664CA650E933C892C@example.com</text>
        </uid>
        <description>
            <text>Sample Contract</text>
        </description>
        <duration>
            <duration>
                <duration>T10H</duration>
            </duration>
        </duration>
    </properties>
</vtodo>
<components>
```

Note that no start time is specified, and no relationship. Relationships are not mandatory until an interval is incorporated into a Sequence.

3.3 Temporal Relations between Intervals

Many iCalendar communications involve more than one vComponent. In iCalendar interactions there are few components they have stereotypical interactions. For example, a vAlarm may be associated with a vevent. The registered relationships for iCalendar components are PARENT and Child. In [XCAL], these are usually expressed as:

```
<relationship>
    <uid>aaaaaaa1</uid>
    <reltype>PARENT</reltype>
```

```
</relationship>
```

WS-Calendar defines additional relationships to describe how intervals relate in time. These Temporal Relationships express the order of performance and to declare the spacing between any two intervlas. These relationships are referred to as the temporal relationships between components.

Table 3-3: Temporal Relationships in WS-Calendar

Temporal Relationship	Short Form	Definition
finishToStart	FS	As soon as the related Component finishes, this interval begins.
finishToFinish	FF	Used without gap when to components must finish at the same time. If there is a gap, it indicates that the referring component will finish execution a duration after the referred-to component.
startToFinish	SF	This component must Finish before the related component starts.
startToStart	SS	These Components must start at the same time
Gap		Attribute to indicate the separation, if any, between the state of the first Interval and the state of the second. Expressed as a duration.

WS-Calendar specifies more elements in the Relationship to accommodate the needs of Temporal Relationships. WS-Calendar also extends iCalendar relationship to allow references to external Components as well as to those internal to the iCalendar object.

Table 3-4: Elements of a WS-Calendar Temporal Relationship

Relationship Element		Definition
Type	String, Mandatory	Enumerated list from union of iCalendar and WS-Calendar Temporal Relationships.
Reference	xcal:uid or xpointer	Identifier of Component in Components collection (if uid) or to external interval (if xpointer).
Gap	xcal:duration *Optional*	Attribute to indicate the separation, if any, between the state of the first Interval and the state of the second. Expressed as a duration. Only used with Temporal Relationships

The relationship below indicates that this Interval is to start ten minutes following the finish of the interval specified.

Example 2: Temporal Relationship

```
<x-wscalendarrelation>
<temporalrelationshiptype>finishtostart</temporalrelationshiptype>
<gap>
    <duration>
        <xcal:duration>T00:10</xcal:duration>
    </duration>
</gap>
<relatedto>
    <uid>00959BC664CA650E933C892C@example.com</uid>
</relatedto>
</x-wscalendarrelation>
```

If there is no temporal separation between Intervals, the gap element is optional. The following examples are equivalent expressions to express a relationship wherein both intervals must start at the same moment.

Example 3: Temporal Relationship with and without Gap

```
<x-wscalendarrelation>
<temporalrelationshiptype>starttostart</temporalrelationshiptype>
<gap>
    <duration>
        <xcal:duration>T00:10</xcal:duration>
    </duration>
</gap>
<relatedto>
    <uid>00959BC664CA650E933C892C@example.com</uid>
</relatedto>
</x-wscalendarrelation>
```

Leaving out the optional Gap element, we have:

```
<x-wscalendarrelation>
<temporalrelationshiptype>starttostart</temporalrelationshiptype>
<relatedto>
    <uid>00959BC664CA650E933C892C@example.com</uid>
</relatedto>
</x-wscalendarrelation>
```

The two expressions of a Temporal Relationship above are equivalent.

Intervals with Temporal Relationships enable the message to express complex temporal relations within a Sequence, as well as express the simple consecutive intervals named a Partition

As the rules for parsing XML do not mandate preservation of order within a sub-set, we cannot assume that order is preserved when parsing a set of Components. For Sequences, mere order is not enough—each Interval must either refer to or be referred by at least one interval. Either way, a Sequence defines a coherent set of intervals that can be assembled out of members of a collection of intervals

3.4 Sequences: Combining Intervals

Section 3.3 introduced Temporal Relationships. A collection of intervals with a coherent set of Temporal Relationships is a Sequence. Temporal Relationships are transitive, so that if Interval A is related to Interval B, and Interval B is related to Interval C, then Interval A is related to Interval C.

Table 3-5: Introducing the Sequence

```
<components>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>First Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:duration>
            <xcal:duration>T1H</xcal:duration>
        </xcal:duration>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Second Interval in Sequence</xcal:text>
        </xcal:description>
```

```
        <xcal:summary>
            <xcal:text>Note the Temporal Relation to the First
                Interval</xcal:text>
        </xcal:summary>
        <xcal:duration>
            <xcal:duration>T15M</xcal:duration>
        </xcal:duration>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>30959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Third Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:duration>
            <xcal:duration>T30M</xcal:duration>
        </xcal:duration>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <relatedto>
                <uid>20959BC664CA650E933C892C@example.com</uid>
            </relatedto>
            <gap>
                <xcal:duration>
                    <xcal:duration>T10M</xcal:duration>
                </xcal:duration>
            </gap>
        </x-wscalendarrelation>
    </properties>
</vtodo>
</components>
```

In this example, the Intervals are one hour, 15 minutes, and 30 minutes long. There is a ten minute period between the seond and third periods.

3.4.1 Scheduling a Sequence

A Sequence becomes a Scheduled Sequence whenever single interval within the sequence is scheduled. An interval is scheduled when it has a specific starting time (dtstart).

Example 4: A Scheduled Sequence

```
<components>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>First Interval in Sequence</xcal:text>
        </xcal:description>
        <dtstart>2010-09-11T13:00</dtstart>
        <xcal:duration>
```

```
            <xcal:duration>T1H</xcal:duration>
        </xcal:duration>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Second Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:duration>
            <xcal:duration>T15M</xcal:duration>
        </xcal:duration>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
</components>
```

Note that the entire Sequence is scheduled when a single Interval within the Sequence is scheduled.

3.5 Alarms

Alarms in WS-Calendar declare when to send notifications between services. Within a single service, alarms declare milestones and target times. The base iCalendar object for all alarms is the VALARM object. This section discusses how the iCalendar VALARM object is used in WS-Calendar.

The use of Alarms in enterprise scheduling is a rapidly changing area as this is written, and alarm mechanisms are out of scope for this document. An Alarm notifies another party that something has happened or is about to happen. Some alarms, such as alarm clocks, are scheduled explicitly. Others arise as a notification from another system. WS-Eventing, oBIX alarms, and CAP and EDXL alerts are just a few of the already defined mechanisms.

In WS-Calendar, an alarm is a VALARM object within an Interval object, Its actions are [XPOINTER] references to the service or event that is triggered. Valarm also supports recurring activities. A long-running Interval service could include a recurring call-out to a 3rd service providing observation of the service's effects. For example, a Demand Response service could be launched accompanied by a recurring 5 minute request to read the meter from another service.

3.6 Time Stamps

Time stamps are used everywhere in inter-domain service performance analysis and have particular use in smart grids to support event forensics. Time stamps are often assembled and collated from events across multiple time zones and from multiple systems.

Different systems may track time and therefore record events with different levels of Tolerance. It is not unusual for a time stamp from a domain with a low Tolerance to appear to have occurred after events from a domain with high-Tolerance time-stamps that it caused. A fully qualified time-stamp includes the granularity measure.

Table 3-6: Aspects of Time Stamps

Time Stamp Element	Definition (Normative)	Note (Non-Normative)

Time Stamp Element	Definition (Normative)	Note (Non-Normative)
timestamp	WS-Calendar:time A fully qualified date and time of event. Mandatory.	May include two objects as defined above.
precision	A Duration defining the accuracy of the TimeStamp value. Mandatory.	Identifies whether one hour interval is indeed one hour or plus or minus some number of milliseconds, seconds and minutes.
timeStampRealm	Of type Uri, shall identify the system where the TimeStamp value originated. The value of this element shall be set by: • The component at the realm border in a particular inter-domain interaction or, • By any component able to accurately set it within a system or sub-system. In the latter case, nothing prevents the component at the realm border to overwrite it without any notice. Optional.	A set of points originating from the same realm are reasonably synchronized. Within a realm, one can assume that time-stamped objects sorted by time are in the order of their occurrence. Between realms, this assumption is rebuttable. A system border is crossed in an interaction when the 2 communication partners are not synchronized based on the same time source. See the example below for more information.
leapSecondsKnown	Xs:bool If True, shall indicate that the TimeStamp value takes into account all leap seconds occurred. Otherwise False. Optional.	Indicates that the time source of the sending device support leap seconds adjustments.
clockFailure	xs:bool If True, shall indicate a failure on the time source preventing the TimeStamp value issuer from setting accurate timestamps. Otherwise False. Mandatory.	Indicates that the time source of the sending device is unreliable. The timestamp should be ignored.
clockNotSynchronized	xs:bool If True, shall indicate the time source of the TimeStamp value issuer is not synchronized correctly, putting in doubt the accuracy of the timestamp. Mandatory.	Indicates that the time source of the sending device is not synchronized with the external UTC time source.

Time Stamp Element	Definition (Normative)	Note (Non-Normative)
timeSourceAccuracy	A Duration defining the accuracy of the time source used in the TimeStampRealm system. Optional.	Represents the time accuracy class of the time source of the sending device relative to the external UTC time source.

3.6.1 Time Stamp Realm Discussion

Within a single system, or synchronized system of systems, one can sort the temporal order of event by sorting them by TimeStamp. Determining the order of events is the first step of event forensics. This assumption does not apply when events are gathered across systems.

Different systems may not have synchronized time, or may synchronize time against different sources. This means different system clocks may drift apart. It may be that a later timestamp from one system occurred before an earlier timestamp in another. As this drift is unknown, it cannot be automatically corrected for without additional information.

The TimeStampRealm element identifies which system created an event time-stamp. The TimeStampRealm identifies a source system in inter-domain interactions (a system of systems). For example: http://SystemA.com and http://SystemB.com identify 2 systems. This example assumes SystemA and SystemB do not have a common time source.

The TimeStampRealm can also be used to identify sub-systems in intra-domain interactions (sub-systems of a system). For For example: http://SystemA.com/SubSystem1 and http://SystemA.com/SubSystem2 identify 2 subsystems of the same higher level system. In case the upper level SystemA does not have a global time source for synchronizing all of its sub-system, it can be useful to identify sub-systems in such a way.

4 Service Characteristics: Attachments & Performance

4.1 Services and Service Characteristics

While iCalendar expresses time and intervals, WS-Calendar associates those intervals with specific services and service characteristics. WS-Calendar uses the ATTACH element that is already part of each iCalendar components to specify services and performance characteristics.

In iCalendar, the ATTACH element carries unstructured information associated with the event or alarm communication. Attachments in iCalendar can also be in the form of URIs pointing outside the iCalendar structure.WS-Calendar uses structured XML to communicate service intents.

4.1.1 Attachments

The XML artifact in the attachment may be in-line, i.e., contained within the ATTACH element of the VTODO or VALARM object, or it may be found in another section of the same XML object, sharing the same message as WS-Calendar element, or it may be discovered by external reference. Attachments, then, are used to request “perform as described here”, or “perform as described below”, or “perform as described elsewhere.”

The ATTACH element in WS-Calendar has three elements as below.

Table 4-1: Elements of a WS-Calendar Attachment

Attachment Element	Use	Discussion
artifact	any in-line XML (xs:any). *Optional.* An attachment must have at least one artifact or reference	Defined per the business process associated with this interaction. WS-Calendar. This is not an object, it is merely a name for use in documentation An attachment must have at least one of
reference	[XPOINTER] *Optional* An attachment must have at least one of artifact or reference	Points to external XML, or XML located elsewhere in document
performance	WsCalendar:Performance *Optional*	Specifies time-related performance characteristics.

When a WS-Calendar reference uses an external reference to specify a service, that reference is an object of the type [XPOINTER] (see section 1.2)..[XPOINTER] is a general purpose URI and XML traversal standard. This [XPOINTER] object is in the named data element “Reference.”

Example 5: Use of an Attachment with inline XML artifact

```
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
        <xcal:text>Sample Contract</xcal:text></xcal:description>
        <attach>
            <artifact>
```

```
                <emix-wip>
                    <price>8.45</price>
                    <quantity>8.45</quantity>
                </emix-wip>
            <artifact/>
        </attach>
    </properties>
</vtodo>
```

Note: as this is written, there is no EMIX specification. The Artifact is of type xs:any, allowing compliant XML from any namespace to be used.

Example 6: Use of an Attachment with external reference

```
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
        <xcal:text>Sample Contract</xcal:text></xcal:description>
        <attach>
            <reference>http://scheduled.ws-calendar-
                service.com/contract1<reference>
        </attach>
    </properties>
</vtodo>
```

4.1.2 Specifying Timely Performance

Service coordination between systems requires precise communication about expectation for the timeliness of performance. These expectations can be set for each interval or for an entire sequence. This communication is through the performance component of the Attachment.

The Performance component refines the meaning of time-related service communication. All elements of the Performance object use the Duration element as defined in [RFC5545].

Table 4-2: Performance Characteristics

Performance Characteristic	Definition	Discussion
startBeforeTolerance	A Duration enumerating how far before the requested start time the requested service may commence.	Indicates if a service that begins at 1:57 is compliant with a request to start at 2:00
startAfterTolerance	A Duration enumerating how far after the requested start time the requested service may commence.	Indicates if a service that begins at 2:01 is compliant with a request to start at 2:00
endBeforeTolerance	A Duration enumerating how far before scheduled end time may end.	Indicates if a service that ends at 1:57 is compliant with a request to end at 2:00
endAfterTolerance	A Duration enumerating how far after the scheduled end time the requested service may commence.	Indicates if a service that ends at 2:01 is compliant with a request to end at 2:00

Performance Characteristic	Definition	Discussion
durationLongTolerance	A Duration indicating by how much the performance duration may exceed the duration specified in the Interval . It may be 0.	Used when run time is more important than start and stop time. DurationLongTolerance SHALL NOT be used when Start and End Tolerances are both specified.
durationShortTolerance	A Duration indicating by how much the performance duration may fall short of duration specified in the Interval . It may be 0.	Used when run time is more important than start and stop time. DurationShortTolerance SHALL NOT be used when Start and End Tolerances are both specified.
granularity	A Duration enumerating the smallest unit of time measured or tracked	Whatever the time tolerance above, there is some minimum time that is considered insignificant. A Granularity of 1 second defines the tracking and reporting requirements for a service.

Performance is part of the core WS-Calendar service definition. Similar products or services, identical except for different Performance characteristics may appear in different markets. Performance characteristics influence the price offered and the service selected.

Note that Performance object does not indicate time, but only duration. A performance object associated with an unscheduled Interval does not change when that Interval is scheduled.

The Performance object is an optional component of each WS-Calendar attachment.

Example 7: Performance Component

```
<attach>
    <uri>http://scheduled.ws-calendar-service.com/contract1</uri>
    <performance>
        <properties>
            <startbeforetolerance>
                <duration>
                    <duration>T10M</duration>
                </duration>
            </startbeforetolerance>
            <startaftertolerance>
                <duration>
                    <duration>T0M</duration>
                </duration>
            </startaftertolerance>
            <durationlongtolerance>
                <duration>
                    <duration>T0M</duration>
                </duration>
            </durationlongtolerance>
            <durationshorttolerance>
                <duration>
                    <duration>T0M</duration>
                </duration>
            </durationshorttolerance>
        </properties>
    </performance>
</attach>
```

In the example, the service can start as much as 10 minutes earlier than the scheduled time, and must start no later than the scheduled time. Whenever the service starts, it the service must execute for exactly the duration indicated.

Generally, the implementer should refrain from expressing unnecessary or redundant performance characteristics.

4.1.3 Combining Service and Performance

Services, references and performance each appear in the ATTACH element of the iCalendar components.

Example 8: Interval with inline XML artifact and optional specified Performance

```
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
        <xcal:text>Sample Contract</xcal:text></xcal:description>
        <attach>
            <artifact>
                <emix-wip>
                    <price>8.45</price>
                    <quanity>8.45</quantiyprice>
                </emix-wip>
            <artifact/>
            <performance>
                <properties>
                    <startbeforetolerance>
                        <duration>
                            <duration>T10M</duration>
                        </duration>
                    </startbeforetolerance>
                    <startaftertolerance>
                        <duration>
                            <duration>T0M</duration>
                        </duration>
                    </startaftertolerance>
                </properties>
            </performance>
        </attach>
    </properties>
</vtodo>
```

Example 9: Interval with external reference and optional specified performance

```
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
        <xcal:text>Sample Contract</xcal:text></xcal:description>
        <attach>
            <reference>http://scheduled.ws-calendar-
                service.com/contract1<reference>
            <performance>
                <properties>
                    <startbeforetolerance>
                        <duration>
                            <duration>T10M</duration>
                        </duration>
                    </startbeforetolerance>
                    <startaftertolerance>
```

```
                        <duration>
                            <duration>T0M</duration>
                        </duration>
                    </startaftertolerance>
                </properties>
            </performance>
        </attach>
    </properties>
</vtodo>
```

690 # 5 Inheritance and Entry Points: Calendar Gluons

691 ## 5.1.1 Calendar Gluons

692 WS-Calendar introduces a new iCalendar component, the Calendar Gluon. In physics, Gluons act to
693 mediate as well as to participate in the interactions between quarks. A Calendar Gluon defines
694 information to be inherited by each Interval in the Sequence, as well as scheduling the entire sequence. A
695 Calendar Gluon is essentially the Interval component profiled down to minimal elements for which
696 inheritance rules are then defined for the sequence. (See Appendix *Overview of WS-Calendar, its*
697 *Antecedents and its Use*) Calendar Gluons use iCalendar relations to apply service information to
698 Sequences.

699 *Table 5-1: Calendar Gluon elements in WS-Calendar*

Calendar Gluon Element	Use	Discussion
x-wscalendarType	Mandatory xs:string, value always “CalendarGluon”	Added vtodo attribute, ignored by iCalendar processors
dtStamp	[XCAL]:dtstamp *Mandatory*	Time and date that Calendar Gluon object was created
uid	*Mandatory*	Used to enable unambiguous referencing of each VTODO object
summary	Text’ *Optional*	Text describing the Calendar Gluon
related	WsCalendar:Relationship *Mandatory*	A Calendar Gluon must have a relationship with at least one other component. The only relationship defined for the Calendar Gluon is the IsParent.
dtStart	[XCAL]:Time. Start time for the related interval of the sequence. *Optional*	An Calendar Gluon may either have a dtStart or a dtEnd, but may not have both.
dtEnd	[XCAL]:Time. Scheduled completion time for the related interval of the sequence. *Optional*	An Calendar Gluon may either have a dtStart or a dtEnd, but may not have both.
duration	[XCAL]:Duration *Optional*	If specified, a duration is inherited by all intervals in the referred-to sequence,
attach	WSCalendar:Attachment Mandatory Multipleoccurs	Contains WS-Calendar:attachment attribute defining service and performance. Can be inherited by all intervals in sequence.

Because the properties of Calendar Gluon properties are inherited by the child Sequence, they can serve as the elements in any Interval in the Sequence. An inherited element can even serve as a substitute for an Interval mandatory element. For example, Duration is mandatory for all Intervals. A Duration expressed in a Calendar Gluon is inherited by each Interval in the associated Sequence. This makes Intervals without internal Duration compliant, because the Interval inherits the Duration from the Calendar Gluon. If an Interval in the associated Sequence does include a Duration, that value overrides the value from the Calendar Gluon.

5.1.2 Calendar Gluons and Sequences

The Calendar Gluon is used to define common service requirements for an entire sequence. If a RelatedComponent has a parent relationship with the an Interval in a sequence, then the RelatedComponent's Attachment defines service attributes by all Intervals in the Sequence.

In this example, the Sequence in the previous example is expressed using an Calendar Gluon.

Example 10: Sequence with Performance defined in the Calendar Gluon

```
<components>
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text> Calendar Gluon with sequence </xcal:text>
        </xcal:description>
        <xcal:comment>
            <xcal:text> creates common performance expectations (+/- 1 second)
                for the entire sequence. Also sets common duration (15
                minutes) for all members of the sequence, No interval may end
                after its scheduled end-time </xcal:text>
        </xcal:comment>
        <xcal:duration>
            <xcal:duration>T15M</xcal:duration>
        </xcal:duration>
        <attach>
            <performance>
                <properties>
                    <endbeforetolerance>
                        <duration>
                            <duration>T1S</duration>
                        </duration>
                    </endbeforetolerance>
                    <endaftertolerance>
                        <duration>
                            <duration>T1S</duration>
                        </duration>
                    </endtaftertolerance>
                </properties>
            </performance>
        </attach>
        <xcal:related-to>
            <xcal:parameters>
                    <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:text>10959BC664CA650E933C892C@example.com </xcal:text>
        </xcal:related-to>
    </properties>
</x-calendargluon>
<vtodo>
    <properties>
```

```
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>First Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:summary>
            <xcal:text>Inherits all performance from Gluon as well
                As the duration</xcal:text>
        </xcal:summary>
        <attach>
            <artifact>
                <emix-wip>
                    <price>8.45</price>
                    <quantity>4200</quantity>
                </emix-wip>
            <artifact/>
        </attach>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Second Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:summary>
            <xcal:text>Inherits all performance from Gluon, follows
                Finish of Interval 1, inherits duration</xcal:text>
        </xcal:summary>
        <attach>
            <artifact>
                <emix-wip>
                    <price>8.49</price>
                    <quantity>4500</quantity>
                </emix-wip>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
            <gap>
                <xcal:duration>
                    <xcal:duration>T0M</xcal:duration>
                </xcal:duration>
            </gap>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>30959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Third Interval in Sequence</xcal:text>
        </xcal:description>
```

```
        <xcal:summary>
            <xcal:text>Inherits all performance from Gluon, follows
                Finish of Interval 2, overrides duration</xcal:text>
        </xcal:summary>
        <attach>
            <artifact>
                <emix-wip>
                    <price>7.45</price>
                    <quantity>6000</quantity>
                </emix-wip>
            <artifact/>
        </attach>
        <xcal:duration>
            <xcal:duration>T30M</xcal:duration>
        </xcal:duration>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <relatedto>
                <uid>20959BC664CA650E933C892C@example.com</uid>
            </relatedto>
            <gap>
                <xcal:duration>
                    <xcal:duration>T5M</xcal:duration>
                </xcal:duration>
            </gap>
        </x-wscalendarrelation>
    </properties>
</vtodo>
</components>
```

Note that the performance expectations, identical for each interval, have moved into the Calendar Gluon. Not also that while the duration for all intervals in the partition is set in the Calendar Gluon, interval 3 overrides that with a half hour duration assigned locally. The Calendar Gluon happens to related to the first Interval in the sequence; there are specific use cases (discussed below) which require it to be linked to other Intervals.

5.1.3 Inheritance rules for Calendar Gluons

In general, the rules that anything specified in the Parent Calendar Gluon applies to each Child. The Parent of an Interval in a Sequence is parent to all Intervals in the Sequence. As a Sequence creates single temporal relationship, assigning a start time (dtstart) to any Interval allows the starting time to be computed for any of them.

Table 5-2 Gluon Inheritance rules

Attribute	Inheritance Rules
General	A Interval or Calendar Gluon inherits its attributes through it's the closest parent. Local specification of an attributes overrides any inheritance.
Duration	Follows general rules
Temporal Relation	Relationship Type and Gap only are inherited. Either may be overridden locally. To specify no gap when a parent specifies a gap, an explicit zero duration gap must be specified. Related-to is not inherited.
Performance	Performance is either inherited intact or overridden completely. There are no rules for recombining partial Performance objects through inheritance..

Attribute	Inheritance Rules
Artifacts	Artifacts are combined within their respective namespaces, and are evaluated for completeness after Artifact inheritance. Referring specifications should detail any conformance requirements.
Schedules	In general, schedule dates are inherited as if they consisted of a separate Date and a Time. The Date and the Time are evaluated separately. Thus a child may specify a Date on which it is willing to have a Time scheduled, or a Time at which it is willing to perform a service on any requested Date. If a parent specifies both, and a child specifies one, the paired elements (parent-time:child-time or parent-date:child-date) must match.

5.1.4 Optimizing the expression of a Partition

Partitions are Sequences with consecutive Intervals. Communication of a Partition can be further optimized by bringing the relationship into the Calendar Gluon. Notice that while the type of the relationship is defined in the Calendar Gluon, the Temporal Relation for each Interval must still be expressed within the Interval.

Example 11: Partition with Duration and Performance defined in the Calendar Gluon

```
<components>
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Calendar Gluon for energy markets with consecutive
                Identical intervals</xcal:text>
        </xcal:description>
        <xcal:comment>
            <xcal:text> creates common performance expectations that the
                granularity for measuring all Intervals is (+/- 1 second)
                Also sets common duration (15 minutes)for all members of
                the sequence). Each interval in the partitions begins
                immediately after its predecessor finishes. </xcal:text>
        </xcal:comment>
        <xcal:duration>
            <xcal:duration>T15M</xcal:duration>
        </xcal:duration>
        <attach>
            <artifact>
                <emix-wip>PRODUCT SPECIFICATION UNDEFINED</emix-wip>
            <artifact/>
            <performance>
                <properties>
                    <granularity>
                        <duration>
                            <duration>T1S</duration>
                        </duration>
                    </granularity>
                </properties>
            </performance>
        </attach>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <gap>
```

```
                <xcal:duration>
                    <xcal:duration>T0S</xcal:duration>
                </xcal:duration>
            </gap>
        </x-wscalendarrelation>
        <xcal:related-to>
            <xcal:parameters>
                    <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:text>10959BC664CA650E933C892C@example.com </xcal:text>
        </xcal:related-to>
    </properties>
</x-calendargluon>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>First Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:summary>
            <xcal:text>Inherits all performance from Gluon as well
                As the duration and the Temporal Relation</xcal:text>
        </xcal:summary>
        <attach>
            <artifact>
                <emix-wip>
                    <price>8.45</price>
                    <quantity>4200</quantity>
                </emix-wip>
            <artifact/>
        </attach>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Second Interval in Sequence</xcal:text>
        </xcal:description>
        <attach>
            <artifact>
                <emix-wip>
                    <price>8.49</price>
                    <quantity>4500</quantity>
                </emix-wip>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
```

```
            <xcal:text>30959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Third Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:summary>
            <xcal:text>Inherits all performance from Gluon, follows
                Finish of Interval 2, overrides duration</xcal:text>
        </xcal:summary>
        <attach>
            <artifact>
                <emix-wip>
                    <price>7.45</price>
                    <quantity>6000</quantity>
                </emix-wip>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>20959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<components>
```

This Partition shows a school schedule in which classes start one hour apart. Each service is performed for 50 minutes, and there is a 10 minute gap between each as students move between classes. Classes may not begin before the schedule, but they may start up to five minutes late.

Stripped of all annotations, this can be expressed as follows:

Example 12: Partition without annotations

```
<components>
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:duration>
            <xcal:duration>T50M</xcal:duration>
        </xcal:duration>
        <attach>
            <artifact>
                <classroom>demonstration specification</classroom>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <gap>
                <xcal:duration>
                    <xcal:duration>T10M</xcal:duration>
                </xcal:duration>
            </gap>
        </x-wscalendarrelation>
        <xcal:related-to>
            <xcal:parameters>
                    <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:text>10959BC664CA650E933C892C@example.com </xcal:text>
        </xcal:related-to>
    </properties>
</x-calendargluon>
```

```
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <attach>
            <artifact>
                <classroom><students>48</students></classroom>
            <artifact/>
        </attach>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <attach>
            <artifact>
                <classroom><students>65</students></classroom>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>30959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <attach>
            <artifact>
                <classroom><students>34</students></classroom>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>20959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<components>
```

A sequence can also be scheduled in the Calendar Gluon.

Example 13: A Scheduled Sequence showing Temporal Relationship Inheritance

```
<components>
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
        <xcal:uid>
            <xcal:text>00959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
            <dtstart>2010-09-11 T00:15</dtstart>
        <attach>
```

```
            <artifact>
                <classroom>demonstration specification</classroom>
            <artifact/>
        </attach>
        <xcal:related-to>
            <xcal:parameters>
                    <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:text>10959BC664CA650E933C892C@example.com </xcal:text>
        </xcal:related-to>
    </properties>
</x-calendargluon>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>First Interval in Sequence</xcal:text>
        </xcal:description>
        <dtstart>2010-09-11T13:00</dtstart>
        <xcal:duration>
            <xcal:duration>T1H</xcal:duration>
        </xcal:duration>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Second Interval in Sequence</xcal:text>
        </xcal:description>
        <xcal:duration>
            <xcal:duration>T15M</xcal:duration>
        </xcal:duration>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
</components>
```

5.1.5 Mixed Inheritance of Start Time

A Sequence has not been scheduled until it has both a start time and a start date. Start time and date SHALL be expressed together when all components are in a single communication. Time and Date MAY be separated when the full sequence and schedule are created by reference.

To illustrate this, here is the classroom scheduling Partition from Example 12, updated to include each day's school opening.

Example 14: Partition with Duration and Performance defined in the Calendar Gluon

```
<components>
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
```

```
        <xcal:uid>
            <xcal:text>
                90959BC664CA650E933C892C@invokingexample.com
            </xcal:text>
        </xcal:uid>
        <dtstart>2010-09-13T09:00</dtstart>
        <xcal:related-to>
            <xcal:parameters>
                <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:uri>http://scheduled.ws-calendar-service.com/classSchedule
                </xcal:uri>
        </xcal:related-to>
    </properties>
</x-calendargluon>
</components>
```

Here, an external Calendar Gluon (above) makes reference to a published classroom schedule service:

```
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
        <xcal:uid>
            <xcal:text>http://scheduled.ws-calendar-service.com/classSchedule
                </xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>MWF Classroom Schedule
                Identical intervals</xcal:text>
        </xcal:description>
        <xcal:comment>
            <xcal:text>Publishes a common classroom schedule for Monday,
                Wednesday, Friday for a semester at a school. Note that each
                day starts at 9:00</xcal:text>
        </xcal:comment>
        <dtstart>T09:00</dtstart>
        <xcal:duration>
            <xcal:duration>T50M</xcal:duration>
        </xcal:duration>
        <attach>
            <xcal:uri></xcal:uri>
        </attach>
        <x-wscalendarrelation>
            <temporalrelationshiptype>finishtostart</temporalrelationshiptype>
            <gap>
                <xcal:duration>
                    <xcal:duration>T10M</xcal:duration>
                </xcal:duration>
            </gap>
        </x-wscalendarrelation>
        <xcal:related-to>
            <xcal:parameters>
                <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:text>10959BC664CA650E933C892C@example.com </xcal:text>
        </xcal:related-to>
    </properties>
</x-calendargluon>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
```

```
        <attach>
            <artifact>
                <classroom><students>48</students></classroom>
            <artifact/>
        </attach>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <attach>
            <artifact>
                <classroom><students>65</students></classroom>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>30959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <attach>
            <artifact>
                <classroom><students>34</students></classroom>
            <artifact/>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>20959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<components>
```

In the example above, a general purpose classroom calendar has been created and advertised with an URL. The class day always starts at 9:00. The referring Calendar Gluon scheduled a particular instance of this Sequence for Monday, September 13.

This double inheritance, in which a Sequence inherits from a Calendar Gluon which inherits from a Calendar Gluon is a useful pattern for scheduling an advertised service.

5.1.6 Other Scheduling Scenarios

Sometimes, the invoker of a service is interested only in single Interval of the Sequence, but the entire Sequence is required. In the example below, the second Interval is advertised, i.e., the Calendar Gluon points to the second Interval. The first interval might be a required ramp-period, during which the underlying process is “warming up”, and which may bring some lesser service to market during that ramp time. The ramp-down time at the end is similarly fixed. The entire Service offering is represented by the exposed (it has a public URI) Calendar Gluon.

Example 15: Standard Sequence with Ramp-Up and Ramp Down

```
<components>
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
        <xcal:uid>
            <xcal:text>http://scheduled.ws-calendar-service.com/runcontract
            </xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Advertisement of schedule with ramp up and ramp down
                services.</xcal:text>
        </xcal:description>
        <xcal:comment>
            <xcal:text>Invokes second of three Intervals in the Sequence
            </xcal:text>
        </xcal:comment>
        <attach>
            <xcal:uri><emix-wip[4]></emix-wip></xcal:uri>
        </attach>
        <xcal:related-to>
            <xcal:parameters>
                <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:text>20959BC664CA650E933C892C@example.com </xcal:text>
        </xcal:related-to>
    </properties>
        <xcal:duration>
            <xcal:duration>T6H</xcal:duration>
        </xcal:duration>
</x-calendargluon>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>10959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Ramp-Up Interval</xcal:text>
        </xcal:description>
        <xcal:summary>
            <xcal:text>Required as part of operations. Slowly increasing, yet
                fixed over-all, energy produced.
            </xcal:text>
        </xcal:summary>
        <xcal:duration>
            <xcal:duration>T45M</xcal:duration>
        </xcal:duration>
        <attach>
            <artifact>
                <emix-wip>describes ramp-up</emix-wip>
            </artifact>
        </attach>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
```

[4] There is no EMIX-WIP specification. EMIX-WIP represents a generic energy market artifact, perhaps indicative of future specifications.

```
            <xcal:text>20959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Run Interval</xcal:text>
        </xcal:description>
        <xcal:summary>
            <xcal:text>Inherits all performance from Gluon, follows
                Finish of Interval 2, overrides duration</xcal:text>
        </xcal:summary>
        <attach>
            <artifact>
                <emix-wip >Product Definition</emix-wip>
            </artifact>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>10959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
<vtodo>
    <properties>
        <x-wscalendartype>Interval</x-wscalendartype>
        <xcal:uid>
            <xcal:text>30959BC664CA650E933C892C@example.com</xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Ramp-down Interval</xcal:text>
        </xcal:description>
        <xcal:summary>
            <xcal:text>Required as part of operations. Fixed time and fixed,
                while diminishing, energy produced.
            </xcal:text>
        </xcal:summary>
        <xcal:duration>
            <xcal:duration>T30M</xcal:duration>
        </xcal:duration>
        <attach>
            <artifact>
                <emix-wip>describes ramp-up</emix-wip>
            </artifact>
        </attach>
        <x-wscalendarrelation>
            <relatedto>
                <uid>20959BC664CA650E933C892C@example.com</uid>
            </relatedto>
        </x-wscalendarrelation>
    </properties>
</vtodo>
```

When the service is scheduled, the time and duration are specified. The duration only applies to the Second Interval as all others have their duration explicitly specified.

```
<components>
<x-calendargluon>
    <properties>
        <x-wscalendartype>CalendarGluon</x-wscalendartype>
        <xcal:uid>
            <xcal:text>http://scheduled.ws-calendar-service.com/scheduleB
                </xcal:text>
        </xcal:uid>
        <xcal:description>
            <xcal:text>Advertisement of schedule with ramp up and ramp down
```

```
                services.</xcal:text>
        </xcal:description>
        <xcal:comment>
            <xcal:text>Invokes second of three Intervals in the Sequence
            </xcal:text>
        </xcal:comment>
        <attach>
            <artifact>
                <emix-wip[5]>
                    <execute-price>15000</execute-price>
                </emix-wip>
            </artifact>
        </attach>
        <xcal:related-to>
            <xcal:parameters>
                    <xcal:reltype>PARENT</xcal:reltype>
            </xcal:parameters>
            <xcal:text>http://scheduled.ws-calendar-service.com/runcontract
            </xcal:text>
        </xcal:related-to>
        <xcal:duration>
            <xcal:duration>T6H</xcal:duration>
        </xcal:duration>
    </properties>
</x-calendargluon>
</components>
```

In this case, the specific interval is scheduled and a run time of 6 hours is specified for a price of $15,000.

[5] There is no EMIX-WIP specification. EMIX-WIP represents a generic energy market artifact, perhaps evocative of future specifications.

6 WS-Calendar Models

6.1 Abstract model for WS-Calendar Objects

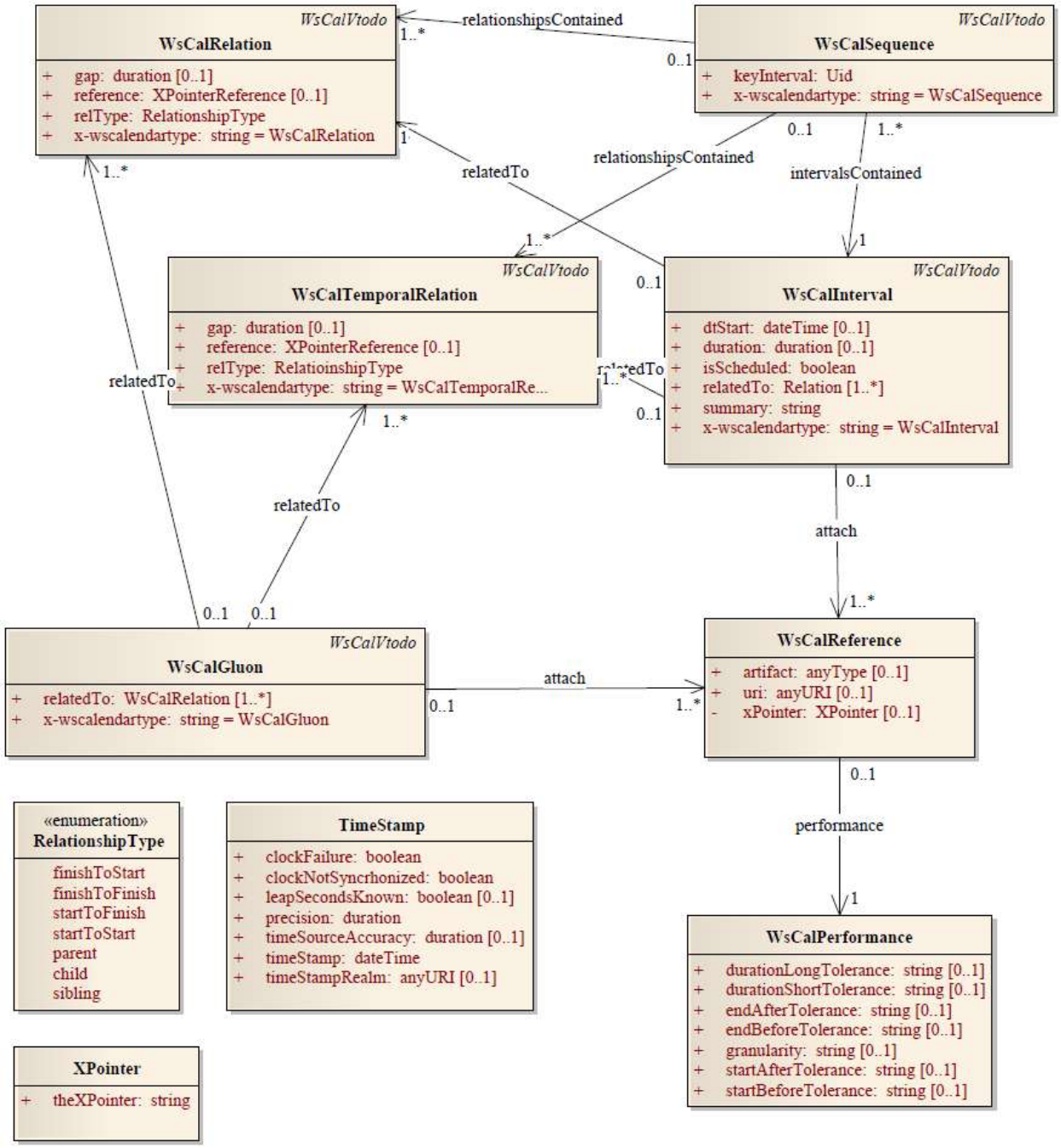

Figure 1: Abstract UML Model

6.2 Implementation Model for WS-Calendar

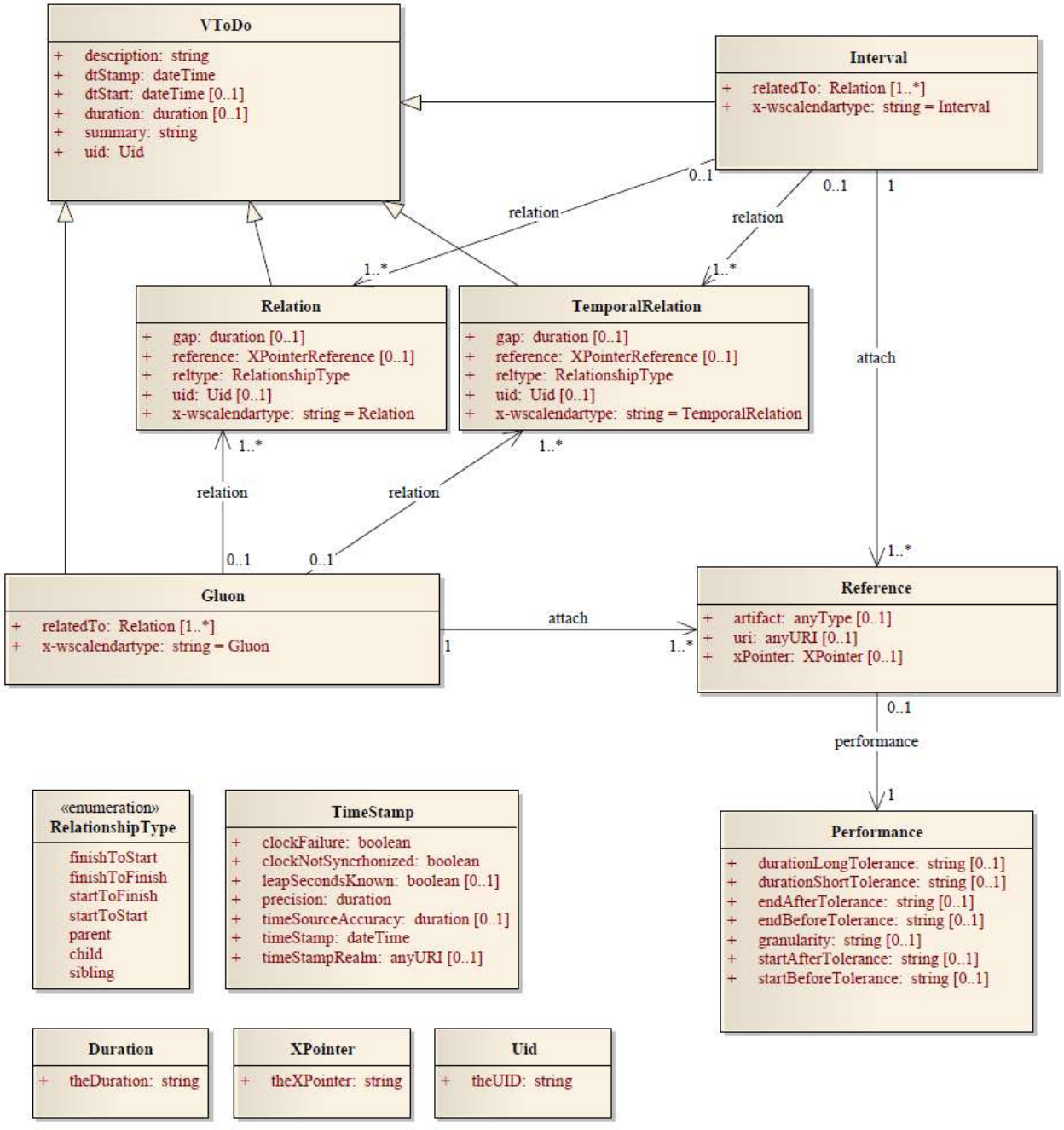

Figure 2: Implementation Model for WS-Calendar

7 Calendar Services

The Service interactions are built upon and make the same assumptions about structure as the CalDAV protocol defined in **[RFC4791]** and related specifications. It does NOT require nor assume the WebDAV nor CalDAV protocol but does make use of some of the same elements and structures in the CalDAV XML namespace.

Calendar resources, for example events and tasks are stored as named resources (files) inside special collections (folders) known as "**Calendar Collections**".

These services can be looked upon as a layer built on top of CalDAV and defines the basic operations which allow creation, retrieval, update and deletion. In addition, query, and free-busy operations are defined to allow efficient, partial retrieval of calendar data.

These services assume a degree of conformity with CalDAV is established such that services built in that manner do not have a significant mismatch. It is assumed that some WS-Calendar services will be built without any CalDAV support.

7.1 Overview of the protocol

The protocol is an HTTP based RESTfull protocol using a limited set of methods. Each request may be followed by a response containing status information.

The following methods are specified in the protocol description, PUT, POST, GET, DELETE. To avoid various issues with certain methods being blocked clients may use the X-HTTP-Method-Override: header to specify the intended operation. Servers SHOULD behave as if the named method was used.

```
POST /user/fred/calendar/ HTTP/1.1
...
X-HTTP-Method-Override: PUT
Properties
```

A service or resource will have a number of properties which describe the current state of that service or resource. These properties are accessed through a GET on the target resource or service with an ACCEPT header specifying application/xrd+xml. See Section 7.1.3.6

The following operations are defined by this specification:

- Retrieval and update of service and resource properties
- Creation of a calendar object
- Retrieval of a calendar object
- Update of a calendar object
- Deletion of a calendar object
- Query
- Free-busy query

7.1.1 Calendar Object Resources

The same restrictions apply to Calendar Object Resources as specified in CalDAV **[RFC4791]** section 4.2. An additional constraint for CalWS is that no timezone specifications are transferred.

7.1.2 Timezone information

It is assumed that the client and server each have access to a full set of up to date timezone information. Timezones will be referenced by a timezone identifier from the full set of Olson data together with a set of well-known aliases defined **[TZDB]**. CalWS services may advertise themselves as timezone servers through the server properties object.

7.1.3 Issues not addressed by this specification.

A number of issues are not addressed by this version of the specification, either because they should be addressed elsewhere or will be addressed at some later date.

7.1.3.1 Access Control

It is assumed that the targeted server will set an appropriate level of access based on authentication. This specification will not attempt to address the issues of sharing or Access Control Lists (ACLs).

7.1.3.2 Provisioning

The protocol will not provide any explicit provisioning operations. If it is possible to authenticate or address a principals calendar resources then they MUST be automatically created if necessary or appropriate

7.1.3.3 Copy/Move

These operations are not yet defined for this version of the CalWS protocol. Both operations raise a number of issues. In particular implementing a move operation through a series of retrievals, insertions and deletions may cause undesirable side-effects. Both these operations will be defined in a later version of this specification.

7.1.3.4 Creating Collections

We will not address the issue of creating collections within the address space. The initial set is created by provisioning.

7.1.3.5 Retrieving collections

This operation is currently undefined. A GET on a collection may fail or return a complete calendar object representing the collection.

7.1.3.6 Setting service and resource properties.

These operations are not defined in this version of the specification. In the future it will be possible to define or set the properties for the service or resources within the service.

7.1.4 CalWS Glossary

7.1.4.1 Hrefs

An href is a URI reference to a resource, for example

```
"http://example.org/user/fred/calendar/event1.ics".
```

The URL above reflects a possible structure for a calendar server. All URLs should be absolute or path-absolute following the rules defined in **RFC4918** Section 8.3.

7.1.4.2 Calendar Object Resource

A calendar object resource is an event, meeting or a task. Attachments are resources but NOT calendar object resources. An event or task with overrides is a single calendar resource entity.

7.1.4.3 Calendar Collection

A folder only allowed to contain calendar object resources.

7.1.4.4 Scheduling Calendar Collection

A folder only allowed to contain calendar resources which is also used for scheduling operations. Scheduling events placed in such a collection will trigger implicit scheduling activity on the server.

7.1.4.5 Principal Home

The collection under which all the resources for a given principal are stored. For example, for principal "fred" the principal home might be "/user/fred/"

7.2 Error conditions

Each operation on the calendar system has a number of pre-conditions and post-conditions that apply.

A "precondition" for a method describes the state of the server that must be true for that method to be performed. A "post-condition" of a method describes the state of the server that must be true after that method has been completed. Any violation of these conditions will result in an error response in the form of a CalWS XML error element containing the violated condition and an optional description. \

Each method specification defines the preconditions that must be satisfied before the method can succeed. A number of post-conditions are generally specified which define the state that must exist after the execution of the operation. Preconditions and post-conditions are defined as error elements in the CalWS XML namespace.

7.2.1 Example: error with CalDAV error condition

```
<?xml version="1.0" encoding="utf-8"
      xmlns:CW="Error! Reference source not found.""
      xmlns:C="urn:ietf:params:xml:ns:caldav" ?>
<CW:error>
  <C:supported-filter>
    <C:prop-filter name="X-ABC-GUID"/>
  </C:supported-filter>
  <CW:description>Unknown property </CW:description>
</CW:error>
```

8 Properties and link relations

8.1 Property and relation-type URIs

In the XRD entity returned properties and related services and entities are defined by absolute URIs which correspond to the extended relation type defined in **[web linking]** Section 4.2. These URIs do NOT correspond to any real entity on the server and clients should not attempt to retrieve any data at that target.

Certain of these property URIs correspond to CalDAV preconditions. Each URL is prefixed by the CalWS relations and properties namespace http://docs.oasis-open.org/ns/wscal/calws. Those properties which correspond to CalDAV properties have the additional path element "caldav/", for example

```
http://docs.oasis-open.org/ns/wscal/calws/caldav/supported-calendar-data
```

corresponds to

```
CalDAV:supported-calendar-data
```

In addition to those CalDAV properties, the CalWS specification defines a number of other properties and link relations with the URI prefix of http://docs.oasis-open.org/ns/wscal/calws**.**

8.2 supported-features property.

http://docs.oasis-open.org/ns/wscal/calws/supported-features

This property defines the features supported by the target. All resources contained and managed by the service should return this property. The value is a comma separated list containing one or more of the following

- calendar-access - the service supports all MUST requirements in this specification

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/supported-features"
          >calendar-access</Property>
```

8.3 max-attendees-per-instance

http://docs.oasis-open.org/ns/wscal/calws/max-attendees-per-instance

Defines the maximum number of attendees allowed per event or task.

8.4 max-date-time

http://docs.oasis-open.org/ns/wscal/calws/max-date-time

Defines the maximum date/time allowed on an event or task

8.5 max-instances

http://docs.oasis-open.org/ns/wscal/calws/max-instances

Defines the maximum number of instances allowed per event or task

8.6 max-resource-size

http://docs.oasis-open.org/ns/wscal/calws/max-resource-size

Provides a numeric value indicating the maximum size of a resource in octets that the server is willing to accept when a calendar object resource is stored in a calendar collection.

8.7 min-date-time

http://docs.oasis-open.org/ns/wscal/calws/min-date-time

Provides a DATE-TIME value indicating the earliest date and time (in UTC) that the server is willing to accept for any DATE or DATE-TIME value in a calendar object resource stored in a calendar collection.

8.8 description

http://docs.oasis-open.org/ns/wscal/calws/description

Provides some descriptive text for the targeted collection.

8.9 timezone-service relation.

http://docs.oasis-open.org/ns/wscal/calws/timezone-service

The location of a timezone service used to retrieve timezone information and specifications. This may be an absolute URL referencing some other service or a relative URL if the current server also provides a timezone service.

```
<Link rel="http://docs.oasis-open.org/ns/wscal/calws/calws/timezone-service"
          href="http://example.com/tz" />
```

8.10 principal-home relation.

http://docs.oasis-open.org/ns/wscal/calws/principal-home

Provides the URL to the user home for the currently authenticated principal.

```
<Link rel="http://docs.oasis-open.org/ns/wscal/calws/principal-home"
          href="http://example.com/user/fred" />
```

8.11 current-principal-freebusy relation.

http://docs.oasis-open.org/ns/wscal/calws/current-principal-freebusy

Provides the URL to use as a target for freebusy requests for the current authenticated principal.

```
<Link rel="http://docs.oasis-open.org/ns/wscal/calws/current-principal-freebusy"
          href="http://example.com/freebusy/user/fred" />
```

8.12 principal-freebusy relation.

http://docs.oasis-open.org/ns/wscal/calws/principal-freebusy

Provides the URL to use as a target for freebusy requests for a different principal.

```
<Link rel="http://docs.oasis-open.org/ns/wscal/calws/principal-freebusy"
          href="http://example.com/freebusy" />
```

8.13 child-collection relation.

http://docs.oasis-open.org/ns/wscal/calws/child-collection

Provides information about a child collections for the target. The href attribute gives the URI of the collection. The element should only have CalWS child elements giving the type of the collection, that is the CalWS:collection link property and the CalWS-calendar-collection link property. This allows clients to determine the structure of a hierarchical system by targeting each of the child collections in turn.

The xrd:title child element of the link element provides a description for the child-collection.

```
<Link rel="http://http://docs.oasis-open.org/ns/wscal/calws/child-collection"
      href="http://example.com/calws/user/fred/calendar">
  <Title xml:lang="en">Calendar</Title>
  <Property type="http://docs.oasis-open.org/ns/wscal/calws/collection"
            xsi:nil="true" />
```

```
  <Property type="http://docs.oasis-open.org/ns/wscal/calws/calendar-
collection"
            xsi:nil="true" />
</Link>
```

8.14 created link property

http://docs.oasis-open.org/ns/wscal/calws/created

Appears within a link relation describing collections or entities. The value is a date-time as defined in RFC3339 Section 5.6

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/created"
          >1985-04-12T23:20:50.52Z</Property>
```

8.15 last-modified property

http://docs.oasis-open.org/ns/wscal/calws/last-modified

Appears within an xrd object describing collections or entities. The value is the same format as would appear in the Last-Modified header and is defined in **[RFC2616],** Section 3.3.1

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/last-modified"
          >Mon, 12 Jan 1998 09:25:56 GMT</Property>
```

8.16 displayname property

http://docs.oasis-open.org/ns/wscal/calws/displayname

Appears within an xrd object describing collections or entities. The value is a localized name for the entity or collection.

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/displayname"
          >My Calendar</Property>
```

8.17 timezone property

http://docs.oasis-open.org/ns/wscal/calws/timezone

Appears within an xrd object describing collections. The value is a text timezone identifier.

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/timezone"
          >America/New_York</Property>
```

8.18 owner property

http://docs.oasis-open.org/ns/wscal/calws/owner

Appears within an xrd object describing collections or entities. The value is a server specific uri.

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/owner"
         >/principals/users/mike</Property>
```

8.19 collection link property

http://docs.oasis-open.org/ns/wscal/calws/collection

Appears within a link relation describing collections or entities. The property takes no value and indicates that this child element is a collection.

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/collection"
          xsi:nil="true" />
```

8.20 calendar-collection link property

http://docs.oasis-open.org/ns/wscal/calws/calendar-collection

Appears within a link relation describing collections or entities. The property takes no value and indicates that this child element is a calendar collection.

```
<Property type="http://docs.oasis-open.org/ns/wscal/calws/calendar-collection"
          xsi:nil="true" />
```

8.21 CalWS:privilege-set XML element

http://docs.oasis-open.org/ns/wscal/calws:privilege-set

Appears within a link relation describing collections or entities and specifies the set of privileges allowed to the current authenticated principal for that collection or entity.

```
<!ELEMENT calws:privilege-set (calws:privilege*)>
<!ELEMENT calws:privilege ANY>
```

Each privilege element defines a privilege or access right. The following set is currently defined

- CalWS: Read - current principal has read access
- CalWS: Write - current principal has write access

```
<calWS:privilege-set>
  <calWS:privilege><calWS:read></calWS:privilege>
  <calWS:privilege><calWS:write></calWS:privilege>
</calWS:privilege-set>
```

9 Retrieving Collection and Service Properties

Properties, related services and locations are obtained from the service or from service resources in the form of an XRD document as defined by [XRD-1.0].

Given the URL of a CalWS service a client retrieves the service XRD document through a GET on the service URL with an ACCEPT header specifying application/xrd+xml.

Retrieving resource properties is identical to obtaining service properties, that is, execute a GET on the target URL with an ACCEPT header specifying application/xrd+xml.

The service properties define the global limits and defaults. Any properties defined on collections within the service hierarchy override those service defaults. The service may choose to prevent such overriding of defaults and limits when appropriate.

9.1 Request parameters

- None

9.2 Responses:

- 200: OK
- 403: Forbidden
- 404: Not found

9.3 Example - retrieving server properties:

```
>>Request

GET / HTTP/1.1
Host: example.com
ACCEPT:application/xrd+xml

>>Response
<XRD xmlns="http://docs.oasis-open.org/ns/xri/xrd-1.0"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <Expires>1970-01-01T00:00:00Z</Expires>
    <Subject>http://example.com/calws</Subject>
    <Property type="http://docs.oasis-open.org/ns/wscal/calws/created"
         >1970-01-01</Property>

    <Link rel="http://docs.oasis-open.org/ns/wscal/calws/timezone-service"
        href="http://example.com/tz" />

    <calWS:privilege-set>
    <calWS:privilege><calWS:read></calWS:privilege>
    </calWS:privilege-set>

    <Link rel="http://docs.oasis-open.org/ns/wscal/calws/principal-home"
        type="collection"
        href="http://example.com/calws/user/fred">
    <Title xml:lang="en">Fred's calendar home</Title>
    </Link>

    <Link rel="http://docs.oasis-open.org/ns/wscal/calws/child-collection"
        type="calendar,scheduling"
        href="http://example.com/calws/user/fred/calendar">
    <Title xml:lang="en">Calendar</Title>
```

```
    </Link>

    <Property type="http://docs.oasis-open.org/ns/wscal/calws/max-instances"
        >1000</Property>

    <Property type="http://docs.oasis-open.org/ns/wscal/calws/max-attendees-
per-instance"
        >100</Property>

</XRD>
```

10 Creating Calendar Object Resources

Creating calendar object resources is carried out by a POST on the parent collection. The body of the request will contain the resource being created. The request parameter "action=create" indicates this POST is a create. The location header of the response gives the URL of the newly created object.

10.1 Request parameters

- action=create

10.2 Responses:

- 201: created
- 403: Forbidden - no access

10.3 Preconditions for Calendar Object Creation

- **CalWS:target-exists**: The target of a PUT must exist. Use POST to create entities and PUT to update them.
- **CalWS:not-calendar-data:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST be a supported media type (i.e., iCalendar) for calendar object resources;
- **CalWS:invalid-calendar-data:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST be valid data for the media type being specified (i.e., MUST contain valid iCalendar data);
- **CalWS:invalid-calendar-object-resource:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST obey all restrictions specified in Calendar Object Resources (e.g., calendar object resources MUST NOT contain more than one type of calendar component, calendar object resources MUST NOT specify the iCalendar METHOD property, etc.);
- **CalWS:unsupported-calendar-component:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST contain a type of calendar component that is supported in the targeted calendar collection;
- **CalWS:uid-conflict:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST NOT specify an iCalendar UID property value already in use in the targeted calendar collection or overwrite an existing calendar object resource with one that has a different UID property value. Servers SHOULD report the URL of the resource that is already making use of the same UID property value in the CalWS:href element
  <!ELEMENT uid-conflict (CalWS:href)>
- **CalWS:invalid-calendar-collection-location:** In a COPY or MOVE request, when the Request-URI is a calendar collection, the Destination-URI MUST identify a location where a calendar collection can be created;
- **CalWS:exceeds-max-resource-size:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST have an octet size less than or equal to the value of the CalDAV:max-resource-size property value on the calendar collection where the resource will be stored;
- **CalWS:before-min-date-time:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST have all of its iCalendar DATE or DATE-TIME property values (for each recurring instance) greater than or equal to the value of the CalDAV:min- date-time property value on the calendar collection where the resource will be stored;

- **CalWS:after-max-date-time:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST have all of its iCalendar DATE or DATE-TIME property values (for each recurring instance) less than the value of the CalDAV:max-date-time property value on the calendar collection where the resource will be stored;
- **CalWS:too-many-instances:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST generate a number of recurring instances less than or equal to the value of the CalDAV: max-instances property value on the calendar collection where the resource will be stored;
- **CalWS:too-many-attendees-per-instance:** The resource submitted in the PUT request, or targeted by a COPY or MOVE request, MUST have a number of ATTENDEE properties on any one instance less than or equal to the value of the CalDAV:max-attendees-per-instance property value on the calendar collection where the resource will be stored;

10.4 Example - successful POST:

```
>>Request

POST /user/fred/calendar/?action=create HTTP/1.1
Host: example.com
Content-Type: application/xml+calendar; charset="utf-8"
Content-Length: ?

<?xml version="1.0" encoding="utf-8" ?>
<icalendar xmlns="urn:ietf:params:xml:ns:icalendar-2.0">
  <vcalendar>
  ...
  </vcalendar>
</icalendar>

>>Response

HTTP/1.1 201 Created
Location: http://example.com/user/fred/calendar/event1.ics
```

10.5 Example - unsuccessful POST:

```
>>Request

POST /user/fred/readcalendar/?action=create HTTP/1.1
Host: example.com
Content-Type: text/text; charset="utf-8"
Content-Length: ?

This is not an xml calendar object

>>Response

HTTP/1.1 403 Forbidden
 <?xml version="1.0" encoding="utf-8"
      xmlns:D="DAV:"
      xmlns:C="urn:ietf:params:xml:ns:caldav" ?>
 <D:error>
     <C:supported-calendar-data/>
     <D:description>Not an icalendar object</C:description>
 </D:error>
```

11 Retrieving resources

A simple GET on the href will return a named resource. If that resource is a recurring event or task with overrides, the entire set will be returned. The desired format is specified in the ACCEPT header. The default form is application/xml+calendar

11.1 Request parameters

- none

11.2 Responses:

- 200: OK
- 403: Forbidden - no access
- 406 The requested format specified in the accept header is not supported.

11.3 Example - successful fetch:

```
>>Request

GET /user/fred/calendar/event1.ics HTTP/1.1
Host: example.com

>>Response

HTTP/1.1 200 OK
Content-Type: application/xml+calendar; charset="utf-8"
Content-Length: ?

<?xml version="1.0" encoding="utf-8" ?>
<icalendar xmlns="urn:ietf:params:xml:ns:icalendar-2.0">
  <vcalendar>
    ...
  </vcalendar>
</icalendar>
```

11.4 Example - unsuccessful fetch:

```
>>Request

PUT /user/fred/calendar/noevent1.ics HTTP/1.1
Host: example.com

>>Response

HTTP/1.1 404 Not found
```

12 Updating resources

Resources are updated with the PUT method targeted at the resource href. The body of the request contains a complete new resource which effectively replaces the targeted resource. To allow for optimistic locking of the resource use the if-match header.

When updating a recurring event all overrides and master must be supplied as part of the content.

Preconditions as specified in Section 10.3 are applicable.

12.1 Responses:

- 200: OK
- 304: Not modified - entity was modified by some other request
- 403: Forbidden - no access, does not exist etc. See error response

Example 16: Successful Update

```
>>Request

PUT /user/fred/calendar/event1.ics HTTP/1.1
Host: example.com
Content-Type: application/xml+calendar; charset="utf-8"
Content-Length: ?

<?xml version="1.0" encoding="utf-8" ?>
<icalendar xmlns="urn:ietf:params:xml:ns:icalendar-2.0">
  <vcalendar>
     ...
  </vcalendar>
</icalendar>

>>Response

HTTP/1.1 200 OK
```

Example 17: Unsuccessful Update

```
>>Request

PUT /user/fred/readcalendar/event1.ics HTTP/1.1
Host: example.com
Content-Type: application/xml+calendar; charset="utf-8"
Content-Length: ?

<?xml version="1.0" encoding="utf-8" ?>
<icalendar xmlns="urn:ietf:params:xml:ns:icalendar-2.0">
  <vcalendar>
    ...
  </vcalendar>
</icalendar>

>>Response

HTTP/1.1 403 Forbidden
Content-Type: application/xml; charset="utf-8"
Content-Length: xxxx

<?xml version="1.0" encoding="utf-8"
```

```
      xmlns:D="DAV:"
      xmlns:CW=" http://docs.oasis-open.org/ws-calendar/CalWS" ?>
<CW:error>
  <CW:target-exists/>
  <CW:description>Target of update must exist</C:description>
</CW:error>
```

13 Deletion of resources

Delete is defined in **[RFC 2616]** Section 9.7. In addition to conditions defined in that specification, servers must remove any references from the deleted resource to other resources. Resources are deleted with the DELETE method targeted at the resource URL. After a successful completion of a deletion a GET on that URL must result in a 404 - Not Found status.

13.1 Delete for Collections

Delete for collections may or may not be supported by the server. Certain collections are considered undeletable. On a successful deletion of a collection all contained resources to any depth must also be deleted.

13.2 Responses:

- 200: OK
- 403: Forbidden - no access
- 404: Not Found

14 Querying calendar resources

Querying provides a mechanism by which information can be obtained from the service through possibly complex queries. A list of icalendar properties can be specified to limit the amount of information returned to the client. A query takes the parts

- Limitations on the data returned
- Selection of the data
- Optional timezone id for floating time calculations.

The current specification uses CalDAV multiget and calendar-query XML bodies as specified in **[RFC 4791]** with certain limitations and differences.

1. The POST method is used for all requests, the action being identified by the outer element.
2. While CalDAV servers generally only support [RFC 5545] and assume that as the default, the delivery format for CalWS will, by default, be [draft-xcal].
3. The CalDAV query allows the specification of a number of DAV properties. Specification of these properties, with the exception of DAV:getetag, is considered an error in CalWS.
4. The CalDAV:propnames element is invalid

With those differences, the CalDAV specification is the normative reference for this operation.

14.1 Limiting data returned

This is achieved by specifying one of the following

- CalDAV:allprop return all properties (some properties are specified as not being part of the allprop set so are not returned)
- CalDAV:prop An element which contains a list of properties to be returned . May only contain DAV:getetag and CalDAV:calendar-data

Of particular interest, and complexity, is the calendar-data property which can contain a time range to limit the range of recurrences returned and/or a list of calendar properties to return.

14.2 Pre/postconditions for calendar queries

The preconditions as defined in in **[RFC 4791]** Section 7.8 apply here. CalDav errors may be reported by the service when preconditions or postconditions are violated.

14.3 Example: time range limited retrieval

This example shows the time-range limited retrieval from a calendar which results in 2 events, one a recurring event and one a simple non-recurring event.

```
>> Request <<

POST /user/fred/calendar/ HTTP/1.1
Host: calws.example.com
Depth: 1
Content-Type: application/xml; charset="utf-8"
Content-Length: xxxx

<?xml version="1.0" encoding="utf-8" ?>
<C:calendar-query xmlns:D="DAV:"
                  xmlns:C="urn:ietf:params:xml:ns:caldav">
  <D:prop>
    <D:getetag/>
    <C:calendar-data content-type="application/xml+calendar" >
```

```
      <C:comp name="VCALENDAR">
        <C:prop name="VERSION"/>
        <C:comp name="VEVENT">
          <C:prop name="SUMMARY"/>
          <C:prop name="UID"/>
          <C:prop name="DTSTART"/>
          <C:prop name="DTEND"/>
          <C:prop name="DURATION"/>
          <C:prop name="RRULE"/>
          <C:prop name="RDATE"/>
          <C:prop name="EXRULE"/>
          <C:prop name="EXDATE"/>
          <C:prop name="RECURRENCE-ID"/>
        </C:comp>
      </C:comp>
    </C:calendar-data>
  </D:prop>
  <C:filter>
    <C:comp-filter name="VCALENDAR">
      <C:comp-filter name="VEVENT">
        <C:time-range start="20060104T000000Z"
                      end="20060105T000000Z"/>
      </C:comp-filter>
    </C:comp-filter>
  </C:filter>
</C:calendar-query>

>> Response <<

HTTP/1.1 207 Multi-Status
Date: Sat, 11 Nov 2006 09:32:12 GMT
Content-Type: application/xml; charset="utf-8"
Content-Length: xxxx

<?xml version="1.0" encoding="utf-8" ?>
<D:multistatus xmlns:D="DAV:"
               xmlns:C="urn:ietf:params:xml:ns:caldav">
  <D:response>
    <D:href>http://cal.example.com/bernard/work/abcd2.ics</D:href>
    <D:propstat>
      <D:prop>
        <D:getetag>"fffff-abcd2"</D:getetag>
        <C:calendar-data content-type="application/xml+calendar" >
          <xc:icalendar
             xmlns:xc="urn:ietf:params:xml:ns:icalendar-2.0">
   <xc:vcalendar>
     <xc:properties>
      <xc:calscale><text>GREGORIAN</text></xc:calscale>
      <xc:prodid>
       <xc:text>-//Example Inc.//Example Calendar//EN</xc:text>
      </xc:prodid>
      <xc:version><xc:text>2.0</xc:text></xc:version>
     </xc:properties>
     <xc:components>
      <xc:vevent>
       <xc:properties>
        <xc:dtstart>
          <xc:parameters>
            <xc:tzid>US/Eastern<xc:tzid>
          <xc:parameters>
          <xc:date-time>20060102T120000</xc:date-time>
        </xc:dtstart>
        <xc:duration><xc:duration>PT1H</xc:duration></xc:duration>
        <xc:summary>
```

```
          <xc:text>Event #2</xc:text>
        </xc:summary>
        <xc:uid>
          <xc:text>00959BC664CA650E933C892C@example.com</xc:text>
        </xc:uid>
        <xc:rrule>
          <xc:recur>
            <xc:freq>DAILY</xc:freq>
            <xc:count>5</xc:count>
          </xc:recur>
        </xc:rrule>
      </xc:properties>
    </xc:vevent>

    <xc:vevent>
      <xc:properties>
        <xc:dtstart>
          <xc:parameters>
            <xc:tzid>US/Eastern<xc:tzid>
          <xc:parameters>
          <xc:date-time>20060104T140000</xc:date-time>
        </xc:dtstart>
        <xc:duration><xc:duration>PT1H</xc:duration></xc:duration>
        <xc:summary>
          <xc:text>Event #2 bis</xc:text>
        </xc:summary>
        <xc:uid>
          <xc:text>00959BC664CA650E933C892C@example.com</xc:text>
        </xc:uid>
        <xc:recurrence-id>
          <xc:parameters>
            <xc:tzid>US/Eastern<xc:tzid>
          <xc:parameters>
          <xc:date-time>20060104T120000</xc:date-time>
        </xc:recurrence-id>
        <xc:rrule>
          <xc:recur>
            <xc:freq>DAILY</xc:freq>
            <xc:count>5</xc:count>
          </xc:recur>
        </xc:rrule>
      </xc:properties>
    </xc:vevent>

    <xc:vevent>
      <xc:properties>
        <xc:dtstart>
          <xc:parameters>
            <xc:tzid>US/Eastern<xc:tzid>
          <xc:parameters>
          <xc:date-time>20060106T140000</xc:date-time>
        </xc:dtstart>
        <xc:duration><xc:duration>PT1H</xc:duration></xc:duration>
        <xc:summary>
          <xc:text>Event #2 bis bis</xc:text>
        </xc:summary>
        <xc:uid>
          <xc:text>00959BC664CA650E933C892C@example.com</xc:text>
        </xc:uid>
        <xc:recurrence-id>
          <xc:parameters>
            <xc:tzid>US/Eastern<xc:tzid>
          <xc:parameters>
          <xc:date-time>20060106T120000</xc:date-time>
```

```
        </xc:recurrence-id>
        <xc:rrule>
          <xc:recur>
            <xc:freq>DAILY</xc:freq>
            <xc:count>5</xc:count>
          </xc:recur>
        </xc:rrule>
       </xc:properties>
      </xc:vevent>
     </xc:components>
    </xc:vcalendar>
   </xc:icalendar>
          </C:calendar-data>
        </D:prop>
        <D:status>HTTP/1.1 200 OK</D:status>
      </D:propstat>
    </D:response>
    <D:response>
      <D:href>http://cal.example.com/bernard/work/abcd3.ics</D:href>
      <D:propstat>
        <D:prop>
          <D:getetag>"fffff-abcd3"</D:getetag>
          <C:calendar-data content-type="application/xml+calendar" >
            <xcal:icalendar
               xmlns:xc="urn:ietf:params:xml:ns:icalendar-2.0">
    <xc:vcalendar>
     <xc:properties>
      <xc:calscale><text>GREGORIAN</text></xc:calscale>
      <xc:prodid>
       <xc:text>-//Example Inc.//Example Calendar//EN</xc:text>
      </xc:prodid>
      <xc:version><xc:text>2.0</xc:text></xc:version>
     </xc:properties>
     <xc:components>
      <xc:vevent>
       <xc:properties>
        <xc:dtstart>
          <xc:parameters>
            <xc:tzid>US/Eastern<xc:tzid>
          <xc:parameters>
          <xc:date-time>20060104T100000</xc:date-time>
        </xc:dtstart>
        <xc:duration><xc:duration>PT1H</xc:duration></xc:duration>
        <xc:summary>
         <xc:text>Event #3</xc:text>
        </xc:summary>
        <xc:uid>
         <xc:text>DC6C50A017428C5216A2F1CD@example.com</xc:text>
        </xc:uid>
        <xc:rrule>
          <xc:recur>
            <xc:freq>DAILY</xc:freq>
            <xc:count>5</xc:count>
          </xc:recur>
        </xc:rrule>
       </xc:properties>
      </xc:vevent>
     </xc:components>
    </xc:vcalendar>
   </xc:icalendar>
        </C:calendar-data>
      </D:prop>
      <D:status>HTTP/1.1 200 OK</D:status>
    </D:propstat>
```

```
  </D:response>
</D:multistatus>
```

15 Free-busy queries

Free-busy queries are used to obtain free-busy information for a calendar-collection or principals. The result contains information only for events to which the current principal has sufficient access.

When targeted at a calendar collection the result is based only on the calendaring entities contained in that collection. When targeted at a principal free-busy URL the result will be based on all information which affect the principals free-busy status, for example availability.

The possible targets are:

- A calendar collection URL
- The XRD link with relation CalWS/current-principal-freebusy
- The XRD link with relation CalWS/principal-freebusy with a principal given in the request.

The query follows the specification defined in Error! Reference source not found. with certain limitations. As an authenticated user to the CalWS service scheduling read-freebusy privileges must have been granted. As an unauthenticated user equivalent access must have been granted to unauthenticated access.

Freebusy information is returned by default as xcalendar vfreebusy components, as defined by **[draft-xcal]**. Such a component is not meant to conform to the requirements of VFREEBUSY components in **[RFC 5546]**. The VFREEBUSY component SHOULD conform to section "4.6.4 Free/Busy Component" of **[RFC 5545]**. A client SHOULD ignore the ORGANIZER field..

Since a Freebusy query can only refer to a single user, a client will already know how to match the result component to a user. A server MUST only return a single vfreebusy component.

15.1 ACCEPT header

The Accept header is used to specify the format for the returned data. In the absence of a header the data should be returned as specified in **[draft-xcal]**, that is, as if the following had been specified

```
ACCEPT: application/xml+calendar
```

15.2 URL Query Parameters

None of these parameters are required except for the conditions noted below. Appropriate defaults will be supplied by the server.

15.2.1 start

Default: The default value is left up to the server. It may be the current day, start of the current month, etc.

Description: Specifies the start date for the Freebusy data. The server is free to ignore this value and return data in any time range. The client must check the data for the returned time range.

Format:A profile of an **[RFC3339]** Date/Time. Fractional time is not supported. The server MUST support the expanded version e.g.

```
2007-01-02T13:00:00-08:00
```

It is up to the server to interpret local date/times.

Example:

```
2007-02-03T15:30:00-0800
2007-12-01T10:15:00Z
```

Notes: Specifying only a start date/time without specifying an end-date/time or period should be interpreted as in **[RFC 5545**]. The effective period should cover the remainder of that day.

Date-only values are disallowed as the server cannot determine the correct start of the day. Only

UTC or date/time with offset values are permitted.

15.2.2 end

Default: Same as start

Description: Specifies the end date for the Freebusy data. The server is free to ignore this value.

Format: Same as start

Example: Same as start

15.2.3 period

Default: The default value is left up to the server. The recommended value is "P42D".

Description: Specifies the amount of Freebusy data to return. A client cannot specify both a period and an end date. Period is relative to the start parameter.

Format: A duration as defined in section 4.3.6 of **[RFC 5545]**

Example:

```
P42D
```

15.2.4 account

Default: none

Description: Specifies the principal when the request is targeted at the XRD CalWS/principal-freebusy. Specification of this parameter is an error otherwise.

Format: Server specific

Example:

```
fred
/principals/users/jim
user1@example.com
```

15.3 URL parameters - notes

The server is free to ignore the start, end and period parameters. It is recommended that the server return at least 6 weeks of data from the current day.

A client MUST check the time range in the VFREEBUSY response as a server may return a different time range than the requested range.

15.4 HTTP Operations

The server SHOULD return an Etag response header for a successful GET request targeting a Freebusy read URL. Clients MAY use the Etag response header value to do subsequent "conditional" GET requests that will avoid re-sending the Freebusy data again if it has not changed.

15.5 Response Codes

Below are the typical status codes returned by a GET request targeting a Free-busy URL. Note that other HTTP status codes not listed here might also be returned by a server.

- 200 OK
- 302 Found
- 400 Start parameter could not be understood / End parameter could not be understood / Period parameter could not be understood
- 401 Unauthorized

- 403 Forbidden
- 404 The data for the requested principal is not currently available, but may be available later.
- 406 The requested format in the accept header is not supported.
- 410 The data for the requested principal is no longer available
- 500 General server error

15.6 Examples

The following are examples of URLs used to retrieve Free-busy data for a user:

```
http://www.example.com/freebusy/user1@example.com?
start=2007-09-01T00:00:00-08:00&end=2007-09-31T00:00:00-08:00

http://www.example.com/freebusy/user1@example.com?
start=2007-09-01T00:00:00-08:00&end=2007-09-31T00:00:00-08:00

http://www.example.com/freebusy/user1@example.com

http://www.example.com/freebusy?user=user%201@example.com&
start=2008-01-01T00:00:00Z&end=2008-12-31T00:00:00Z
```

Some Request/Response Examples:

A URL with no query parameters:

```
>> Request <<
GET /freebusy/bernard/ HTTP/1.1
Host: www.example.com

>> Response <<
HTTP/1.1 200 OK
Content-Type: application/xml+calendar; charset="utf-8"
Content-Length: xxxx

<xc:icalendar xmlns:xc="urn:ietf:params:xml:ns:icalendar-2.0">
  <xc:vcalendar>
    <xc:properties>
      <xc:calscale><text>GREGORIAN</text></xc:calscale>
      <xc:prodid>
        <xc:text>-//Example Inc.//Example Calendar//EN</xc:text>
      </xc:prodid>
      <xc:version><xc:text>2.0</xc:text></xc:version>
    </xc:properties>
    <xc:components>
      <xc:vfreebusy>
        <xc:properties>
          <xc:uid>
            <xc:text>76ef34-54a3d2@example.com</xc:text>
          </xc:uid>
          <xc:dtstart>
            <xc:date-time>20060101T000000Z</xc:date-time>
          </xc:dtstart>
          <xc:dtend>
            <xc:date-time>20060108T000000Z</xc:date-time>
          </xc:dtend>
          <xc:dtstamp>
            <xc:date-time>20050530T123421Z</xc:date-time>
          </xc:dtstamp>
          <xc:freebusy>
            <xc:parameters>
              <xc:fbtype>BUSYTENTATIVE<xc:fbtype>
            <xc:parameters>
            <xc:period>20060102T100000Z/20060102T120000Z</xc:period>
```

```
          </xc:freebusy>
          <xc:freebusy>
            <xc:period>20060103T100000Z/20060103T120000Z</xc:period>
          </xc:freebusy>
          <xc:freebusy>
            <xc:period>20060104T100000Z/20060104T120000Z</xc:period>
          </xc:freebusy>
          <xc:freebusy>
            <xc:parameters>
              <xc:fbtype>BUSYUNAVAILABLE<xc:fbtype>
            <xc:parameters>
            <xc:period>20060105T100000Z/20060105T120000Z</xc:period>
          </xc:freebusy>
          <xc:freebusy>
            <xc:period>20060106T100000Z/20060106T120000Z</xc:period>
          </xc:freebusy>
      </xc:vfreebusy>
    </xc:components>
  </xc:vcalendar>
<xc:icalendar>
```

A URL with start and end parameters:

```
>> Request <<
GET /freebusy/user1@example.com?start=2007-09-01T00:00:00-08:00&end=2007-09-
31T00:00:00-08:00
HTTP/1.1
Host: www.example.com

>> Response <<
HTTP/1.1 200 OK
Content-Type: application/xml+calendar; charset="utf-8"
Content-Length: xxxx

<xc:icalendar xmlns:xc="urn:ietf:params:xml:ns:icalendar-2.0">
  <xc:vcalendar>
    <xc:properties>
      <xc:calscale><text>GREGORIAN</text></xc:calscale>
      <xc:prodid>
        <xc:text>-//Example Inc.//Example Calendar//EN</xc:text>
      </xc:prodid>
      <xc:version><xc:text>2.0</xc:text></xc:version>
    </xc:properties>
    <xc:components>
      <xc:vfreebusy>
        <xc:properties>
          <xc:uid>
            <xc:text>76ef34-54a3d2@example.com</xc:text>
          </xc:uid>
          <xc:dtstart>
            <xc:date-time>20070901T000000Z</xc:date-time>
          </xc:dtstart>
          <xc:dtend>
            <xc:date-time>20070931T000000Z</xc:date-time>
          </xc:dtend>
          <xc:dtstamp>
            <xc:date-time>20050530T123421Z</xc:date-time>
          </xc:dtstamp>
          <xc:freebusy>
            <xc:period>20070915T230000Z/20070916T010000Z</xc:period>
          </xc:freebusy>
      </xc:vfreebusy>
    </xc:components>
  </xc:vcalendar>
<xc:icalendar>
```

A URL for which the server does not have any data for that user:

```
>> Request <<
GET /freebusy/user1@example.com?start=2012-12-01T00:00:00-08:00&end=2012-12-
31T00:00:00-08:00
HTTP/1.1
Host: www.example.com

>> Response <<
HTTP/1.1 404 No data
```

16 Conformance

WS-Calendar Intervals SHALL have a Duration. Intervals MAY have a StartTime. Intervals SHALL NOT include an END time. If a non-compliant Interval is received with an END time, it may be ignored.

A performance component SHALL not include Start, Stop, and Duration elements. Two out of the three elements is acceptable, but not three.

In Partitions, the Description, Summary and Priority of each Interval SHALL be excluded.

An Calendar Gluon may either have a dtStart or a dtEnd, but may not have both.

All OASIS specifications require conformance

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Mike Douglas, Rensselaer Polytechnic Institute
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Tong Li, IBM

B. An Introduction to Internet Calendaring

The WS-Calendar Technical Committee thanks CalConnect for contributing this overview of iCalendar and its use.

B.1 icalendar

B.1.1 History

The iCalendar specification was first produced by the IETF in 1998 as RFC 2445 [1]. Since then it has become the dominant standard for calendar data interchange on the internet and between devices (desktop computers, mobile phones etc.). The specification was revised in 2009 as RFC 5545 [4].

Alongside iCalendar is the iTIP specification (RFC 2446 [2] and revised as RFC 5546[5]) that defines how iCalendar is used to carry out scheduling operations (for example, how an organizer can invite attendees to a meeting and receive their replies). This forms the basis for email-based scheduling using iMIP (the specification that describes how to use iTIP with email - RFC 2447 [3]).

iCalendar itself is a text-based data format. However, an XML format is also available, providing a one-to-one mapping to the text format (draft [7]).

iCalendar data files typically have a .ics file name extension. Most desktop calendar clients can import or export iCalendar data, or directly access such data over the Internet using a variety of protocols.

B.1.2 Data model

The iCalendar data format has a well defined data model. "iCalendar objects" encompass a set of "iCalendar components" each of which contains a set of "iCalendar properties" and possibly other sub-components. An iCalendar property consists of a name, a set of optional parameters (specified as "key-value" pairs) and a value.

iCalendar components include:

"VEVENT" which represents an event

"VTODO" which represents a task or to-do

"VJOURNAL" which represents a journal entry

"VFREEBUSY" which represents periods of free or busy time information

"VTIMEZONE" which represents a timezone definition (timezone offset and daylight saving rules)

"VALARM" is currently the only defined sub-component and is used to set alarms or reminders on events or tasks.

Properties include:

"DTSTART" which represents a start time for a component

"DTEND" which represents an end time for a component

"SUMMARY" which represents a title or summary for a component

"RRULE" which can specify rules for repeating events or tasks (for example, every day, every week on Tuesdays, etc.)

"ORGANIZER" which represents the calendar user who is organizing an event or assigning a task

"ATTENDEE" which represents calendar users attending an event or assigned a task

In addition to this data model and the pre-defined properties, the specification defines how all those are used together to define the semantics of calendar objects and scheduling. The semantics are basically a set of rules stating how all the components and properties are used together to ensure that all iCalendar products can work together to achieve good interoperability. For example, a rule requires that all events must have one and only one "DTSTART" property. The most important part of the iCalendar specification

is the semantics of the calendaring model that it represents. The use of text or XML to encode those is secondary.

B.1.3 Scheduling

The iTIP specification defines how iCalendar objects are exchanged in order to accomplish the key task needed to schedule events or tasks. An example of a simple workflow is as follows:

1. To schedule an event, an organizer creates the iCalendar object representing the event and adds calendar users as attendees.
2. The organizer then sends an iTIP "REQUEST" message to all the attendees.
3. Upon receipt of the scheduling message, each attendee can decide whether they want to attend the meeting or not.
4. Each attendee can then respond back to the organizer using an iTIP "REPLY" message indicating their own attendance status.

iTIP supports other types of scheduling messages, for example, to cancel meetings, add new instances to a repeating meeting, etc.

B.1.4 Extensibility

iCalendar was designed to be extensible, allowing for new components, properties and parameters to be defined as needed. A registry exists to maintain the list of standard extensions with references to their definitions to ensure anyone can use them and work well with others.

B.2 Calendar data access and exchange protocols

B.2.1 Internet Calendar Subscriptions

An Internet calendar subscription is simply an iCalendar data file made available on a web server. Users can use this data in two ways:

- The data can be downloaded from the web server and then imported directly into an iCalendar aware client. This solution works well for calendar data that is not likely to change over time (for example the list of national holidays for the next year).
- Calendar clients that support "direct" subscriptions can use the URL to the calendar data on the web server to download the calendar data themselves. Additionally, the clients can check the web server on a regular basis for updates to the calendar data, and then update their own cached copy of it. This allows calendar data that changes over time to be kept synchronized.

B.2.2 CalDAV

CalDAV is a calendar access protocol and is defined in RFC 4791 [6]. The protocol is based on WebDAV which is an extension to HTTP that provides enhanced capabilities for document management on web servers.

CalDAV is used in a variety of different environments, ranging from very large internet service providers, to large and small corporations or institutions, and to small businesses and individuals.

CalDAV clients include desktop applications, mobile devices and browser-based solutions. It can also be used by "applets", for example, a web page panel that displays a user's upcoming events.

One of the key aspects of CalDAV is its data model. Simply put, it defines a "calendar home" for each calendar user, within which any number of "calendars" can be created. Each "calendar" can contain any number of iCalendar objects representing individual events, tasks or journal entries. This data model ensures that clients and servers can interoperate well.

In addition to providing simple operations to read, write and delete calendar data, CalDAV provides a querying mechanism to allow clients to fetch calendar data matching specific criteria. This is commonly

used by clients to do "time-range" queries, i.e., find the set of events that occur within a given start/end time period.

CalDAV also supports access control allowing for features such as delegated calendars and calendar sharing.

CalDAV also specifies how scheduling operations can be done using the protocol. Whilst it uses the semantics of the iTIP protocol, it simplifies the process by allowing simple calendar data write operations to trigger the sending of scheduling messages, and it has the server automatically process the receipt of scheduling messages. Scheduling can be done with other users on the CalDAV server or with calendar users on other systems (via some form of "gateway").

B.2.3 ActiveSync/SyncML

ActiveSync and SyncML are technologies that allow multiple devices to synchronize data with a server, with calendar data being one of the classes of data supported. These have typically been used for low-end and high-end mobile devices.

B.2.4 CalWS

CalWS is a web services calendar access API developed by The Calendaring and Scheduling Consortium and the OASIS organization, to be used as part of the Oasis WS-Calendar standard. It provides an API to access and manipulate calendar data stored on a server. It follows a similar data model to CalDAV and has been designed to co-exist with a CalDAV service offering the same data.

B.2.5 iSchedule

iSchedule is a protocol to allow scheduling between users on different calendaring systems and across different internet domains. It transports iTIP scheduling messages using HTTP between servers. Servers use DNS and various security mechanisms to determine the authenticity of messages received.

It has been specifically designed to be independent of any calendar system in use at the endpoints, so that it is compatible with many different systems. This allows organizations with different calendar systems to exchange scheduling messages with each other, and also allows a single organization with multiple calendar systems (for example due to mergers, or different departmental requirements) to exchange scheduling messages between users of each system.

B.3 References

[1] https://datatracker.ietf.org/doc/rfc2445/ : ‘Internet Calendaring and Scheduling Core Object Specification’

[2] https://datatracker.ietf.org/doc/rfc2446/ :‘iCalendar Transport-Independent Interoperability Protocol’

[3] https://datatracker.ietf.org/doc/rfc2447/ : ‘iCalendar Message-Based Interoperability Protocol’

[4] https://datatracker.ietf.org/doc/rfc5545/ :‘Internet Calendaring and Scheduling Core Object Specification’

[5] https://datatracker.ietf.org/doc/rfc5546/ : ‘iCalendar Transport-Independent Interoperability Protocol’

[6] https://datatracker.ietf.org/doc/rfc4791/ : ‘Calendaring Extensions to WebDAV’

[7] https://datatracker.ietf.org/doc/draft-daboo-et-al-icalendar-in-xml/ : ‘xCal: The XML format for iCalendar’

C. Overview of WS-Calendar, its Antecedents and its Use

iCalendar has long been the predominant message format for an Internet user to send meeting requests and tasks to other Internet users by email. The recipient can respond to the sender easily or counter propose another meeting date/time. iCalendar support is built into all major email systems and email clients. While SMTP is the predominant means to transport iCalendar messages, protocols including WebDAV and SyncML are used to transport collections of iCalendar information. No similar standard for service interactions has achieved similar widespread use.

The Calendar and Scheduling Consortium (CalConnect), working within the IETF, updated the iCalendar standard in the summer of 2009 to support extension ([RFC5545]). In 2010, the same group defined [XCAL], a canonical XML serialization for iCalendar, currently (08/21/2008) on the recommended standards track within the IETF. This specification supports extensions, including handling non-standard, i.e., non-iCalendar, data during message storage and retrieval.

WS-Calendar builds on this work, and consists of extensions to the vocabulary of iCalendar, along with standard services to extend calendaring and scheduling into service interactions. iCalendar consists of a number of fields that support the delivery, update, and synchronization of if calendar messages and a list of components. The components can specify defined relationships between each other.

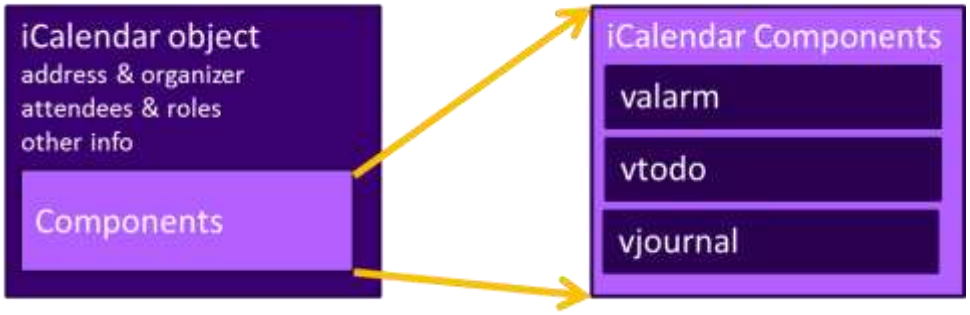

Figure 3: iCalendar overview

WS-Calendar defines the Interval, a profile of the vtodo component requiring only a duration and an artifact to define service delivery and performance. WS-Calendar also defines the CalendarGluon component, a container for holding only a service delivery and performance artifact, to associate with a component or group of components.

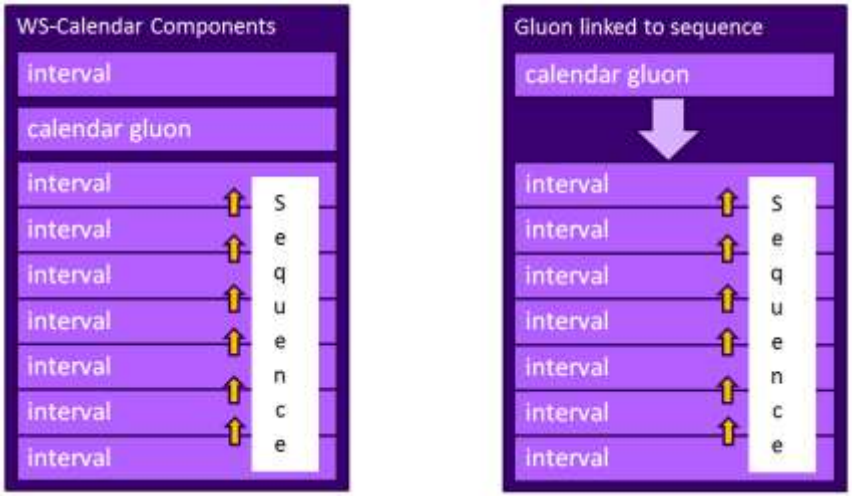

Figure 4: WS-Calendar and EMIX

A set of intervals that have defined temporal relationships is a Sequence. Temporal relationships express how the occurrence of one interval is related to another. For example, Interval B may begin 10 minutes after Interval A completes, or Interval D may start 5 minutes after Interval C starts. An Calendar Gluon linked to a Sequence defines service performance for all Intervals in the Sequence. Because each interval has its own service performance contract, specifications built on WS-Calendar can define rules for inheritance and over-rides with a sequence.

The Partition is a sub-class of a Sequence in which all Intervals follow consecutively with no lag time. Intervals in a Partition normally have the same Duration, but WS-Calendar does support overriding the duration on an individual basis.

C.1 Scheduling Sequences

A Sequence is a general pattern of behaviors and results that does not require a specific schedule. A publishing service may advertise a Sequence with no schedule, i.e., no specific time for performance. When the Sequence is invoked or contracted, a specific performance time is added. In the original iCalendar components, this would add the starting date and time (dtStart) to the component. In WS-Calendar, we add the starting date and time only to the first Interval of a Sequence; the performance times for all other Intervals in the Sequence are derived from that one start time.

C.1.1 Academic Scheduling example

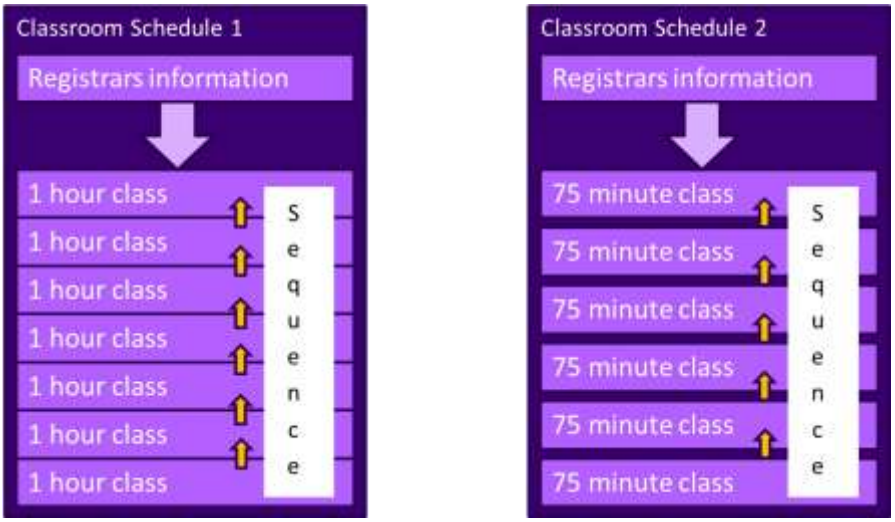

Figure 5: Classroom Scheduling Example

A college campus uses two schedules to schedule its buildings. In Schedule 1, classes start on the hour, and follow one after another; each class starts on the hour. In the second schedule, each class lasts an hour and a quarter, and there is a fifteen minute gap between classes; classes start on the half hour. On many campuses, the sequence in Schedule 1 may describe classes taught on Monday, Wednesday, and Friday. Schedule 2 may describe classes taught on Tuesday and Thursday.

The registrar's office knows some key facts about each classroom, including whether it hosts a class during a particular period, and the number of students that will be in that class. The college wishes to optimize the provision of building services for each class. Such services may include adequate ventilation and comfortable temperatures to assure alert students. Other services may ensure that the classroom projection systems and A/V support services are warmed up in advance of a class, or powered off when a classroom is vacant.

Although most classes meet over typical schedule for the week (M-W-F or Tu-Th), some classes may not meet on Friday, or may have a tutorial section one day a week. The registrar's system, ever mindful of student privacy, shares only minimal information with the building systems such as how many students will be supported.

The Registrar's system schedule building systems using the Calendar Gluon (registrar's information) and the student counts for each interval, and schedules the Sequence in classroom schedule 1 three days a week for the next 10 weeks. The Registrar's system also schedules the sequence in classroom schedule 2 two days a week, also for 10 weeks.

This example demonstrates a system (A) that offers services using either of two sequences. Another business system (B) with minimal knowledge of how (A) works determines the performance requirements for (A). The business system (B) communicates these expectations are by scheduling the Sequences offered by (A).

C.1.2 Market Performance schedule

A factory relies on an energy-intensive process which is performs twice a year for eight weeks. The factory has some flexibility about scheduling the process; it can perform the work in either the early morning or the early evening; it avoids the afternoon when energy costs are highest. The factory works up a detailed profile of when it will need energy to support this process.

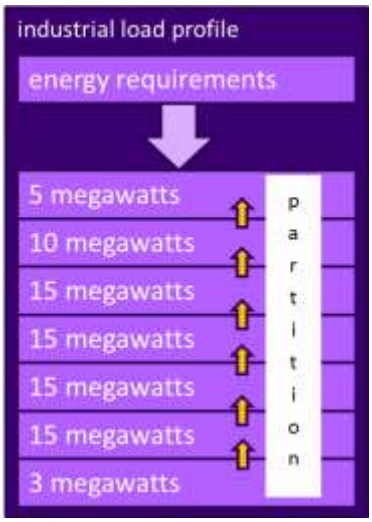

Figure 6: Daily Load Profile for Market Operations Example

Factory management has decided that they want to use only renewable energy products for this process. They approach two regional wind farms with the intent of making committed purchases of wind energy. The wind farms consider their proposals taking into account the seasonal weather forecasts they use to project their weather capacity, and considering the costs that may be required to buy additional wind energy on the spot market to make up any shortfalls.

Each energy supplier submits of the same sequence, a schedule, i.e. a daily starting time, and a price for the season's production. After considering the bids, and other internal costs of each proposal, the factory opts to accept a contract for the purchase of a fixed load profile (Partition), using the evening wind generation from one of the suppliers. This contract specifies Schedules of load purchases (starting data and time for the sequence) for each day.

2618 # D. Revision History

Revision	Date	Editor	Changes Made
1.0 WD 01	2010-03-11	Toby Considine	Initial document, largely derived from Charter
1.0 WD 02	2010-03-30	Toby Considine	Straw-man assertion of elements, components to push conversation
1.0 WD 03	2010-04-27	Toby Considine	Cleaned up Elements, added [XPOINTER] use, xs:duration elements
1.0 WD 04	2010-05-09	Toby Considine	Aligned Chapter 4 with the vAlarm and vToDo objects.
1.0 WD 05	2010-05-18	Toby Considine	Responded to comments, added references, made references to [XCAL] more consistent,
1.0 WD 06	2010-05-10	Toby Considine	Responded to comments from CalConnect, mostly constancy of explanations
1.0 WD 07	2010-07-28	Toby Considine	Incorporated input from informal public review, esp. SGIP PAP04. Firmed up relationships between scheduled objects
1.0 WD 08	2010-08-07	Toby Considine	Aligned with Interval / Partition / Sequence language. Reduced performance characteristics to before / after durations.
1.0 WD 09	2010-08-15	Toby Considine	Formalized Attachment section and rolled Performance into the Attachment. Created RelatedComponent object. Added CalWS Outline to specification. Removed SOOP section
1.0 WD 10	2010-08-28	Toby Considine, Benoit Lepeuple	Updated Time Stamp section Added background Appendices Incorporated Association language to replace RelatedComponent Recast examples to show inheritance, remove inconsistencies
1.0 WD 11	2010-09-11	Toby Considine	Traceability Release in support of a re-shuffling of the document. Sections 3, 4 were re-shuffled to create: 3: Interval / Relationships / Time Stamps 4: Performance / Attachments 5: Associations & Inheritance Also, changed all associations to Gluons. No paragraphs have been changed, just shuffled, changes accepted, to create clean base for editing
1.0 WD 12	2010-09-14	Toby Considine Dave Thewlis	Edits for clarity and flow following changes in WD11, updated examples based upon XSD artifacts. Adding final contribution from CalConnect for Services.

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