

Accredited Standards Committee  
X3, Information Processing Systems

Doc: X3T10.1/95A227R1  
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Project: 0989D SSA-TL1  
Ref Doc.: X3T10.1/0989D  
Reply to: Mark DeWilde

To: X3T10.1 Membership  
From: Mark DeWilde  
Subject: TL1 Support for SAT regions

### BACKGROUND

Section 8.5.5 of the TL1 Specification discusses SAT regions. While describing the potentially useful aspects of the construct, it does not describe a mechanism to implement or control the creation of the regions with any hope of interoperability. The ability to set a node for reflection or transmission of SAT is a Master-owned resource, as is the ability to set the quotas. It is both an unhealthy mixing of protocol layers and an interoperability risk to use a means outside of TL1 to manage the regions, check for region overlap/conflict, and to enforce minimal control policies over regions. One solution would be to drop the concept of SAT regions altogether and simplify the process. SAT regions, however, provide a valuable method to create optimized system Spatial Reuse, one of SSA's major marketing points. Instead, I recommend we define a means for Configutors to request the Master to create and delete SAT regions, and to extend SAT Region boundaries. This entails the creation of a new pair of TL1 SMS's for this purpose. Presumably, an upper level protocol would make requests through a transport layer service to manage the region. The upper level protocols would communicate to agree on the extents of the regions, but the allocation and detection of conflicts would be managed at the transport layer.

### PROPOSAL

Create two new TL1 SMS's. The REQUEST REGION SMS is originated by configutors to request SAT Region control by the master. The format of the SMS is shown:

REQUEST REGION SMS

BYTE	BIT 7	6	5	4	3	2	1	BIT 0
0	SMS CODE = 0Eh							
1	SSA-TL1 VERSION = 02h							
2	TAG							
3	TAG							
4 - 7	RETURN PATH							
8 - 15	ENDPOINT #1 UNIQUE ID / CREATOR UNIQUE ID							
16 - 23	ENDPOINT #2 UNIQUE ID							
24	RESERVED						OPCODE	
25	ENDPOINT #1 PORT NUMBER							
26	ENDPOINT #2 PORT NUMBER							
27	A QUOTA							
28	B QUOTA							
29	RESERVED							

The TAG field is returned by the Master in the REQUEST REGION REPLY SMS in response to the REQUEST REGION SMS. It shall be unique among all tags active in the sender.

The RETURN PATH field specifies the path component that shall be placed in the ADDRESS field of the REQUEST REGION REPLY SMS.

The ENDPOINT #1 UNIQUE ID / CREATOR UNIQUE ID field is the UNIQUE ID of the node that is the first endpoint of the requested SAT region when used with a Create Region OPCODE. When used with the remaining OPCODES, it is the UNIQUE ID of the Region Creator as returned in the REQUEST REGION REPLY SMS.

The ENDPOINT #2 UNIQUE ID field is the UNIQUE ID of the node that is the second endpoint of the requested SAT region.

The OPCODE field specifies the requested operation. The possible values are:

00h = Create SAT region

01h = Extend a region by moving the endpoint of the region specified by the CREATOR UNIQUE ID returned in a REQUEST REGION REPLY SMS in response to an earlier QUERY MEMBERSHIP OPCODE to the ENDPOINT #2 and port shown in the respective fields.

02h = 01h = Delete the region in which this node resides. The region must have been created by a node that resides in the same region as this node. The nodes in the region return to the general pool of nodes that existed prior to the creation of SAT regions.

The ENDPOINT #1 PORT NUMBER field is a number that represents port numbers from 1 to 128 on the node indicated by the ENDPOINT #1 UNIQUE ID field. Since SAT regions may end on Switch ports, an 8-bit field is required

The ENDPOINT #2 PORT NUMBER field is a number that represents port numbers from 1 to 128 on the node indicated by the ENDPOINT #2 UNIQUE ID field. Since SAT regions may end on Switch ports, an 8-bit field is required

The A QUOTA field is the value the Master shall use in the CONFIGURE PORT SMS's sent to the nodes that are being grouped into the SAT Region. All nodes in the region will have their A QUOTA values set to this value.

The B QUOTA field is the value the Master shall use in the CONFIGURE PORT SMS's sent to the nodes that are being grouped into the SAT Region. All nodes in the region will have their B QUOTA values set to this value.

Several rules apply to SAT regions:

- a) SAT Regions do not "nest". No SAT region can overlap or be enclosed by another.
- b) If the master detects that a web change has caused a SAT region to contain no Configutors, it will delete the SAT region and return the nodes to the pre-region configuration.
- c) When Configutors membership in a region changes due to a request they did not originate, the Master notifies them of the change using a Master Alert. See Section 11.2.4. An ALERT CODE of C0h will indicate this change, with the subtype indicating addition to a region, or deletion from a region.
- d) There may not be two consecutive ports of the same node on the path between the endpoints of a SAT region.

The REQUEST REGION REPLY SMS is originated by the Master in response to a REQUEST REGION SMS. The format of this SMS follows.

REQUEST REGION REPLY SMS

BYTE	BIT 7	6	5	4	3	2	1	BIT 0
0	SMS CODE = 0Fh							
1	SSA-TL1 VERSION = 02h							
2	TAG							
3	TAG							
4 - 11	CREATOR UNIQUE ID/ERROR BYTE							
12	RESERVED					STATUS CODE		
13	RESERVED							

The TAG field is returned by the Master in the REQUEST REGION REPLY SMS in response to the REQUEST REGION SMS. It shall be unique among all tags active in the sender.

The CREATOR UNIQUE ID field is returned by the Master and is the UNIQUE ID of the node that the Master acknowledges as the creator of the region. If the node receiving the reply was the successful creator, this serves as a verification. If the node was attempting a create and failed, it can be used in a subsequent extend command to add nodes to the region. If the node performed a successful extend operation, it will contain the UNIQUE ID of the node that created the original region. If the extend operation failed, it will contain the UNIQUE ID of the creator node of the SAT region preventing the extend operation, if any.

The STATUS CODE field indicates the result of the REQUEST REGION SMS. The values follow.

- 00h Successful Operation
- 01h Failure. SAT regions not supported
- 02h Failure. Requested create or extend overlaps existing region
- 03h Failure. Attempt to create or extend Region not including requester.
- 04h Failure. Attempt to delete Region not including requester.
- 05h Failure No path between endpoints found.
- 06h SMS rejected, Invalid ENDPOINT, CREATOR UNIQUE ID or PORT NUMBER

The process that a configurator uses to manage a SAT region is as follows.

- a) To create a SAT region, the configurator sends a REQUEST REGION SMS to the Master indicating the endpoints and SAT quotas of the requested region, as well as an OPCODE of 00h. The Master checks its internal data structures for possible overlap of SAT regions, and membership of the requester in the new region.

If overlap exists, the Master returns the UNIQUE ID of the region's creator along with a status code of 02h indicating overlapped region requested in the REQUEST REGION REPLY SMS. The CREATOR UNIQUE ID field of the REQUEST REGION RESPONSE SMS contains the UNIQUE ID of the node that created the region that caused the conflict. The requesting node may use this information to extend the region to include itself.

If there is no overlap, then the Master enters the new Region endpoints, CREATOR UNIQUE ID and values for the quotas into its internal data structures. The Master returns the UNIQUE ID of the node requesting the region in the CREATOR UNIQUE ID field of the REQUEST REGION RESPONSE SMS. The Status code in the response is set to 00h.

If the creation was successful, the Master configures the ports in the region using the quotas supplied in the REQUEST REGION SMS. The Master also sends a Master Alert with an ALERT CODE value of C0h and a subtype of 00h. to each Configurator in the region. The endpoints are set to reflect SAT and SAT' as necessary to form the region.

The endpoints of the region requested are defined by the ENDPOINT #1 UNIQUE ID and ENDPOINT #2 UNIQUE ID fields in conjunction with the ENDPOINT #1 PORT NUMBER and ENDPOINT #2 PORT NUMBER fields in the request. If the region defined by the endpoints does not contain the requester, and the OPCODE field in the REQUEST REGION SMS is 00h or 01h, then the Master returns a REGION RESPONSE SMS with a status of 03h, Attempt to create or extend region not including requester. The CREATOR UNIQUE ID field is invalid.

- b) If the Master does not support the creation of SAT regions, then it returns a REQUEST REGION REPLY SMS to the requester with a status code of 01h, SAT regions not supported. The CREATOR UNIQUE ID field is invalid.
- c) If a create region request resulted in a failure due to overlapped regions as described in b, then the requester may issue a REQUEST REGION SMS with an opcode of 01h, extend region. Bytes 8 to 15 of the SMS are set to the CREATOR UNIQUE ID that was returned with the REQUEST REGION RESPONSE SMS indicating failure on the create region request. The ENDPOINT #1 PORT NUMBER field is ignored. The ENDPOINT #2 UNIQUE ID and ENDPOINT #2 PORT NUMBER fields contain the new endpoint identifier for the extended region, which will be extended from the endpoint with the lowest address (shortest path) from the new endpoint. The quotas remain as set by the original creator, as does the value for the creator's UNIQUE ID as acknowledged by the Master. The Master checks that the requested extend will not overlap a SAT region already created between the old endpoint and new endpoint of the region to be extended.

If there is no overlap caused by extending the region, then the Master returns a REQUEST REGION RESPONSE SMS with a STATUS CODE of 00h, indicating a successful extend. The Master then configures the ports in the region using the quotas defined in the create request. The Master also sends a Master Alert with an ALERT CODE value of C0h and a subtype of 00h to all the configurators that have been added to the region.

If overlap exists, the Master returns the UNIQUE ID of the blocking region's creator along with a status code of 02h indicating overlapped region requested in the REQUEST REGION REPLY SMS. The CREATOR UNIQUE ID field of the REQUEST REGION RESPONSE SMS contains the UNIQUE ID of the node that created the region that caused the conflict.

- d) A configurator may delete a region of which it is a member. The process is as follows.

The Configurator creates a REQUEST REGION SMS with an OPCODE field of 02h. The node must supply the region's CREATOR UNIQUE ID in bytes 8-15. The ENDPOINT #2 UNIQUE ID, ENDPOINT #1 PORT NUMBER and ENDPOINT #2 PORT NUMBER fields are ignored.

If the region defined does not contain the requester, then the Master returns a REQUEST REGION RESPONSE SMS with a status of 04h, Attempt to delete region not including requester. The CREATOR UNIQUE ID field is invalid.

If the region defined does contain the requester, the Master configures the ports to the system default state. The Master also sends a Master Alert with an ALERT CODE value of C0h and a subtype of 01h to all the configurators that resided in the region. The Master deletes the region information from its internal data structures. Finally, the Master returns a REQUEST REGION RESPONSE SMS with a status of 00h, Successful operation.. The CREATOR UNIQUE ID field is invalid.

- e) If a new Master is elected, the SAT region information held by the old Master is lost. The new Master will issue CONFIGURE PORT SMSs to all the ports in the system, using its system default values which effectively clears out all existing SAT regions. When the creators of SAT regions receive the CONFIGURE PORT SMS indicating a new Master, they may repeat the process of creating SAT regions, thus rebuilding the Master's SAT region database if the new Master Supports SAT regions.
- f) If the endpoints, CREATOR UNIQUE ID or PORT NUMBER fields in the REQUEST REGION SMS are invalid, then the Master will return a REQUEST REGION RESPONSE SMS with a status code of 06h. Byte 4 will contain the first byte number of the offending field in the REQUEST REGION SMS.

Additionally, to section 11.2.4, add the following text in support of the new SMS's:

- d) To inform configutors that they have been included in a SAT Region as a result of a REQUEST REGION SMS from another configutor.

Change Table 25-ALERT CODE VALUES:

Change "Type BCh to BFh, Master Generated alerts (not used in ASYNC ALERT). "

to: "Type BCh to C0h, Master Generated alerts (not used in ASYNC ALERT)."

Add additional row:

TYPE	SUBTYPE	TYPE INFORMATION	ALERT CODE VALUE	PORT MODE
C0h	00h	00h	SAT REGION MEMBERSHIP ESTABLISHED	UNCHANGED
C0h	01h	00h	SAT REGION MEMBERSHIP DELETED	UNCHANGED

Sincerely,  
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