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Session Initiation Protocol (SIP) Event Notification Extension for
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Abstract

This document specifies mechanisms for adjusting the rate of Session Initiation Protocol (SIP) event notifications. These mechanisms can be applied in subscriptions to all SIP event packages.

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Internet-Draft

Event Rate Control

October 2010

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Internet-Draft

Event Rate Control

October 2010

Table of Contents

1.	Introduction	4
2.	Definitions and Document Conventions	5
3.	Overview	5
3.1.	Use Case for Limiting the Maximum Rate of Notifications .	5
3.2.	Use Case for Setting a Minimum Rate for Notifications . .	6
3.3.	Use Case for Specifying an Adaptive Minimum Rate of Notifications	7
3.4.	Requirements	7
4.	Basic Operations	8
4.1.	Subscriber Behavior	8
4.2.	Notifier Behavior	9
5.	Operation of the Maximum Rate Mechanism	9
5.1.	Subscriber Behavior	9
5.2.	Notifier Behavior	10
5.3.	Selecting the Maximum Rate	11
5.4.	The Maximum Rate Mechanism for Resource List Server . . .	11
5.5.	Buffer Policy Description	13
5.5.1.	Partial State Notifications	13
5.5.2.	Full State Notifications	13
5.6.	Estimated Bandwidth Savings	14
6.	Operation of the Minimum Rate Mechanism	14
6.1.	Subscriber Behavior	14
6.2.	Notifier Behavior	15
7.	Operation of the Adaptive Minimum Rate Mechanism	16
7.1.	Subscriber Behavior	16
7.2.	Notifier Behavior	16
7.3.	Calculating the Timeout	17
8.	Usage of the Maximum Rate, Minimum Rate and Adaptive Minimum Rate Mechanisms in a combination	18
9.	Protocol Element Definitions	19
9.1.	"min-interval", "max-interval" and "average-interval" Header Field Parameters	19
9.2.	Grammar	20
9.3.	Event Header Field Usage in Responses to the NOTIFY	

request	20
10. IANA Considerations	21
11. Security Considerations	21
12. Acknowledgments	22
13. References	22
13.1. Normative References	22
13.2. Informative References	23
Authors' Addresses	23

[1.](#) Introduction

The SIP events framework [[RFC3265](#)] defines a generic framework for subscriptions to and notifications of events related to SIP systems. This framework defines the methods SUBSCRIBE and NOTIFY, and introduces the concept of an event package, which is a concrete application of the SIP events framework to a particular class of events.

One of the things the SIP events framework mandates is that each event package specification defines an absolute maximum on the rate at which notifications are allowed to be generated by a single notifier. Such a limit is provided in order to reduce network load.

All of the existing event package specifications include a maximum notification rate recommendation, ranging from once in every five seconds [[RFC3856](#)], [[RFC3680](#)], [[RFC3857](#)] to once per second [[RFC3842](#)].

Per the SIP events framework, each event package specification is also allowed to define additional throttle mechanisms which allow the subscriber to further limit the rate of event notification. So far none of the event package specifications have defined such a mechanism.

The resource list extension [[RFC4662](#)] to the SIP events framework also deals with rate limiting of event notifications. The extension allows a subscriber to subscribe to a heterogeneous list of resources with a single SUBSCRIBE request, rather than having to install a subscription for each resource separately. The event list

subscription also allows rate limiting, or throttling of notifications, by means of the Resource List Server (RLS) buffering notifications of resource state changes, and sending them in batches. However, the event list mechanism provides no means for the subscriber to set the interval for the throttling; it is strictly an implementation decision whether batching of notifications is supported, and by what means.

This document defines an extension to the SIP events framework defining the following three Event header field parameters that allow a subscriber to set a maximum, a minimum and an adaptive minimum rate of event notifications generated by the notifier:

min-interval: specifies a minimum notification time period (maximum rate) between two notifications, in seconds.

max-interval: specifies a maximum notification time period (minimum rate) between two notifications, in seconds.

average-interval: specifies an average maximum notification time period (adaptive minimum rate) between two notifications, in seconds.

The requirements and model are further discussed in [Section 3](#). All these mechanisms are simply timer values that indicate the minimum, maximum and average maximum time period allowed between two notifications. As a result of these mechanisms, a compliant notifier will adjust the rate at which it generates notifications.

These mechanisms are applicable to any event subscription, both single event subscription and event list subscription.

[2](#). Definitions and Document Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)] and

indicate requirement levels for compliant implementations.

Indented passages such as this one are used in this document to provide additional information and clarifying text. They do not contain normative protocol behavior.

[3.](#) Overview

[3.1.](#) Use Case for Limiting the Maximum Rate of Notifications

A presence client in a mobile device contains a list of 100 buddies or presentities. In order to decrease the processing and network load of watching 100 presentities, the presence client has employed a Resource List Server (RLS) with the list of buddies, and therefore only needs a single subscription to the RLS in order to receive notification of the presence state of the resource list.

In order to control the buffer policy of the RLS, the presence client sets a maximum rate ("min-interval" parameter), i.e. a minimum time interval between two notifications. The RLS will buffer notifications that do not comply with the maximum rate and batch all of the buffered state changes together in a single notification only when allowed by the maximum rate. The maximum rate applies to the overall resource list, which means that there is a hard cap imposed by the maximum rate to the number of notifications the presence

client can expect to receive. For example, with a "min-interval" of 20 seconds, the presence application can expect to receive a notification no more frequently than every 20 seconds.

The presence client can also modify the "min-interval" parameter during the lifetime of the subscription. For example, if the User Interface (UI) of the application shows inactivity for a period of time, it can simply pause the notifications by setting the "min-interval" parameter to the subscription expiration time, while still keeping the subscription alive. When the user becomes active again, the presence client can resume the stream of notifications by re-subscribing with a "min-interval" parameter set to the earlier used value. Application of the mechanism defined by [RFC 5839](#) [[RFC5839](#)] can also eliminate the transmission of a (full-state) notification carrying the latest resource state to the presence client after a

subscription refresh.

3.2. Use Case for Setting a Minimum Rate for Notifications

A location application is monitoring the movement of a target. In order to decrease the processing and network load, the location application has made a subscription with a set of location filters [[I-D.ietf-geopriv-loc-filters](#)] that specify trigger criteria, e.g. to send an update only when the target has moved at least n meters. However, the application is also interested in receiving the current state periodically even if the state of the target has not changed enough to satisfy any of the trigger criteria, e.g. has not moved at least n meters within the period.

In order to control the actual state, the location application sets a minimum rate ("max-interval" parameter), i.e. a maximum time interval between two notifications.

The location application can also modify the "max-interval" parameter during the lifetime of the subscription. When the subscription to the movement of a target is made, the notifier may not have the location information available. Thus, the first notification might be empty, or certain values might be absent. An important use case is placing constraints on when complete state should be provided after creating the subscription. The "max-interval" parameter indicates to the notifier the maximum amount of time that should be allowed to elapse between NOTIFY requests containing complete state information. Once state is acquired and the second notification is sent, the subscriber updates or changes the "max-interval" parameter to a more sensible value. This update can be performed in the 200 OK response to the NOTIFY request that contains the complete state information.

3.3. Use Case for Specifying an Adaptive Minimum Rate of Notifications

The minimum rate mechanism introduces a static and instantaneous rate control without the functionality to increase or decrease the notification frequency adaptively. However, there are some applications that would work better with an adaptive minimum rate control. This section illustrates the tracking scenario.

A tracking application is monitoring the movement of a target. In order to decrease the processing in the application, the tracking application wants to make a subscription that dynamically decreases the minimum rate of notifications if the target has sent out several notifications recently. However, if there have been only few recent notifications by the target, the tracking application wants the minimum rate of notifications to increase.

The application sets an adaptive minimum rate ("average-interval" parameter), i.e. an average maximum time interval between two notifications. The "average-interval" parameter value is used by the notifier to dynamically calculate the actual maximum time ("timeout" parameter) between two notifications. In order to dynamically calculate the maximum time, the notifier takes into consideration the frequency at which notifications have been sent recently. In the adaptive minimum rate mechanism the notifier can increase or decrease the notification frequency compared to minimum rate mechanism based on the recent number of notifications sent out in the last period.

The tracking application can also modify the "average-interval" parameter during the lifetime of the subscription.

3.4. Requirements

- REQ1: The subscriber must be able to set a maximum rate ("min-interval" parameter) of notifications in a specific subscription.
- REQ2: The subscriber must be able to set a minimum rate ("max-interval" parameter) of notifications in a specific subscription.
- REQ3: The subscriber must be able to set an adaptive minimum rate ("average-interval" parameter), which adjusts the minimum rate of notifications based on a moving average.
- REQ4: It must be possible to apply the maximum rate, the minimum rate and the adaptive minimum rate mechanisms all together, or in any combination, in a specific subscription.

- REQ5: It must be possible to use any of the different rate control

mechanisms in subscriptions to any events.

REQ6: It must be possible to use any of the different rate control mechanisms together with any other event filtering mechanisms.

REQ7: The notifier must be allowed to use a policy in which the "min-interval", "max-interval" and "average-interval" parameters are adjusted from the value given by the subscriber.

For example, due to congestion reasons, local policy at the notifier could temporarily dictate a policy that in effect increases the subscriber-configured minimum time period between two notifications. In another example, the notifier can decrease the proposed minimum time by the subscriber to match it with the remaining expiry time left for the subscription.

REQ8: The different rate control mechanisms must address corner cases for setting the time periods between two notifications. At a minimum, the mechanisms must address the situation when the time between two notifications would exceed the subscription duration and should provide mechanisms for avoiding this situation.

REQ9: The different rate control mechanisms must be possible to be invoked, modified, or removed in the course of an active subscription.

REQ10: The different rate control mechanisms must allow for the application of authentication and integrity protection mechanisms to subscriptions invoking that mechanism.

[4.](#) Basic Operations

[4.1.](#) Subscriber Behavior

In general, the way in which a subscriber generates SUBSCRIBE requests and processes NOTIFY requests is according to [RFC 3265](#) [[RFC3265](#)].

A subscriber that wants to have a maximum, minimum or adaptive minimum rate of event notifications in a specific event subscription does so by including a "min-interval", "max-interval" or "average-interval" Event header field parameter(s) as part of the SUBSCRIBE

request.

A subscriber that wants to update a previously agreed event rate control parameter does so by including the updated "min-interval", "max-interval" or "average-interval" Event header field parameter(s) as part of a subsequent SUBSCRIBE request or a 2xx response to the NOTIFY request. If the subscriber did not include at least one of the "min-interval", "max-interval", or "average-interval" header field parameters in the most recent SUBSCRIBE request in a given dialog, it **MUST NOT** include an Event header field with any of those parameters in a 2xx response to a NOTIFY request in that dialog.

[4.2.](#) Notifier Behavior

In general, the way in which a notifier processes SUBSCRIBE requests and generates NOTIFY requests is according to [RFC 3265](#) [[RFC3265](#)].

A notifier that supports the different rate control mechanisms will comply with the value given in "min-interval", "max-interval" and "average-interval" parameters and adjust its rate of notification accordingly. However, if the notifier needs to lower the subscription expiration value or if a local policy or other implementation-determined constraint at the notifier can not satisfy the rate control request, then the notifier can adjust (i.e. increase or decrease) appropriately the subscriber requested rate control.

[5.](#) Operation of the Maximum Rate Mechanism

[5.1.](#) Subscriber Behavior

A subscriber that wishes to apply a maximum rate to notifications in a subscription **MUST** construct a SUBSCRIBE request that includes a minimum time interval between two consecutive notifications included in the "min-interval" Event header field parameter. The value of this parameter is an integral number of seconds in decimal.

Note that the witnessed time between two consecutive received notifications may not conform to the "min-interval" value for a number of reasons. For example, network jitter and retransmissions may result in the subscriber receiving the notifications with smaller intervals than the "min-interval" value recommends.

A subscriber that wishes to update the previously agreed maximum rate of notifications **MUST** include the updated "min-interval" Event header

field parameter in a subsequent SUBSCRIBE request or a 2xx response to the NOTIFY request.

A subscriber that wishes to remove the maximum rate control from notifications MUST indicate so by not including a "min-interval" Event header field parameter in a subsequent SUBSCRIBE request or a 2xx response to the NOTIFY request.

There are two main consequences for the subscriber when applying the maximum rate mechanism: state transitions may be lost, and event notifications may be delayed. If either of these side effects constitute a problem to the application that utilizes the event notifications, developers are instructed not to use the mechanism.

[5.2.](#) Notifier Behavior

A notifier that supports the maximum rate mechanism MUST extract the value of the "min-interval" Event header parameter from a SUBSCRIBE request or a 2xx response to the NOTIFY request and use it as the suggested minimum time allowed between two notifications. This value can be adjusted by the notifier, as defined in [Section 5.3](#).

A compliant notifier MUST reflect back the possibly adjusted minimum time interval in a "min-interval" Subscription-State header field parameter of the subsequent NOTIFY requests. The indicated "min-interval" value is adopted by the notifier, and the notification rate is adjusted accordingly.

A notifier that does not understand this extension will not reflect the "min-interval" Subscription-State header field parameter in the NOTIFY requests; the absence of this parameter indicates to the subscriber that no rate control is supported by the notifier.

A compliant notifier MUST NOT generate notifications more frequently than the maximum rate allows for, except when generating the notification either upon receipt of a SUBSCRIBE request (the first notification), when the subscription state is changing from "pending" to "active" state or upon termination of the subscription (the last notification). Such notifications reset the timer for the next notification.

When a local policy dictates a maximum rate for notifications, a

notifier will not generate notifications more frequently than the local policy maximum rate, even if the subscriber is not asking for maximum rate control. The notifier MAY inform the subscriber about such local policy maximum rate using the "min-interval" Subscription-State header field parameter included in the subsequent NOTIFY requests.

Retransmissions of NOTIFY requests are not affected by the maximum rate mechanism, i.e., the maximum rate mechanism only applies to the

generation of new transactions. In other words, the maximum rate mechanism does not in any way break or modify the normal retransmission mechanism specified in [RFC 3261](#) [[RFC3261](#)].

[5.3](#). Selecting the Maximum Rate

Special care needs to be taken when selecting the "min-interval" value. For example, the maximum rate could potentially set a minimum time value between notifications that exceeds the subscription expiration value. Such a configuration would effectively quench the notifier, resulting in exactly two notifications to be generated. If the subscriber requests a "min-interval" value greater than the subscription expiration, the notifier MUST lower the "min-interval" value and set it to the expiration time left. According to [RFC 3265](#) [[RFC3265](#)] the notifier may also shorten the subscription expiry anytime during an active subscription. If the subscription expiry is shortened during an active subscription, the notifier MUST also lower the "min-interval" value and set it to the reduced expiration time.

In some cases it makes sense to pause the notification stream on an existing subscription dialog on a temporary basis without terminating the subscription, e.g. due to inactivity on the application user interface. Whenever a subscriber discovers the need to perform the notification pause operation, it SHOULD set the "min-interval" value to the remaining subscription expiration value. This results in receiving no further notifications until the subscription expires or the subscriber sends a SUBSCRIBE request resuming notifications.

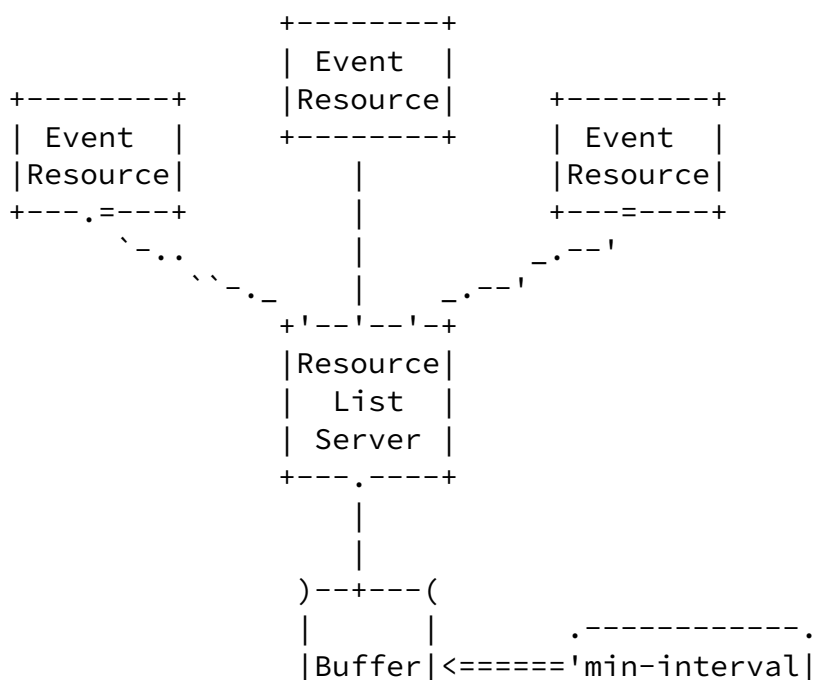
The notifier MAY decide to increase or decrease the proposed maximum rate value by the subscriber based on its local policy, static configuration or other implementation-determined constraints. The notifier MUST include the adjusted "min-interval" value in the

Subscription-State header field's "min-interval" parameter in each of the NOTIFY requests. In addition, different event packages MAY define additional constraints to the allowed "min-interval" intervals. Such constraints are out of the scope of this specification.

5.4. The Maximum Rate Mechanism for Resource List Server

When applied to a list subscription [RFC4662], the maximum rate mechanism has some additional considerations. Specifically, the maximum rate applies to the aggregate notification stream resulting from the list subscription, rather than explicitly controlling the notification of each of the implied constituent events. Moreover, the RLS can use the maximum rate mechanism on its own to control the rate of the back-end subscriptions to avoid overflowing its buffer.

The notifier is responsible for sending out event notifications upon state changes of the subscribed resource. We can model the notifier as consisting of four components: the event state resource(s), the Resource List Server (RLS) (or any other notifier), a notification buffer, and finally the subscriber, or watcher of the event state, as shown in Figure 1.



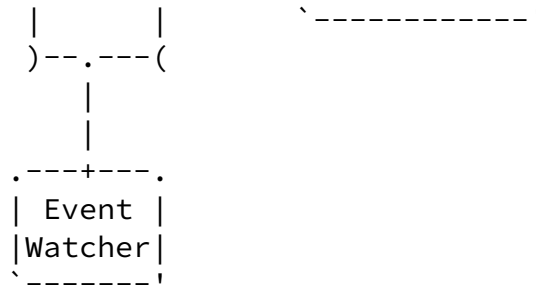


Figure 1: Model for the Resource List Server (RLS) Supporting Throttling

In short, the RLS reads event state changes from the event state resource, either by creating a back end subscription, or by other means; it packages them into event notifications and submits them into the output buffer. The rate at which this output buffer drains is controlled by the subscriber via the maximum rate mechanism. When a set of notifications are batched together, the way in which overlapping resource state is handled depends on the type of the resource state:

In theory, there are many buffer policies that the notifier could implement. However, we only concentrate on two practical buffer policies in this specification, leaving additional ones for further study and out of the scope of this specification. These two buffer policies depend on the mode in which the notifier is operating.

Full-state: Last (most recent) full state notification of each resource is sent out, and all others in the buffer are discarded. This policy applies to those event packages that carry full-state notifications.

Partial-state: The state deltas of each buffered partial notification per resource are merged, and the resulting notification is sent out. This policy applies to those event packages that carry partial-state notifications.

[5.5.](#) Buffer Policy Description

[5.5.1.](#) Partial State Notifications

With partial notifications, the notifier needs to maintain a separate buffer for each subscriber since each subscriber may have a different value for the maximum rate of notifications. The notifier will always need to keep both a copy of the current full state of the resource F , as well as the last successfully communicated full state view F' of the resource in a specific subscription. The construction of a partial notification then involves creating a difference of the two states, and generating a notification that contains that difference.

When the maximum rate mechanism is applied to the subscription, it is important that F' is replaced with F only when the difference of F and F' was already included in a partial state notification to the subscriber allowed by the maximum rate mechanism. Additionally, the notifier implementation SHOULD check to see that the size of an accumulated partial state notification is smaller than the full state, and if not, the notifier SHOULD send the full state notification instead.

[5.5.2.](#) Full State Notifications

With full state notifications, the notifier only needs to keep the full state of the resource, and when that changes, send the resulting notification over to the subscriber.

When the maximum rate mechanism is applied to the subscription, the notifier receives the state changes of the resource, and generates a

notification. If there is a pending notification, the notifier simply replaces that notification with the new notification, discarding the older state.

[5.6.](#) Estimated Bandwidth Savings

It is difficult to estimate the total bandwidth savings accrued by using the maximum rate mechanism over a subscription, since such estimates will vary depending on the usage scenarios. However, it is easy to see that given a subscription where several full state notifications would have normally been sent in any given interval set

by the "min-interval" parameter, only a single notification is sent during the same interval when using the maximum rate mechanism yielding bandwidth savings of several times the notification size.

With partial-state notifications, drawing estimates is further complicated by the fact that the states of consecutive updates may or may not overlap. However, even in the worst case scenario, where each partial update is to a different part of the full state, a rate controlled notification merging all of these n partial states together should at a maximum be the size of a full-state update. In this case, the bandwidth savings are approximately n times the size of the header fields of the NOTIFY request.

It is also true that there are several compression schemes available that have been designed to save bandwidth in SIP, e.g., SigComp [[RFC3320](#)] and TLS compression [[RFC3943](#)]. However, such compression schemes are complementary rather than competing mechanisms to the maximum rate mechanism. After all, they can both be applied simultaneously.

[6.](#) Operation of the Minimum Rate Mechanism

[6.1.](#) Subscriber Behavior

A subscriber that wishes to apply a minimum rate to notifications in a subscription MUST construct a SUBSCRIBE request that includes a maximum time interval between two consecutive notifications included in the "max-interval" Event header field parameter. The value of this parameter is an integral number of seconds in decimal.

A subscriber that wishes to update the previously agreed minimum rate of notifications MUST include the updated "max-interval" Event header field parameter in a subsequent SUBSCRIBE request or a 2xx response to the NOTIFY request.

A subscriber that wishes to remove the minimum rate control from

notifications MUST indicate so by not including a "max-interval" Event header field parameter in a subsequent SUBSCRIBE request or a 2xx response to the NOTIFY request.

The main consequence for the subscriber when applying the minimum rate mechanism is that it can receive a notification even if nothing has changed in the current state of the notifier. However, [RFC 5839](#) [RFC5839] defines a mechanism that allows sending only an etag instead of the full resource state in a notification if the state has not changed.

[6.2.](#) Notifier Behavior

A notifier that supports the minimum rate mechanism MUST extract the value of the "max-interval" Event header field parameter from a SUBSCRIBE request or a 2xx response to the NOTIFY request and use it as the suggested maximum time allowed between two notifications.

The notifier MAY decide to increase or decrease the proposed minimum rate value based on its local policy, static configuration or other implementation-determined constraints. A compliant notifier MUST reflect back the possibly adjusted maximum time interval in a "max-interval" Subscription-State header field parameter of the subsequent NOTIFY requests. The indicated "max-interval" value is adopted by the notifier, and the notification rate is adjusted accordingly.

A notifier that does not understand this extension, will not reflect the "max-interval" Subscription-State header field parameter in the NOTIFY requests; the absence of this parameter indicates to the subscriber that no rate control is supported by the notifier.

A compliant notifier MUST generate notifications when state changes occur or when the time since the most recent notification exceeds the value in the "max-interval" parameter. Depending on the event package and subscriber preferences indicated in the SUBSCRIBE request, the NOTIFY request sent as a result of a max-interval expiration MUST contain either the current full state or the partial state showing the difference between the current state and the last successfully communicated state.

Retransmissions of NOTIFY requests are not affected by the minimum rate mechanism, i.e., the minimum rate mechanism only applies to the generation of new transactions. In other words, the minimum rate mechanism does not in any way break or modify the normal retransmission mechanism.

[7.](#) Operation of the Adaptive Minimum Rate Mechanism

[7.1.](#) Subscriber Behavior

A subscriber that wishes to apply an adaptive minimum rate to notifications in a subscription MUST construct a SUBSCRIBE request that includes an average maximum time interval between two consecutive notifications included in a "average-interval" Event header field parameter. The value of this parameter is an integral number of seconds in decimal.

A subscriber that wishes to update the previously agreed adaptive minimum rate of notifications MUST include the updated "average-interval" Event header field parameter in a subsequent SUBSCRIBE request or a 2xx response to the NOTIFY request.

A subscriber that wishes to remove the adaptive minimum rate control from notifications MUST indicate so by not including a "average-interval" Event header field parameter in a subsequent SUBSCRIBE request or a 2xx response to the NOTIFY request.

The main consequence for the subscriber when applying the adaptive minimum rate mechanism is that it can receive a notification even if nothing has changed in the current state of the notifier. However, [RFC 5839](#) [[RFC5839](#)] defines a mechanism that allows sending only an etag instead of the full resource state in a notification if the state has not changed.

[7.2.](#) Notifier Behavior

A notifier that supports the adaptive minimum rate mechanism MUST extract the value of the "average-interval" Event header parameter from a SUBSCRIBE request or a 2xx response to the NOTIFY request and use it to calculate the actual maximum time between two notifications as defined in [Section 7.3](#).

The notifier MAY decide to increase or decrease the proposed "average-interval" based on its local policy, static configuration or other implementation-determined constraints. A compliant notifier MUST reflect back the possibly adjusted time interval in an "average-interval" Subscription-State header field parameter of the subsequent NOTIFY requests. The indicated "average-interval" value is adopted by the notifier, and the notification rate is adjusted accordingly.

A notifier that does not understand this extension will not reflect the "average-interval" Subscription-State header parameter in the NOTIFY requests; the absence of this parameter indicates to the

subscriber that no rate control is supported by the notifier.

A compliant notifier SHOULD generate notifications when state changes occur or when the time since the most recent notification exceeds the value calculated using the formula defined in [Section 7.3](#).

The adaptive minimum rate mechanism is implemented as follows:

- 1) When a subscription is first created, the notifier creates a record that keeps track of the number of notifications that have been sent in the "period". This record is initialized to contain a history of having sent one message every "average-interval" seconds for the "period".
- 2) The "timeout" value is calculated according to the equation given in [Section 7.3](#).
- 3) If the timeout period passes without a NOTIFY request being sent in the subscription, then the current resource state is sent (subject to any filtering associated with the subscription).
- 4) Whenever a NOTIFY request is sent (regardless of whether due to a timeout or a state change), the notifier updates the notification history record, recalculates the value of "timeout," and returns to step 3.

Retransmissions of NOTIFY requests are not affected by the timeout, i.e., the timeout only applies to the generation of new transactions. In other words, the timeout does not in any way break or modify the normal retransmission mechanism specified in [RFC 3261](#) [[RFC3261](#)].

[7.3](#). Calculating the Timeout

The formula used to vary the absolute pacing in a way that will meet the adaptive minimum rate requested over the period is given in equation (1):

$$\text{timeout} = (\text{average-interval} \wedge 2) * \text{count} / \text{period} \quad (1)$$

The output of the formula, "timeout", is the time to the next notification, expressed in seconds. The formula has three inputs:

average-interval: The value of the "average-interval" parameter conveyed in the Subscription-State header field, in seconds.

period: The rolling average period, in seconds. The value of the "period" parameter is chosen by the notifier, however the notifier MUST choose a value greater than the value of the "average-interval" parameter. The granularity of the values for the

"period" parameter is set by local policy at the notifier. It is an implementation decision whether the notifier uses the same value of the "period" parameter for all subscriptions or individual values for each subscription.

count: The number of notifications that have been sent during the last "period" of seconds not including any retransmissions of requests.

In case both the maximum rate and the adaptive minimum rate mechanisms are used in the same subscription the formula used to dynamically calculate the timeout is given in equation (2):

$$\text{timeout} = \text{MAX}[\text{min-interval}, (\text{average-interval} \wedge 2) * \text{count} / \text{period}] \quad (2)$$

min-interval: The value of the "min-interval" parameter conveyed in the Subscription-State header field, in seconds.

The formula in (2) makes sure that for all the possible values of the "min-interval" and "average-interval" parameters, with "average-interval" > "min-interval", the timeout never results in a lower value than the value of the "min-interval" parameter.

In some situation it may be beneficial for the notifier to achieve an adaptive minimum rate in a different way than the algorithm detailed in this document allows. However, the notifier MUST comply with any "min-interval" or "max-interval" parameters that have been negotiated.

Mechanisms in a combination

Applications can subscribe to an event package using all the rate control mechanisms individually, or in combination; in fact there is no technical incompatibility among them. However there are some combinations of the different rate control mechanisms that make little sense to be used together. This section lists all the combinations that are possible to insert in a subscription; the utility to use each combination in a subscription is also analyzed.

maximum rate and minimum rate: This combination allows to reduce the notification frequency rate, but at the same time assures the reception of a notification every time the most recent notification exceeds a specified interval.

Niemi, et al.

Expires April 21, 2011

[Page 18]

Internet-Draft

Event Rate Control

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A subscriber SHOULD choose a "max-interval" value higher than the "min-interval" value, otherwise the notifier MUST adjust the subscriber provided "max-interval" value to a value equal to or higher than the "min-interval" value.

maximum rate and adaptive minimum rate: It works in a similar way as the combination above, but with the difference that the interval at which notifications are assured changes dynamically.

A subscriber SHOULD choose a "average-interval" value higher than the "min-interval" value, otherwise the notifier MUST adjust the subscriber provided "average-interval" value to a value equal to or higher than the "min-interval" value.

minimum rate and adaptive minimum rate: When using the adaptive minimum rate mechanism, frequent state changes in a short period can result in no notifications for a longer period following the short period. The addition of the minimum rate mechanism ensures the subscriber always receives notifications after a specified interval.

A subscriber SHOULD choose a "max-interval" value higher than the "average-interval" value, otherwise the notifier MUST NOT consider the "max-interval" value.

maximum rate, minimum rate and adaptive minimum rate: This

combination makes little sense to be used although not forbidden.

A subscriber SHOULD choose a "max-interval" and "average-interval" values higher than the "min-interval" value, otherwise the notifier MUST adjust the subscriber provided "max-interval" and "average-interval" values to a value equal to or higher than the "min-interval" value.

A subscriber SHOULD choose a "max-interval" value higher than the "average-interval" value, otherwise the notifier MUST NOT consider the "max-interval" value.

[9.](#) Protocol Element Definitions

This section describes the protocol extensions required for the different rate control mechanisms.

[9.1.](#) "min-interval", "max-interval" and "average-interval" Header Field Parameters

The "min-interval", "max-interval" and "average-interval" parameters

are added to the rule definitions of the Event header field and the Subscription-State header field in [RFC 3265](#) [RFC3265] grammar. Usage of this parameter is described in [Section 5](#), [Section 6](#) and [Section 7](#).

[9.2.](#) Grammar

This section describes the Augmented BNF [RFC5234] definitions for the new header field parameters. Note that we derive here from the ruleset present in [RFC 3265](#) [RFC3265], adding additional alternatives to the alternative sets of "event-param" and "subexp-params" defined therein.

```
event-param      =/ min-interval-param
subexp-params    =/ min-interval-param
min-interval-param = "min-interval" EQUAL delta-seconds
```

```
event-param      =/ max-interval-param
subexp-params    =/ max-interval-param
max-interval-param = "max-interval" EQUAL delta-seconds
```

```

event-param      =/ average-interval-param
subexp-params    =/ average-interval-param
average-interval-param = "average-interval" EQUAL delta-seconds

```

9.3. Event Header Field Usage in Responses to the NOTIFY request

This table expands the table described in [Section 7.2 of RFC 3265 \[RFC3265\]](#) allowing the Event header field to appear in a 2xx response to a NOTIFY request. The use of the Event header field in responses other than 2xx to NOTIFY requests is undefined and out of scope of this specification.

Header field	where proxy	ACK	BYE	CAN	INV	OPT	REG	PRA	SUB	NOT
Event	2xx	-	-	-	-	-	-	-	-	0

A subscriber that wishes to update the value for maximum, minimum or adaptive minimum rate of notifications can do so by including all desired values for the "min-interval", "max-interval" and "average-interval" parameters in an Event header field of the 2xx response to a NOTIFY request. Any of the other header field parameters currently defined for the Event header field by other specifications do not have a meaning if the Event header field is included in the 2xx response to the NOTIFY request. These header field parameters MUST be ignored by the notifier, if present.

The event type listed in the Event header field of the 2xx response to the NOTIFY request MUST match the event type of the Event header field in the corresponding NOTIFY request.

10. IANA Considerations

This specification registers three new SIP header field parameters, defined by the following information which is to be added to the Header Field Parameters and Parameter Values sub-registry under <http://www.iana.org/assignments/sip-parameters>.

Header Field	Parameter Name	Predefined Values	Reference
Event	min-interval	No	[RFCxxxx]
Subscription-State	min-interval	No	[RFCxxxx]
Event	max-interval	No	[RFCxxxx]
Subscription-State	max-interval	No	[RFCxxxx]
Event	average-interval	No	[RFCxxxx]
Subscription-State	average-interval	No	[RFCxxxx]

(Note to the RFC Editor: please replace "xxxx" with the RFC number of this specification, when assigned.)

This specification also updates the reference defining the Event header field in the Header Fields sub-registry under <http://www.iana.org/assignments/sip-parameters>.

Header Name	compact	Reference
Event	o	[RFC3265] [RFCxxxx]

(Note to the RFC Editor: please replace "xxxx" with the RFC number of this specification, when assigned.)

11. Security Considerations

Naturally, the security considerations listed in [RFC 3265](#) [[RFC3265](#)], which the rate control mechanisms described in this document extends, apply in entirety. In particular, authentication and message integrity SHOULD be applied to subscriptions with this extension.

[RFC 3265](#) [[RFC3265](#)] recommends the integrity protection of the Event header field of SUBSCRIBE requests. Implementations of this extension SHOULD also provide integrity protection for the Event header field included in the 2xx response to the NOTIFY request.

Without integrity protection an eavesdropper could see and modify the Event header field; or it could also manipulate the transmission of a 200 (OK) response to the NOTIFY request in order to suppress or flood notifications without the subscriber seeing what caused the problem.

When the maximum rate mechanism involves partial state notifications, the security considerations listed in [RFC 5263](#) [[RFC5263](#)] apply in entirety.

[12.](#) Acknowledgments

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