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Expires in six months January 10, 2002

**Load Grouping Extension
for
Signalling User Adaptation Layers
<draft-bidulock-sigtran-loadgrp-00.ps>**

Status of this Memo

Abstract

This Internet-Draft describes an extension parameter and procedure to the Signalling User Adaptation Protocols [IUA...TUA], based on the Stream Transmission Control Protocol (SCTP) [RFC 2960] which permits an Application Server Processes (ASP) to indicate its placement within a Load Group and permits an Signalling Gateway (SG) to distribute traffic over Load Groups under Application Server Process (ASP) control.

The described procedure provides for Override, Loadshare and Broadcast traffic mode operation within a Load Group consisting of one or more Application Server Processes (ASPs) resulting a mixture of traffic modes within an Application Server (AS). The parameters and procedures described here supplement the *UA Load Selection* [LOADSEL] extension parameters and procedures for improvide distribution of traffic over ASPs and Signalling Gateway Processes (SGPs).

1. Introduction

1.1. Scope

This Internet-Draft provides the *Load Distribution* parameter and associated procedures in extension to the parmeters and procedures of the Signalling User Adaptation Layers (UAs) [IUA...TUA], and the *Load Selection* [LOADSEL] extension, for the purpose of permitting Application Server Process control over grouping of ASPs into Application Servers as part of the procedures of these UA protocols.

This *Load Grouping* extension is intended to be compatible with UA implementations not supporting this extension.

1.2. Terminology

This extension supplements the terminology used in the UA documents [IUA...TUA] and the *Load Selection* extension by adding the following terms:

Load Distribution (LD) – a *Traffic Mode Type* which is applicable within a *Load Group*.

Load Group (LG) – a group of ASPs that share the same traffic distribution within an Application Server. An ASP is permitted to belong to more than one *Load Group* for a given AS.

Load Selection (LS) – an identifier that uniquely identifies a *Load Group* within an Application Server. This identifier is only guaranteed unique within the scope of an Application Server and must be combined with a *Routing Context* or (set of) *Interface Identifier(s)* to uniquely define a *Load Group* at a Signalling Gateway.

Signalling User Adaptation Layer (UA) – one or more of the Stream Control Transmission Protocol (SCTP) [RFC 2960] Signalling User Adatapation Layers [IUA...TUA].

1.3. Overview

Existing UA procedures with regard to traffic distribution and ASP traffic management provide a mechanism to select the algorithm for coordinating state and distributing traffic over a number of Application Server Processes (ASPs) serving an Application Server. These existing procedures provide only simplified distribution approaches which are not ammeniable to large scale systems that need to adapt to dynamic traffic loading or need live reconfiguration for maintenance purposes.

This extension to the Signalling User Adaptation Layers [IUA...TUA] permits close control over the grouping of Application Server Processes serving an Application Server that provides the following capability not existing in the current scheme:

Grouping of ASPs into Load Groups

Under the existing approach, each Application Server Process acts independently with respect to an Application Server. This approach does not provide for the grouping of ASPs into workgroups, not does it provide coordintaed control of the role of groups of ASPs serving an ASP. As a result, the existing scheme does not scale well in this regard.

This extension draft provides for the grouping of ASPs into load groups with a traffic distribution mode (Load Distribution) within the load group that is independent of the Application Sever traffic mode.

1.3.1. Existing Traffic Distribution

Figure 1 illustrates the existing traffic distribution algorithm that is used across the Signalling User Adaptation Layers.

When an SGP distributes a Signalling User Adaptation Layer message towards the Application Server based on the Routing (Link) Key, it selects an ASP that is active for the AS according to a Traffic Mode Type that is associated with the AS. The Traffic Mode Type describes three general distribution algorithms: Override, Loadshare and Broadcast.

The detailed actions taken for these distribution algorithms are described in Section 4 of the Signalling User Adaptation Layer specifications [IUA...TUA]; however, they can be summarized as follows:

Traffic Mode Type Override:– When distributing messages to an Override Application Server, the SGP selects the ASP which is active for the Application Server. In an Override Application Server, at most one ASP can be active for the AS at any given point in time. The active ASP for the AS is selected.

```
                                    ____
           Traffic                 /....\
           Mode Type          ____|__....|
 _______                     |       |...|
|       |------------------->|  ASP  |...|
|  SGP  |-----\              |_______|...|
|_______|----\ \              ____|__....|
         \--\ \ \            |       |...|
             \ \ \---------->|  ASP  |...|
 _______      \ \            |_______|...|
|       |      \ \                |......| Application
|  SGP  |       \ \               |......| Server
|_______|        \ \              |......|
                  \ \             |......|
                   \ \        ____|__....|
                    \ \      |       |...|
                     \ \---->|  ASP  |...|
                      \      |_______|...|
                       \      ____|__....|
                        \    |       |...|
                         \-->|  ASP  |...|
                             |_______|...|
                                  |......|
                                   \____/
```

Figure 1. Existing Traffic Distribution

Traffic Mode Type Loadshare:– When distributing messages to a Loadshare Application Server, the SGP selects one of the ASPs that are active for the Application Server using an implementation dependent loadsharing algorithm based on some unspecified aspect of the traffic or static configuration data.

Traffic Mode Type Broadcast:– When distributing messages to a Broadcast Application Server, the SGP sends a copy of the message to each of the ASPs that are active for the Application Server. (The ASPs themselves decide which, if any, of the ASPs will process the message.)

In general, for the Signalling User Adapatation Layers, the Traffic Mode Type is a characteristic of the Application Server, and an Application Server can only have associated with it only one Traffic Mode Type, and thus, only one traffic distribution algorithm can be used across the ASPs that are serving a given Application Server.

This extension document enhances the traffic distribution algorithms of the existing Signalling User Adaptation Layers by introducing an additional level of distribution.

1.3.2. Extended Traffic Distribution

Figure 2 illustrates the extended traffic distribution algorithms that are used across the Signalling User Adaptation Layers as a result of the messages and procedures in this extension.

This extension introduces the concept of a *Load Group*. A *Load Group* is a logical grouping of Application Server Processes (ASPs) into traffic groups serving an Application Server. Signalling Gateway Processes (SGPs) distribute traffic first over *Load Groups* and then distribute traffic within the *Load Group*. Each *Load Group* describes and is identified by a *Load Selection* [LOADSEL] within the Application Server. The *Load Selection* identifies the traffic flows that will be distributed to an associated *Load Group* within an Application Server.

When an SGP distributes a Signalling User Adaptation Layer message towards an Application Server based on the Routing (Link) Key, it first selects an *Load Group* that is active for the Application Server according a traffic distribtuion algorithm determined by the *Load Distribution* that is associated with the Application Server and the *Load Selection* position of the *Load Group* within the AS.

The Traffic Mode Type continues to describe three general distribution algorithms: Override, Loadshare and Broadcast. The change in the behavior of the SGP when selecting an ASP for traffic distribution introduced by this extension is that the SGP also takes into account the concept of a *Load Group* as identified within an AS by its *Load Selection*.

The extended procedures can be summarized as follows:

Traffic Mode Type Override:– When distributing messages to an Override Application Server, the SGP first selects the *Load Group* that is active for the Application Server. In an Override Application Server, at most one *Load Group* can be active for the AS at any given point in time. The active *Load Group* for the AS is selected.

```
                             ____    ____
           Traffic    Load  /....\  /....\
           Mode Type  Group|...___||__....|
 _______                   |..|       |...|
|       |---+---------------->|  ASP  |...|
|  SGP  |    \             |..|_______|...|
|_______|-\   \            |...___||__....|
           \   \           |..|       |...|
            \   \------------>|  ASP  |...|
 _______    |              |..|_______|...|
|       |   |              |......||......| Application
|  SGP  |   |               \____/ |......| Server
|_______|   |                ____  |......|
            |         Load  /....\ |......|
            |         Group|...___||__....|
            |              |..|       |...|
            +---------------->|  ASP  |...|
             \             |..|_______|...|
              \            |...___||__....|
               \           |..|       |...|
                \------------>|  ASP  |...|
                           |..|_______|...|
                           |......||......|
                            \____/  \____/
```

Figure 2. Load Group Traffic Distribution

Traffic Mode Type Loadshare:– When distributing messages to a Loadshare Application Server, the SGP selects one of the *Load Groups* that are active for the Application Server using an implementation dependent loadsharing algorithm based on the *Load Selection* [LOADSEL] associated with the *Load Group*.

Traffic Mode Type Broadcast:– When distrbuting messages to a Broadcast Application Server, the SGP sends a copy of the message to each of the *Load Groups* that are active for the Application Server. (The *Load Groups* themselves decide which, if any, of the *Load Groups* will process the message.)

After selecting an *Load Group* according to the *Traffic Mode Type* for the Application Server, the SGP then selects an ASP within the *Load Group* based on the *Load Distribution* that is associated with the *Load Group*. The *Load Distribution* describes the same three general distribution algorithms that are provided in the *Traffic Mode Type:* Override, Loadshare and Broadcast. When selecting an active ASP within a *Load Group*, the procedures that the SGP will follow can be summarized as follows:

Load Distribution Override:– When distributing messages within an Override Load Group, the SGP selects the ASP which is active for the Load Group. In an Override Load Group, at most one ASP can be active for the *Load Group* at any given point in time. The active ASP for the *Load Group* is selected.

Load Distribution Loadshare:– When distributing messages within a Loadshare Load Group, the SGP selects one of the ASPs that are active for the Load Group using an implementation dependent loadsharing algorithm based on some unspecified aspect of the traffic or static configuration data.

Load Distribution Broadcast:– When distributing messages within a Broadcast Load Group, the SGP sends a copy of the message to each of the ASPs that are active for the Load Group. (The ASPs themselves decide which, if any, of the APSs will process the message.)

The result of this extension is that two levels of traffic distribution are provided for, permitting more flexible membership of ASPs serving Application Servers, and provides the Application Server Process with more control over the traffic patterns for which it is active.

1.4. Sample Configurations

Although this extension does not restrict either Traffic Mode Type or Load Distribution to a static assignment, there are, for example, six (6) combinations of static Traffic Mode Type and Load Distribution assignment under this scheme. Not all of these combinations provide for interesting or useful configurations as follows:

Table 1. Sample Configurations

Mode	Traffic Mode Type	Load Distribution	Description
1	Override	Loadshare	This mode permits a loadshare group of ASPs to override another loadshare group of ASPs.
2		Broadcast	This mode allows "mirrored" ASPs to override each other.
3	Loadshare	Override	This mode allows ASPs to override each other within a traffic slot of a loadshare group.
4		Broadcast	This mode permits "striping" and "mirroring" with loadsharing under ASP control.
5	Broadcast	Override	This mode permits a joining ASP to knock another ASP out of a Broadcast slot for an Application Server.
6		Loadshare	This mode permits "mirroring" and "striping" including automatic loadsharing within a mirror image.

2. Conventions

The keywords **MUST**, **MUST NOT**, **REQUIRED**, **SHALL**, **SHALL NOT, SHOULD**, **SHOULD NOT**, **RECOMMENDED**, **NOT RECOMMENDED**, **MAY**, and **OPTIONAL**, when they appear in this document, are to be interpreted as described in [RFC 2119].

3. Protocol Elements

The following subsections describe the parameters which are added by this extension, their format and the message in which they are used.

3.1. Parameters

This extension adds one new parameter: the *Load Distribution* parameter.

3.1.1. Load Distribution

The *Load Distribution* parameter is used in the *REQ REQ*, *REQ RSP*, *ASPAC* and *ASPAC ACK* messages. It is used in conjunction with the *Traffic Mode Type* parameter [M3UA...TUA] and *Load Selection* parameter [LOADSEL] to further refine the traffic distribution algorithm for an ASP in a *Load Group* serving an Application Server. The *Load Selection* parameter identifies the *Load Group* for which the ASP is registering, activating or deactivating and the *Load Distribution* parameter identifies the traffic distribution that is to be used within the *Load Group*.

The *Load Distribution* parameter is formatted as follows:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0xXXXX         |          Length = 8           |
+-------------------------------+-------------------------------+
|                       Load Distribution                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

EDITOR'S NOTE:– The parameter tag values shown as **`0xXXXX`** above will be assigned by IANA within the common parameter range of the SIGTRAN UAs and may change its value in further versions of this document.

The *Load Distribution* parameter contains the following fields:

Load Distribution field: n x 32-bits (unsigned integer)

THe *Load Distribution* has the same purpose for the *Load Group* that the *Traffic Mode Type* has for the Application Server: it identifies the traffic distribution algorithm to be used within the *Load Group*. Valid values for *Load Distribution* are as follows:

1	Override
2	Loadshare
3	Broadcast

3.2. Messages

This extension adds the *Load Distribtution* parameter as an **OPTIONAL** parameter to be used in conjunction with the common *Traffic Mode Type* in the following messages: [1]

REG REQ	Registration Request message
ASPAC	ASP Active message
ASPAC Ack	ASP Active Ack message

3.2.1. Registration Request (REG REQ)

This extension supplements the *Registration Request (REG REQ)* message by permitting the following optional parameters to be included in the *Routing Key* [M3UA...TUA] parameter or *Link Key* [IUA...M2UA] parameter within the message:

Extension Subparameters	
Load Distribution	Optional

The *Load Distribution* parameter is used in the Routing (Link) Key to further refine the traffic distribution to be received by the registering ASP.

The format of the resulting *Routing Key* or *Link Key* parameter is as follows:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Local-RK(LK)-Identifier                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Traffic Mode Type (optional)                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Load Selection (optional)                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Load Distribution (optional)                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
\                                                               \
/                         Routing Context                       /
\                               or                              \
/                     Interface Identifier(s)                   /
\                                                               \
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

No other changes to the *REG REQ* message, *Routing Key* or *Link Key* parameters format are provided by this extension[1].

When an ASP wishes to register within a *Load Group* associated with an Application Server, it includes the *Load Selection* parameter and *Load Distribution* in the *Routing (Link) Key* for that Application Server in the *REG REQ* message.

The *Load Distribtuion* parameter indicates the traffic distribution method to be used within the *Load Group* as identified by the Load Selection.

3.2.2. Registration Response (REG RSP)

This extension adds the following *Registration Status* values to the *)Registration Status* field in the **REG RSP** message:

0xZZ Error - Unsupported/Invalid Load Distribution

EDITOR'S NOTE:- The *Registration Status* value shown as `0xZZ`) above will be assigned by IANA as a value of the UA-specific *Registration Status* parameter for each SIGTRAN UA and may change its value in further versions of this document.

3.2.3. ASP Active (ASPAC)

This extension supplements the **ASPAC** message by permitting the following optional parameters to be included in the message:

Extension Parameters	
Load Distribution	Optional

The format of the resulting *ASPAC* message is as follows:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0x000b         |           Length = 8          |
+-------------------------------+-------------------------------+
|                       Traffic Mode Type                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0x001d         |           Length = 8          |
+-------------------------------+-------------------------------+
\                                                               \
/                       Load Selection(s)                       /
\                                                               \
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0xXXXX         |           Length = 8          |
+-------------------------------+-------------------------------+
|                       Load Distribution                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
\                                                               \
/                        Routing Context                        /
\                              or                               \
/                     Interface Identifier(s)                   /
\                                                               \
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0x0004         |             Length            |
+-------------------------------+-------------------------------+
\                                                               \
/                          Info String                          /
\                                                               \
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

EDITOR'S NOTE:– The parameter tag values shown as **`0xXXXX`** above will be assigned by IANA within the common parameter range of the SIGTRAN UAs and may change its value in further versions of this document.

No other changes to the **ASPAC** message format are provided by this extension[1].

When an ASP wishes to activate only within a *Load Group* associated with an Application Server, it includes the *Load Selection* and *Load Distribtuion* parameters in the **ASPAC** message.

The *Load Distribtuion* parameter indicates the traffic distribution method to be used within the *Load Group* as identified by the Load Selection.

3.2.4. ASP Active Ack (ASPAC ACK)

This extension supplements the ASPAC ACK message by permitting the following optional parameters to be included in the message:

Extension Parameters	
Load Distribution	Optional

The format of the resulting *ASPAC ACK* message is as follows:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0x000b         |          Length = 8           |
+-------------------------------+-------------------------------+
|                       Traffic Mode Type                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0x001d         |          Length = 8           |
+-------------------------------+-------------------------------+
\                                                               \
/                       Load Selection(s)                       /
\                                                               \
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0xXXXX         |          Length = 8           |
+-------------------------------+-------------------------------+
|                       Load Distribtuion                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
\                                                               \
/                        Routing Context                        /
\                              or                               \
/                    Interface Identifier(s)                    /
\                                                               \
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Tag = 0x0004         |          Length               |
+-------------------------------+-------------------------------+
\                                                               \
/                          Info String                          /
\                                                               \
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

EDITOR'S NOTE:– The parameter tag values shown as **0xXXXX** above will be assigned by IANA within the common parameter range of the SIGTRAN UAs and may change its value in further versions of this document.

No other changes to the **ASPAC ACK** message format are provided by this extension[1].

When an ASP has requested activation within a *Load Group* or the SG otherwise activates the ASP within a *Load Group* the SG responds with an **ASPAC ACK** message including the *Load Selection* that identifies the *Load Group* and optionally includes the *Load Distribution* for the *Load Group* in which the ASP has been activated. If the ASP included the *Load Distribution* parameter in the **ASPAC** message, the SG **MUST** include the *Load Distribution* parameter in the response **ASPAC ACK** message.

The *Load Distribtuion* parameter indicates the traffic distribution method to be used within the *Load Group* as identified by the Load Selection.

3.2.5. Error (ERR)

This extension supplements the **Error (ERR)** message by adding the following values to the common mandatory *Error Code* parameter in the **ERR** message:

0xYY   Invalid/Unsupported Load Distribution

EDITOR'S NOTE:- The *Error Code* value shown throughout this document as `0xYY`) will be assigned by IANA as a value of the common *Error Code* parameter for SIGTRAN UAs and may change its value in further versions of this document.

This new error code is interpreted as follows:

The *"Invalid/Unsupported Load Distribution"* error would be sent by an SGP if an ASP sends an ASP Active with an invalid or unsupported Load Distribution. An example would be a case in which the SGP did not support override within a *Load Group*.

No other changes to the **ERR** message or *Error Code* parameter values are provided by this extension. See Section 4 for extension procedures associated with the **ERR** message.

4. Procedures

This *Load Grouping* extension provides for an additional level of control over the traffic distribution patterns within an Application Server. This extension provides the *Load Distribution* parameter which may be optionally included in the **REG REQ**, **ASPAC** and **ASPAC ACK** messages. In addition, it supplements the ASP State Maintenance and ASP Traffic Maintenance procedures.

4.1. ASP State Maintenance

In addition to the SGP mainting the state of each remote ASP in each Application Server that the ASP is configured to receive traffic, under this extension, the SGP **MAY** also maintain the state of each remote ASP in each *Load Group* within an Application server that the ASP is configured to receive traffic. The *Load Group* state is maintained separate from the ASP and AS states.

4.1.1. Load Group State

The state of the *Load Group* is maintained in the Signalling User Adaptation Layer on the SGPs. The state of the *Load Group* changes due ASP state transitions. The possible states of a *Load Group* are:

LG-DOWN: The *Load Group* is unavaialble. This state implies that all related ASPs are in the **ASP-DOWN** state for this *Load Group*. Initially, the *Load Group* will be in this state.

LG-INACTIVE: The *Load Group* is available but no application traffic is active (i.e, one or more related ASPs are in the **ASP-INACTIVE** state, but none are in the **ASP-ACTIVE** state within the *Load Group*).

LG-ACTIVE: The *Load Group* is available and application traffic is active. This state implies that at least one ASP is in the **ASP-ACTIVE** state within the *Load Group*.

4.1.2. Application Server State

Where ASPs are configured to operation within *Load Groups* under this extension, the Application Server state is interpreted as provided in the Signalling User Adaptation Layer specifications [M3UA...TUA].

4.2. ASP Traffic Maintenance

4.2.1. ASP Active Procedures

This *Load Grouping* extension supplements the ASP Active Procedures as follows:

When an ASP sends an **ASPAC** message to activate the ASP within an Application Server, the ASP **MAY** choose to activate within a *Load Group* for the specified AS by including the *Load Selection* parameter in the **)ASPAC** message.

When an SGP receives an **ASPAC** message with a *Load Selection* parameter in the message, or where the SGP is otherwise configured to activate the ASP in a configured *Load Group*, when the SGP moves the ASP to the ASP-ACTIVE state for the AS, it also moves the ASP to the ASP-ACTIVE state for the *Load Group* identified by the *Load Selector* field in the *Load Selection* parameter. In either case, if the activation is successful, the SGP includes the *Load Selection* parameter in the **ASPAC ACK** message.

If the *Load Selector* in the **ASPAC** message is invalid, the SGP responds with ERR("Error - Invalid Load Selector"). If the *Load Selection* parameter is not present in the **ASPAC** message and the SGP is configured to require one, or the *Load Selector* field is not valid or unconfigured for the Application Server, the SGP responsds with ERR("Error - Unsupported/Unconfigured/Missing Load Selector"). If the *Load Selection* parameter contains an invalid or unsupported *Load Distribution* value, or the *Load Selection* parameter is missing but the SGP cannot determine the distribution applicable to the *Load Group* without one, the SGP response with ERR("Error - Invalid/Unsupported/Missing Load Distribution").

There are three modes of Application Server traffic handling in the SGP at the Application Server level and three modes of AS traffic handling at the Load Group level: Override, Loadshare and Broadcast. When included, the *Traffic Mode Type* parameter in the **ASPAC** message indicates the traffic handling mode to be used in a particular Application Server between Load Groups. When included, the *Load Distribution* field in the *Load Selection* parameter indicates the traffic handling mode to be used between ASPs within a Load Group.

In the case of an Override mode AS, reception of an ASP Active message at an SGP may move a *Load Group* to the LG-ACTIVE state. When an LG moves to the LG-ACTIVE state in an Override mode AS, this causes the (re)direction of all traffic for the AS to the active Load Group. Distribution of traffic within the Load Group is determine on the basis of the Load Distribution mode of the Load Group. Any previously active Load Group is now considered to be in state LG-INACTIVE and **SHOULD** no longer receive traffic from the SGP within the AS. The SGP then **MUST** send a Notify message ("Alternate ASP Active") and include the *Load Selection* parameter in the Notify message indicating the *Load Group* that has become active.

In the case of a Loadshare mode AS, the reception of an ASP Active message at an SGP that moves a *Load Group* to the LG-ACTIVE state causes the direction of specific traffic flows associated with the *Load Selector* to the *Load Group*. The assignment of traffic flows to **Load Selector** values is implementation depenedent, but could be based on specific information in the protocol data message.

In the case of a Broadcast mode AS, reception of an ASP Active message at an SGP that results in moving a *Load Group* to the LG-ACTIVE state within the AS causes the direction of traffic to the newly active *Load Group* in addition to all the other LGs that are currently active for the AS. The algorithm at the SGP for broadcasting traffic within an AS to all the active ASPs is a simple broadcast algorithm, where every message is sent to each of the active Load Groups.

4.2.2. ASP Inactive Procedures

This *Load Grouping* extension supplements the ASP Active procedures of the UAs as follows:

When an ASP wishes to withdraw from a specific *Load Group* within an Application Server, the ASP sends an ASP Inactive message to the SGP with a *Load Selection* parameter included in the message. In the case where the ASP does not include the *Load Selection* parameter in the ASP Inactive message, the SGP must know via configuration data which Load Groups the ASP is a member. Upon receiving an ASP Inactive message with included or implied *Load Selection(s)*, the SGP moves the ASP to the ASP-INACTIVE state in each of the Load Groups indicated.

4.3. Registration

UAs permit Application Server Processes to register for the Routing Context (Interface Identifier) associated with a Routing Key (Link Key). This draft extends the registration procedure to also permit the Application Server Process to register for a *Load Group* identifier in addition to the Routing Contex/Interface Id. This is performed using a *Load Group* which has the same form as the Routing Key, but has some additional fields which are only applicable to Loadsharing.

In addition to the normal registration procedures of the UAs, the following additional error conditions can occur:

"Error - Invalid Load Group"

This error **MUST** be sent in an *Error (ERR)* message if the SG determines that the Load Group is invalid.

"Error - Unsupported/Unconfigured Load Group"

This error **MUST** be sent in an *Error (ERR)* message whenever the SG determines that the Load Group provided in a *REG REQ* message has not be configured and the SG does not support dynamic allocation of Load Selectors for the specified Key, and **MUST** be sent in an *Error (ERR)* message whenever the SG determines that the Load Group provided in a *REG REQ* message is not supported by the SG.

"Error - Invalid/Unsupported/Missing Load Distribution"

This error **MUST** be sent in an *Error (ERR)* message whenever the SG determines that the Load Distribution associated wtih a Load Group is invalid, is not supported by the SG, or is required to determine the Load Distribution algorithm of the *Load Group* but is missing from the Load Group in the *REG REQ* message.

4.4. ASP Activation

When activating, this draft extends the UA activation procedures by permitting an optional *Load Selection* parameter to be included in the ASP Active (ASPAC) and ASP Active Ack (ASPAC Ack) messages. The *Load Selection* parameter is used to indicate for which *Load Group* the concerned Application Server is becoming active.

Whenever the SG is unable to activate the ASP within the selected Application Server *Load Group*, the SG **MUST** reply with an *Error (ERR)* message containing one of the errors defined in the UA documents[1], or one of the following additional errors:

"Error - Invalid Load Group Identifier"

4.5. ASP Deactivation

When deactivating, this draft extends the UA activation procedures by permitting an optional *Load Selection* parameter to be included in the ASP Inactive (ASPIA) and ASP Inactive Ack (ASPIA Ack) message. The *Load Selection* parameter is used to indicate for which traffic in the *Load Group* the concerned Application Server is becoming inactive.

4.6. ASP Failure

When an ASP fails that was supporting load-sharing application servers, the NTFY("ASP Failure")

4.7. ASP Override

4.8. Notification

When the SGP or IPSP notifies its UA peer with a NTFY messages which concerns an ASP, it **MUST** include the *Load Group* (if available) along with the ASP Identifier in the message. The NTFY messages to which this applies are:

NTFY("ASP Failure") –

When the SGP or IPSP notifies the active and inactive ASPs in an AS that it has detected the failure of an ASP or the failure of an association to an ASP (i.e. SCTP Communication Lost Indication), it **MUST** include the *Load Group* (if available) with the ASP Identifier in the message. When the Routing Context(s)/Interface Identifier(s) associated with the Application Servers cannot be implied at the ASP from static configuration data, the Routing Context/Interface Identifier(s) **MUST** also be placed in the NTFY("ASP Failure") message. The notifying SGP or IPSP **MAY** also place the *Load Selection* parameter into the NTFY("ASP Failure") message to indicate the traffic which was applicable to the load selection at the time of the failure.

The purpose of this procedure is to inform the active and inactive ASPs, not only of the ASP failure, but of the identity of the ASP and the load selection for which the failed ASP was responsible.

NTFY("Alternate ASP Active in AS") –

When the SGP or IPSP notifies the previously active ASP in a override AS that an alternate ASP has become active using the NTFY("Alternate ASP Active in AS") message, it **MUST** include the *Load Group* (if available) with the ASP Identifier in the message.

The purpose of this procedure is to inform the previously active ASP, not only of the that another ASP has taken over the traffic for which the notified ASP was previously responsible, but to also indicate the identify of the overriding ASP and the load selection that was overridden.

5. Security

6. IANA Considerations

This extension adds the following parameter tag value (described in Section 3) to the Common Parameter numbering space for the UAs [M3UA...TUA].

0xXXXX Load Distribution

EDITOR'S NOTE:– The *Load Distribution* parameter tag value shown throughout this document as **`0xXXXX`** will be assigned by IANA within the common parameter range of the SIGTRAN UAs and may change its value in further versions of this document.

This extension adds the following value to the *Error Code* parameter of the UAs.

0xYY Invalid/Unsupported Load Distribution

EDITOR'S NOTE:- The *Error Code* value shown as `0xYY`) above will be assigned by IANA as a value of the common *Error Code* parameter for SIGTRAN UAs and may change its value in further versions of this document.

This extension adds the following value to the *Registration Status* field of the *Registration Result* parameter for the UAs [M3UA...TUA].

0xZZ Error - Invalid/Unsupported Load Distribution

EDITOR'S NOTE:- The *Registration Status* value shown as `0xZZ`) above will be assigned by IANA as a value of each UA-specific *Registration Status* parameter for each SIGTRAN UA and may change its value in further versions of this document.

7. Acknowledgements

The authors would like to thank Ken Morneault, Barry Nagelberg, Benjamin J. Wilson, Jacques Rajchgod, Greg Sidebottom and Gery Verwimp for their valuable comments and suggestions.

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This draft expires July, 2002.

Endnotes

[1] For a detailed description of these messages, see Section 3 of M3UA, SUA and TUA [M3UA...TUA].

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