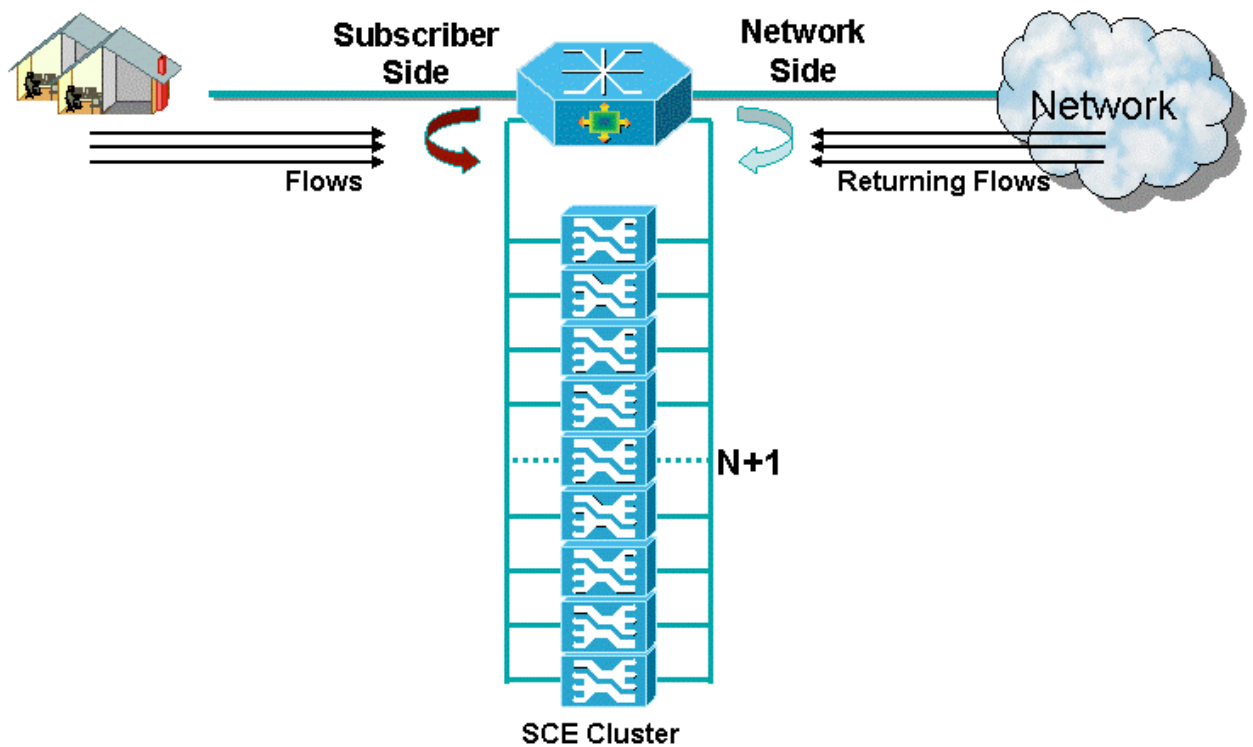


MGSCP

Technical Design Guide



January 2009, Version 2.2

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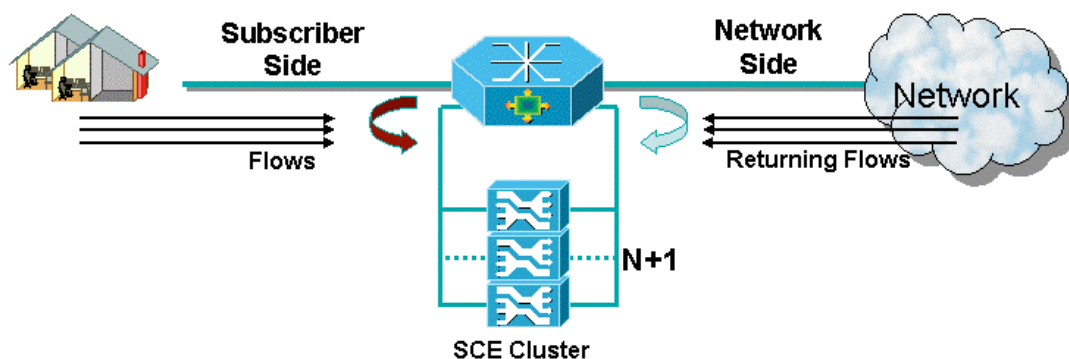
Scope and Purpose

The Cisco Multi-GbE Service Control Platform (MGSCP) provides a scalable solution based on multiple Service Control Engine (SCE) platforms in an environment where a single SCE platform is not sufficient, and includes the ability to monitor, control, and report the traffic of subscribers within this environment.

This technical design guide describes the concept of the MGSCP solution. It also explains how to implement the solution in Multi-Gigabit & Multi-10G Ethernet environments.

The guide explains how to enable network insertion of SCE platforms by integrating the MGSCP with other Cisco platforms such as the Cisco 7600 (which can be achieved by configuring the solution to distribute traffic between a set of SCE platforms and their available Gigabit & 10G interfaces), and explains how load balancing between SCE platforms can be achieved.

The guide describes various network topologies and configurations based on EtherChannel groups, VLANs and VLAN translation, and other mechanisms that enable a scalable subscriber-aware distribution of traffic across a cluster of SCE platforms, while ensuring that all traffic of a given subscriber is handled by the same SCE platform and allowing the service provider to provide subscriber-aware and application-aware DPI functionality. The technical concepts of the different topologies and configurations are explained, allowing the appropriate network insertion solution to be built.



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Solution

Solution Overview

The Cisco SCE platform manages IP traffic using a stateful processing mechanism based on application and subscriber awareness.

This mechanism, which supports a rich feature set, requires the SCE platform to capture both the upstream and downstream flows of a session in order to statefully classify it and provide L7 processing at the application level. To process an application that is implemented with a bundle of flows, such as FTP or SIP, the SCE platform needs to process all the flows that comprise a session of this application.

Furthermore, when the SCE platform is configured to implement per subscriber reporting or control (which is sometimes referred to as *subscriber awareness*), it must process all traffic flows that a given subscriber generates.

These requirements can impose a challenge when inserting SCE platforms into networks because asymmetric routing is often implemented in these networks and the two directions of a single session or the many flows of a specific subscriber may be split between different links.

Cisco SCE platforms are typically inserted into a network by using a bump-in-the-wire approach. SCE platforms are transparent at Layer 2 and Layer 3, so bump-in-the-wire installation involves cutting a network link and inserting an SCE platform.

The Cisco SCE 8000 includes the support for up to four 10G Ethernet interfaces, while the SCE 2020 support up to four Gigabit Ethernet interfaces. This provides an insertion solution for up to two 10G & Gigabit Ethernet links, even in the case where these links include asymmetric routing. The ability to support only two links creates a challenge when there is a need to support a high-speed environment with dual-homed or split flows over more than two links.

This guide explains how to overcome these challenges by using the Cisco SCE platform together with additional Cisco platforms. The solution has been designed by Cisco as an integrated architecture that takes these platform and technology together.



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Cisco 7600 Based

Cisco 7600 Based Solution Overview

Solution Building Blocks

EtherChannel / LACP

The MGSCP solution uses EtherChannel (EC) and the Link Aggregation Control Protocol (LACP) 802.3ad to enable scaling the SCE platform by sending the traffic to an EtherChannel. EtherChannel load balancing is used to distribute the traffic over several SCE platforms. LACP is used to manage the health of the EtherChannel group.

EtherChannel Load Balancing

Originally, EtherChannel was designed to aggregate several physical Ethernet links and logically represent them as a single interface (see graphic).



The EtherChannel mechanism balances the traffic between the physical interfaces using a deterministic hashing algorithm. This algorithm uses a predefined field in the packet header and outputs a fixed Result Bundle Hash (RBH) value that determines which link to use.

The predefined field can take one of the following values:

- dst-ip—Destination IP addresses
- dst-mac—Destination MAC addresses
- dst-port—Destination Layer 4 port
- mpls—Load balancing for MPLS packets
- src-dst-ip—Source and destination IP addresses
- src-dst-mac—Source and destination MAC addresses
- src-dst-port—Source and destination Layer 4 port
- src-ip—Source IP addresses

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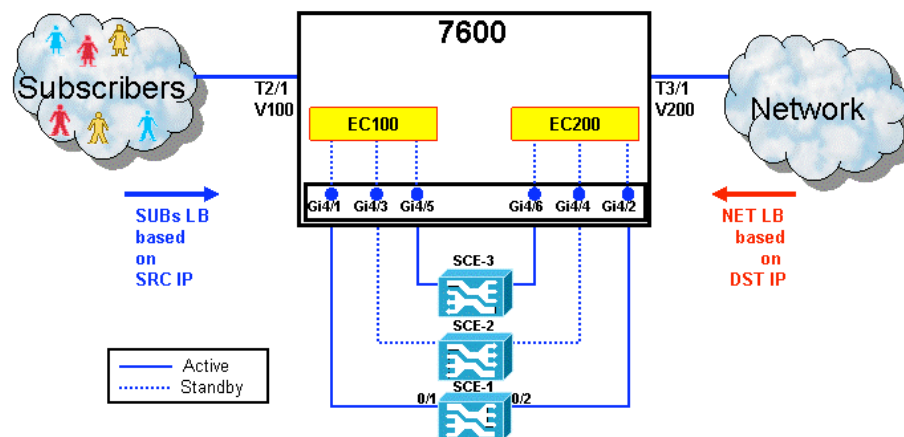


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- src-mac—Source MAC addresses
- src-port—Source Layer 4 port

The MGSCP solution takes advantage of this mechanism and uses the Source and Destination IP addresses (src-ip and dst-ip) as the predefined field to use for EC load balancing on a single Cisco 7600 platform.

Because the Cisco 7600 supports distributed forwarding, it can use a different hashing algorithm on each Line Card that has a DFC installed. This unique capability enables a single Cisco 7600 to perform the functionality shown in the following graphic. (Load-balancing is based on the source IP on one Line Card, and based on destination IP on the second Line Card)



The Cisco-proprietary hash algorithm computes a value in the range of 0 to 7 for the RBH. With these eight RBH values as a basis, a particular port in the EtherChannel is chosen. The port setup includes a mask that indicates which values the port accepts for transmission.

A single EtherChannel can have up to eight active ports. With the maximum number of active ports in a single EtherChannel, each port accepts only one value. If you have four active ports in the EtherChannel, each port accepts two values, and so on. The following table lists the number of values that each port accepts, which depends on the number of active ports in the EtherChannel:

Number of active ports in the EtherChannel	Load balancing
8	1:1:1:1:1:1:1:1
7	2:1:1:1:1:1:1



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6	2:2:1:1:1:1
5	2:2:2:1:1
4	2:2:2:2
3	3:3:2
2	4:4

This table lists the number of values (calculated by the hash algorithm) that a particular port accepts. You cannot control the port that a particular flow uses, but only influence the load balance with a frame distribution method that results in the greatest variety.

Note: The Cisco 7600 Sup720 card identifies MPLS packets based on the Ethernet Type field (0x8847/0x8848). For these packets, the input to the hash block should preferably be the IP information extracted from the L3 portion of the packet. Typically, when the packet contains three or fewer labels, Sup720 would attempt to parse the underlying IP to obtain the IP addresses for the hash.

Biased Distribution

Because the EC hash result has eight distinct values, dividing these values between working ports is only unbiased when working with 1, 2, 4, or 8 ports. Any other configuration creates a biased load.

The following table describes the load balance for each option:

Number of ports in the EtherChannel	Load balancing
8	1/8, 1/8, 1/8, 1/8, 1/8, 1/8, 1/8, 1/8
7	1/4, 1/8, 1/8, 1/8, 1/8, 1/8, 1/8
6	1/4, 1/4, 1/8, 1/8, 1/8, 1/8
5	1/4, 1/4, 1/4, 1/8, 1/8
4	1/4, 1/4, 1/4, 1/4
3	3/8, 3/8, 1/4
2	1/2, 1/2
1	1

From this table it is clear that using 3, 5, 6, or 7 active ports in an EC bundle provides poor load balancing, because some ports get up to twice the load of others.

Recommendation:

Use 2, 4, or 8 active ports per EtherChannel to achieve an effective load balancing.



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Determining the Hashing Destination

The load-balancing algorithm is deterministic. To ascertain the EC port that a specific IP address will use, run the following commands:

```
Cisco 7600 Load-Balancing Configuration
7600#remote login switch
Trying Switch ...
Entering CONSOLE for Switch
Type "^C^C^C" to end this session
7600#test etherchannel load-balance interface port-channel 100 ip 192.168.1.1
Computed RBH: 0x4
Would select Gi4/1 of Po100
```

You can predict the load-balancing scheme and plan accordingly, as illustrated in the following table.

IP Address	Computed RBH	Selected Interface
192.168.1.1	0x4	Gi4/1
192.168.1.2	0x7	Gi4/5
192.168.1.3	0x6	Gi4/1
192.168.1.4	0x1	Gi4/5
192.168.1.5	0x0	Gi4/1
192.168.1.6	0x3	Gi4/5
192.168.1.7	0x2	Gi4/1
192.168.1.8	0x5	Gi4/5



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Using Two EtherChannel Groups and a Cluster of SCE Platforms

A cluster of SCE platforms can be connected to a Cisco 7600 to perform service control processing. The traffic load within the specific environment determines the exact number of SCE platforms required.

The Cisco 7600 configuration should include two EtherChannel groups. One EtherChannel group will be connected to the subscriber interface of the SCE platform and the other group to the network interface (an example is shown in the graphic in this section).

To view the number of links per EtherChannel group, use the following command:

Cisco 7600 Links per EtherChannel
<pre>7600#sh etherchannel Channel-group listing: ----- Group: 100 ----- Group state = L2 Ports: 3 Maxports = 16 Port-channels: 1 Max Port-channels = 16 Protocol: LACP Minimum Links: 0 Group: 200 ----- Group state = L2 Ports: 3 Maxports = 16 Port-channels: 1 Max Port-channels = 16 Protocol: LACP Minimum Links: 0</pre>

To view the EtherChannel status, use the following command:

Cisco 7600 EtherChannel Status
<pre>7600#sh etherchannel summary Flags: D - down P - bundled in port-channel I - stand-alone s - suspended H - Hot-standby (LACP only) R - Layer3 S - Layer2 U - in use f - failed to allocate aggregator</pre>

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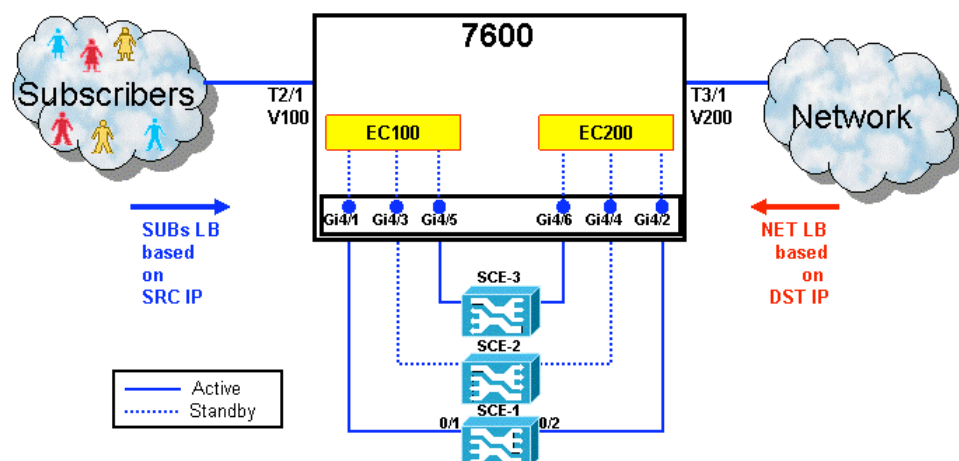
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M - not in use, minimum links not met					
u - unsuitable for bundling					
w - waiting to be aggregated					
Number of channel-groups in use: 2					
Number of aggregators: 2					
Group	Port-channel	Protocol	Ports		
100	Po100(SU)	LACP	Gi4/1(P)	Gi4/3(P)	Gi4/5(H)
200	Po200(SU)	LACP	Gi4/2(P)	Gi4/4(P)	Gi4/6(H)

Because the SCE platform uses a stateful mechanism it must examine both the upstream and downstream of a flow in order to statefully classify the flow and provide L7 processing at the application level. Therefore the order in which the SCE platforms are connected in the EtherChannel group must be carefully designed, otherwise upstream and downstream sides of a single flow will be forwarded to different SCE platforms.

An example of how to connect multiple SCE platforms is shown in the following graphic where:

- Interface Gi4/1 from EtherChannel group 100 and interface Gi4/2 from EtherChannel group 200 are connected to SCE1.
- Interface Gi4/3 from EtherChannel group 100 and interface Gi4/4 from EtherChannel group 200 are connected to SCE2.
- Interface Gi4/5 from EtherChannel group 100 and interface Gi4/6 from EtherChannel group 200 are connected to SCE3.



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Another key feature that needs to be configured for this setup is load balancing based on Source IP for traffic arriving from the subscriber side and load balancing based on Destination IP for traffic arriving from the network side.

The ability to perform this load balancing in one chassis has been introduced in Cisco 6500 IOS version 12.2(18)SXF and 7600 12.2(xx)SRB. (Prior to the 12.2(18)SXF SW release only one hashing was allowed per chassis.) The code now allows using a different hashing function for each DFC so that different slots can provide different functions (that is, one Sup720 card will hash based on the Destination IP and another DFC card will hash based on the Source IP, or vice versa). When scaling the solution to multiple 10GE ports per chassis it is recommended to use the DFCs on the Ingress Line Cards to perform the distributed hashing.

Notes :

- The load balancing function is performed at the ingress port (for instance, interfaces T2/1 and T3/1 in the preceding graphic), and *not* at the EtherChannel interface facing the SCE platforms.
- The 7600 load balancing is done on a single IP Address basis, this means that in a case of Multi-IP Subscribers the IPs may not hand up on the same SCE. This situation may impact the ability to provide the service for Multi-IP Subscribers.

Supervisor and Line Card load balancing is configured at the global configuration level:

- The first line in the configuration file that is not for a specific Line Card refers to the Supervisor load-balancing method.
- Additional lines can be added to the configuration file for configuration per Line Card.

The following code sample illustrates this:

Cisco 7600 EtherChannel Load-Balancing Configuration
--

<pre>port-channel per-module load-balance port-channel load-balance dst-ip port-channel load-balance src-ip module 2</pre>
--



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EtherChannel Protection Using LACP

EtherChannel service protection can be implemented using an LACP failover mechanism. The LACP mechanism allows you to define N+M redundancy, where up to eight active ports and up to eight failover/standby ports can be defined. You can activate EtherChannel failover by configuring the <max-bundle> parameter of an EtherChannel interface, which is available with the LACP protocol.

If an SCE platform fails, the traffic that is going through that SCE platform is cut off. The EtherChannel mechanism of the two EtherChannel groups detects this, stops sending traffic to the failed SCE platform, and redistributes the traffic to a different SCE platform. It is important to understand that redistribution of the traffic takes place.

Cisco 7600 LACP Interface per Bundle Configuration

```
interface Port-channel100
description <<< Subscriber Portchannel VLAN 100 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
load-interval 30
spanning-tree bpduguard enable
lacp max-bundle 2
lacp direct-loadswap
```

In the preceding example the LACP max-bundle was set to 2; it should be set with values of 2, 4, or 8 depending on the number of active ports in the EC.

A higher <lacp port-priority> priority (see previous example) means a lower priority in the LACP. Default values are used for all active ports; the priority is changed only for the standby interface. If one of the SCE platforms or links in the EtherChannel bundle fails, the LACP algorithm will activate the standby port or unit.

During normal operation the Cisco 7600 assigns the eight RBH values to the active ports in a bundle, starting from the lowest port. In the case of a component failure or a link going down, the Cisco 7600 reassigns the affected RBH values to all active ports in the bundle, again starting with the lowest port. This means that if the highest port goes down the impact is relatively low, but if the lowest port in the bundle goes down the impact is higher and may result in a complete reshuffling of the traffic between the SCE platforms.



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LACP Rehashing Enhancement during Link Failure

The assignment of the RBH values during a link failure was enhanced with the 7600 IOS version 12.2(33)SRC with the introduction of the LACP Single Fault Direct Load Balance Swapping feature on a port channel. (Note : This functionality is only available with the 7600 platform and not with the 6500).

This command can be used for only a single link/port failure. If a second failure occurs before the first failure recovers, the loadshare bits for member links are recomputed.

LACP : Direct Loadswap feature provides a solution in a case of a member-link goes down in an EtherChannel, instead of reassigning the load balance bits to all the member-links (whose priority is lesser than the failing port) the load-balance bits are directly assigned from the failing port to the newly bundled port. When the failed port comes up again it retains the load balance bits which it possessed before failing and the port which replaced it is again unbundled.

This feature works with respect to the original state of the EtherChannel that is configured. i.e. when there is a second link going down the method falls back to round robin.

This example shows how to enable LACP single fault direct load swapping on port channel 100:

Cisco 7600 LACP Direct-loadswap

```
interface Port-channel 100
description <<< Subscriber Portchannel VLAN 100 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
load-interval 30
spanning-tree bpdupfilter enable
lacp max-bundle 2
lacp direct-loadswap
```



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Recommendation:

If IOS version 12.2(33)SRC and above is in use, use the < lacp direct-loadswap> function when possible in order to achieve the most efficient recovery from a Link Failure. See details in the following section.

In case where an older IOS version than 12.2(33)SRC is in use it is recommended to place the standby SCE/link in the middle. For example : in the case of a 4+1 redundancy, links 1, 2, 4, and 5 should be active, and link 3 is in standby. You can configure this by setting the <lacp port-priority> option for the standby port to its highest value.

This configuration will provide the most efficient failover, which will have the lowest impact on the service during a link failover.



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VLAN Design and Considerations

In many MGSCP solution topologies, VLANs are a major consideration in design and implementation. In these cases, the actual use of VLANs is determined by the specific topology.

Cisco 7600 ports that are connected to the SCE platform can be configured as either Access or Trunk ports. Access ports should be used when only one VLAN is to be supported. Trunk ports should be used when multiple VLANs are to be supported either during the first phase of deployment or in the future.

When using the Trunk port option, packets with VLAN tags pass through the Trunk ports and should be modified/translated in order to force traffic to be switched via the SCE cluster.

This functionality requires using a VLAN tag translation mechanism that is supported by the Cisco 7600.

Note: The simplest implementations of the MGSCP solution do not require VLAN translation.

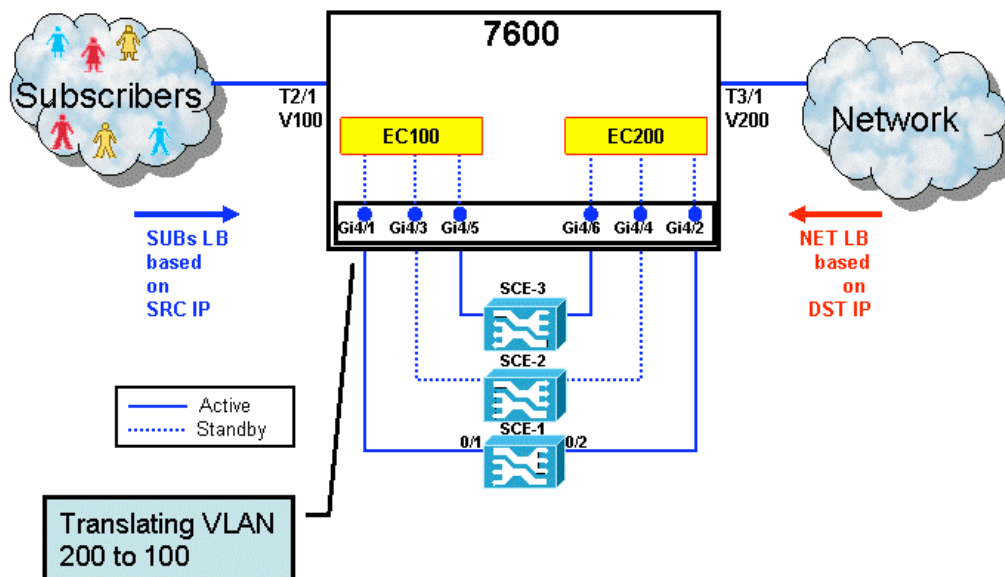
Vlan Translation by the Cisco 7600

IOS supports VLAN translation (known as VLAN mapping) per port. Using this feature, it is easy to set a mapping between the VLAN tags on the subscriber side trunks to the VLAN tags on the network side trunks and vice versa.

Because the configuration is done per port group of the Cisco 7600 Line Card it means that a group of ports requiring the same VLAN mapping should be located on the same Line Card (or same port group in a Line Card).



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Cisco 7600 switchport vlan mapping

To map the traffic arriving on the VLAN <original-vlan-id> to the VLAN <translated-vlan-id> and the traffic that is internally tagged with the VLAN <translated-vlan-id> with the VLAN <original-vlan-id> before leaving the port, use the `switchport vlan mapping` command. To clear the mapping between a pair of VLANs or clear all the mappings that are configured on the switch port, use the `no` form of the command.

Cisco 7600 VLAN Translation Command Syntax

```
switchport vlan mapping original-vlan-id translated-vlan-id
no switchport vlan mapping { {original-vlan-id translated-vlan-id} | all }
```

Cisco 7600 VLAN Translation Configuration

```
interface GigabitEthernet4/1
description <<< Connected to SCE1 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
```

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```
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 100 mode active
!
interface GigabitEthernet4/2
description <<< Connected to SCE1 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 200 mode active
```

Note: Translation (mapping) is only configured on one side of the loop and is used for both incoming and outgoing VLAN tags.
VLAN mapping is configured on interface Gi4/2 but is not enabled.

Note: The CDP protocol must be disabled on the 7600 interface facing the SCE platform port when implementing this solution; this prevents the Cisco 7600 from sending CDP error messages.



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VLAN Translation and STP:

Where Spanning Tree Protocol (STP) is deployed prior to SCE platform/MGSCP deployment, some design consideration should be taken into account before implementing VLAN translation. This is because STP BPDU packets already include a VLAN ID and in that case VLAN translation can seriously affects the proper operation of STP.

IOS handles this issue by running an intelligent VLAN translation/mapping; it translates the VLAN value both at the Ethernet header level and at the Ethernet payload level.

Recommendation:

- Implement VLAN translation on the Cisco 7600 platform.
- Disable BPDU processing on ports facing the SCE platform.

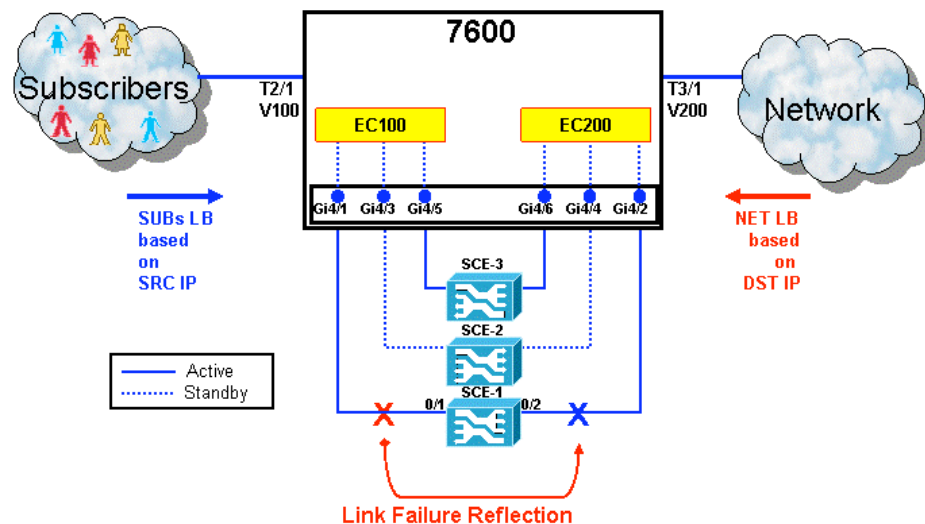


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SCE Link Failure Reflection

Link failure reflection is an important part of the solution that allows the SCE platform to behave as a bump-in-the-wire.

The link failure reflection feature reflects a link failure that occurs on one side of the link to the other side. This ensures that the Cisco 7600 ports connected to the same SCE platform are synchronized and fail at the same time, and avoids the need to wait for the LACP to discover that a failure took place. This avoids “black-holing” situations where the switch continues to send traffic to an SCE platform when the other side of the SCE platform is disconnected.



There are several options for implementing the link failure reflection feature. The appropriate option depends on the way the SCE platform ports are physically connected to the Cisco 7600 and the redundancy requirement of the network design.

By default, link failure reflection is disabled. Enabling and disabling link failure reflection should be done under the `<interface LineCard 0>` configuration, as shown in the example in this section.

Mode A: `<link failure-reflection>`

This mode reflects the failure of one side of a specific SCE platform link to the other side of the link, but does not affect the other link. For example, a failure on link GBE 0/1 will affect GBE 0/2, but will have no impact on GBE 0/3 and GBE 0/4.

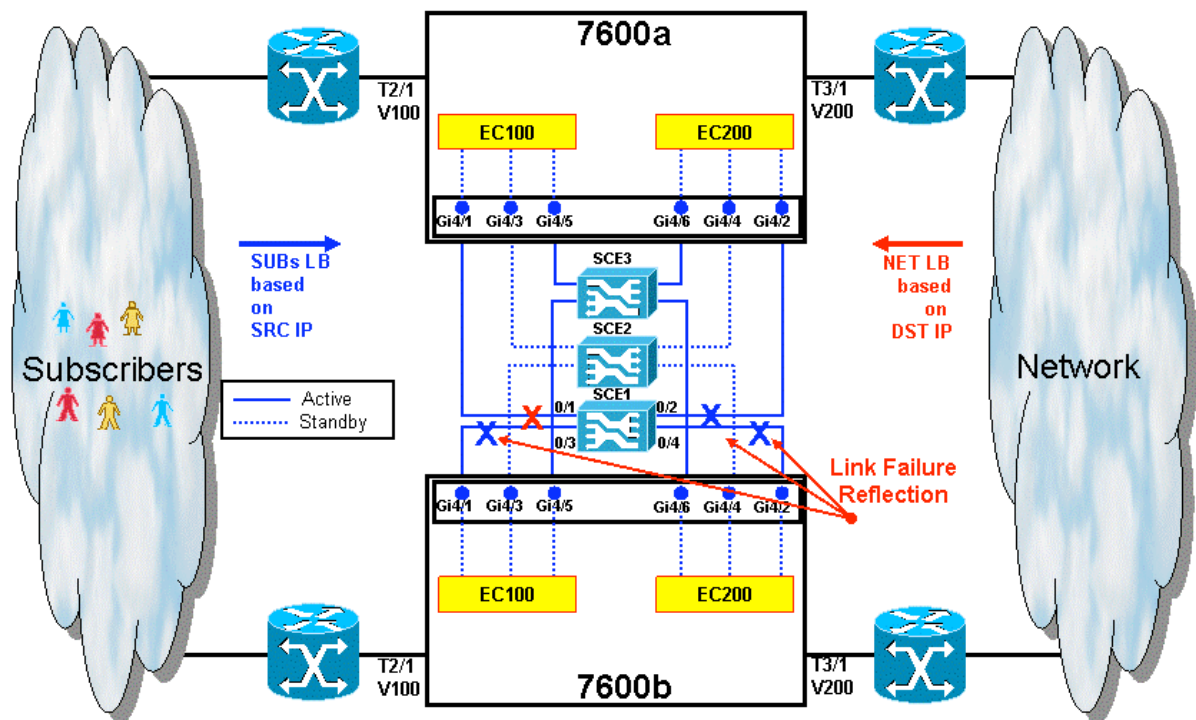


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Mode B: `<link failure-reflection on-all-ports>`

The `<on-all-ports>` keyword enables reflection of a link failure to all the other three ports. For example, a failure on link GBE 0/1 will affect GBE 0/2, GBE 0/3, and GBE 0/4, as shown in the following graphic.

`<Link failure-reflection on-all-ports>`, graphic example:



Typically, this is used when the SCE platform is part of a fully redundant (also known as dual-homed) design, to make sure that all the network elements are aware of the failure.

Mode C: `link failure-reflection on-all-ports linecard-aware`

The `linecard-aware` mode disables link failure reflection if the SCE platform detects that two ports that are connected to same router or switch Line Card (SCE 2020 4xGBE platforms only) fail at the same time (link failure reflection would take the whole SCE platform down). By providing this functionality, the MGSCP solution



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can continue to provide service in the case of failure of a Cisco 7600 Line Card, whole chassis, or SW upgrade.

This mode is a superset of the two previous modes. A failure of one port of the Cisco SCE 2000 is reflected to the other three ports depending on whether the failure appears to be in the SCE platform itself or not, as follows:

- In the case where one interface of the Cisco SCE 2000 is down, indicating a potential problem with the Cisco 7600 port or the fiber to which the SCE platform is connected, link failure is reflected to all other three SCE platform ports.
- In the case where two reciprocal ports of the Cisco SCE 2000 are down, indicating a potential problem with the Cisco 7600 Line Card to which the SCE platform links are connected and not the interface, no action is taken. This allows the second link pair in the SCE platform to continue functioning without interruption providing service to the second Cisco 7600.

The following example enables the reflection of a link failure to all ports:

SCE Link Reflection Configuration
<pre>SCE>enable 10 Password: SCE#config SCE(config)#interface LineCard 0 SCE(config if)#link failure-reflection on-all-ports SCE(config if)#</pre>



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SCE Port Negotiation Mode

Because the MGSCP solution is typically installed in a carrier-grade environment, detection of a link failure is necessary for fast convergence of the service. Two elements affect proper detection of link failures:

- Link reflection settings (see [SCE Platform Link Failure Reflection](#)).
- Port negotiation mode, which determines the reliability of the link state with other equipments in the network.

Autonegotiation is enabled by default on the Cisco 7600. On the SCE platform, autonegotiation is disabled by default. SCE GBE port autonegotiation can be configured as part of the SCE platform physical interface configuration, as illustrated in the following code samples:

SCE GBE Interface Enable Autonegotiation Configuration
--

<pre>interface GigaBitEthernet 0/1 auto-negotiate</pre>

SCE GBE Interface Disable Autonegotiation Configuration

<pre>interface GigaBitEthernet 0/1 no auto-negotiate ## to disable auto neg</pre>

Recommendation:

Enable autonegotiation when using link reflection.

Note that some equipment and devices in the market are not fully compliant with the IEEE 802.3 standard. Problems with autonegotiation may occur due to this interoperability.



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SCE Flow Control Mode

The 7600/6500 default interfaces configuration is set to <flowcontrol send on>.

It is mandatory to set the 7600 interfaces pointing the SCE to <flowcontrol send off>, so that flowcontrol messages should NOT be sent from the 7600 to the SCE.



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SCE Connection Mode

The SCE platform interfaces are physically turned on during the first phase of SCE platform startup, but the SCE operating system is still down during this phase. You can keep the interfaces down and make sure that no traffic is forwarded through the SCE platform until it is in full operation mode by using the SCE `<connection-mode inline on-failure cutoff>` under the `<Interface LineCard 0>` configuration commands.

You will need to `<shutdown>` the application (that is, Interface Line Card 0) in order to apply `<cutoff>` mode. Starting with SCOS release 3.0.5 you can issue a `<shutdown>` command before applying configuration changes and then issue a `<no shut>` command after the `<connection-mode>` command.



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Cisco 7600 HW and SW Requirements

The MGSCP solution uses several Cisco 7600 features, some of which require specific SW and HW versions.

Feature	Min. 7600 SW Requirement	Min. 6500 SW Requirement	HW Requirement
Per line card EtherChannel load balancing	12.2(33)SRC	12.2(18)SXF	SUP7203B or 3BXL, and an addition DFC on Ingress/Egress Line Card.
VLAN translation		12.2(17b)SXA	Note that not all Line Card HW supports VLAN translation.
DFC3B—distributed forwarding card		12.2(18)SXF	—
Supervisor Engine 7203B or 3BXL		12.2(18)SXF	—



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Cisco 7600 usage of WS-6704 & WS-6708 Line cards

MGSCP Cluster based on SCE8000 requires the use of 10GbE Interface Line Cards, typically WS-6704 & WS-6708. The WS-6704 module have 4 * 10GbE ports, while the WS-6708-port have 8 * 10GbE ports.

Two factors should be taken into consideration while connecting the SCEs to the Line card:

- The internal architecture of the line cards.
- The ratio between Upstream and Downstream traffic, typically 60% Downstream vs. 40% Upstream

The optimal configuration for the WS-6704 line card :

SCE-A Subscriber Side connected to Interface 1

SCE-A Network Side connected to interface 3

SCE-B Subscriber Side connected to Interface 4

SCE-B Network Side connected to interface 2

The optimal configuration for the WS-6708 line card (see picture below) :

SCE-1 Subscriber Side connected to Interface 1

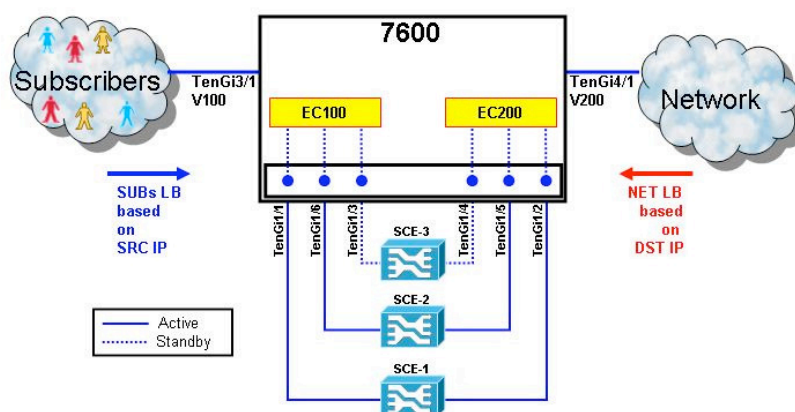
SCE-1 Network Side connected to interface 2

SCE-2 (standby unit) Subscriber Side connected to Interface 3

SCE-2 (standby unit) Network Side connected to interface 4

SCE-3 Subscriber Side connected to Interface 6

SCE-3 Network Side connected to interface 5



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SM Support and Implementation

This section is relevant when an MGSCP solution is deployed in a subscriber-aware environment, so that the appropriate package per subscriber is required. In this case you must take required configuration changes of the Subscriber Manager (SM) into account.

The implementation of the MGSCP solution includes a deployment of multiple SCE platforms where there is no a priori knowledge about the location of each subscriber. Working in Pull mode, the SM does not provide the SCE platforms with information for all subscribers. When an SCE platform cannot associate IP traffic with a subscriber it sends a Pull request to the SM and the SM responds with the subscriber information (including Subscriber ID and Package ID). This allows an SCE platform to query the SM and then apply the proper package for a specific subscriber.

After installing the SM, configure the SM to operate in Pull mode and provide the IP addresses of the SCE platforms with which it will communicate.

To configure the SM, edit its configuration file, `p3sm.cfg`, using any standard text editor, and set the following parameters:

- `introduction_mode`—`pull` or `push`
- Configure the `SCE.xxx` sections to add the SCE platforms to the repository

The following is an example of the relevant part of the `p3sm.cfg` file:

SM p3sm.cfg Configuration
<pre>#### p3sm.cfg #### [SM General] # The following parameter defines whether the SM introduces the subscribers to the # SCEs # immediately after the subscriber's login operation (push-mode) or when the SCE # requests # subscriber information specifically (pull-mode). # Optional values: [pull, push]. Default: push. introduction_mode=pull # The following parameter defines whether the SM should remove # a subscriber from an SCE when a different SCE indicates that # the subscriber's traffic started to flow through it. by such # an operation the SM forces that a subscriber is handled by one # SCE at any given time.</pre>

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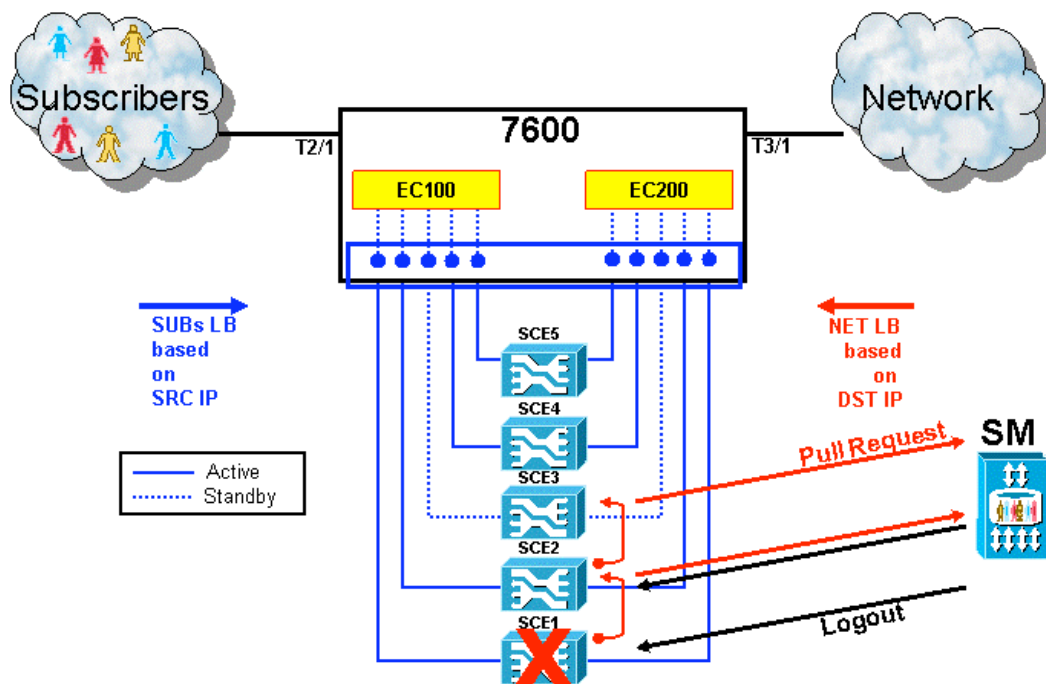
```
# This parameter takes affect only in pull mode.
# Use this parameter only in N+1 SCE topology when used with a
# 7600 switch as a dispatcher
# Optional values: [true, false]. Default: false.
# SM RESTART REQUIRED
force_subscriber_on_one_sce=true

# Each SCE section represents single SCE box.
# The format of the SCE section clause is SCE.XXX when XXX represents
the SCE logical
# name.
# The following parameter defines IP address of the SCE box
# ip=<ip address>
# [SCE.XXX]
[SCE.SCE-1]
ip=192.168.141.101
[SCE.SCE-2]
ip=192.168.141.102
[SCE.SCE-3]
ip=192.168.141.103
[SCE.SCE-4]
ip=192.168.141.104
[SCE.SCE-5]
ip=192.168.141.105
[SCE.SCE-6]
ip=192.168.141.106
[SCE.SCE-7]
ip=192.168.141.107
[SCE.SCE-8]
ip=192.168.141.108
[SCE.SCE-9]
ip=192.168.141.109
```

During a failover the traffic of a group of subscribers is switched/redistributed from one SCE platform to another SCE platform (as shown in the following graphic).



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In general, the migration of subscribers from one SCE platform to another should not pose a challenge in Pull mode. The new SCE platform pulls the subscriber and applies the proper package, and at the same time the subscriber is aged out at the old SCE platform.

The subscriber aging parameter should be configured to prevent SCE platform capacity problems in Pull mode. The aging parameter defines a timeout, and any subscriber that does not generate traffic during this timeout interval will be automatically logged out from the SCE platform.

The following is an example of the SCE Subscriber aging parameter:

SCE Subscriber Aging Configuration

```
interface LineCard 0
link failure-reflection
connection-mode inline on-failure cutoff
subscriber aging anonymous timeout 1440
subscriber aging introduced
subscriber aging introduced timeout 1440
subscriber anonymous-group name anonymous IP-range 0.0.0.0:0x00000000
```



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Note that this process occurs in all SCE platforms in parallel and may cause some scaling challenges.

The SCE2000 & SCE8000 platform default configuration (which is not configurable via the CLI) includes a parameter that allows a maximum of 180 Pull requests per second.

Suppose that each SCE platform is populated with 70 per cent of its subscriber capacity. When redistribution occurs, each SCE platform has 30 per cent free subscriber capacity and starts to pull new arriving subscribers. When these 30 per cent of entries are filled, another 40 per cent of subscribers (from the failed SCE platform) remain, but there is no further capacity at the SCE platform level. Furthermore, old subscribers only start to be aged out after the aging time, which could be as much as 30 minutes.

To address this challenge, the SM can be activated in a special mode known as `<force_subscriber_on_one_sce>`. In this mode, when the SM receives a Pull request, it checks whether the subscriber is already active on another SCE platform. If so, it sends a Pull response to the requesting SCE platform and then sends a logout to the SCE platform where the subscriber was previously located. This accelerates the process of pulling subscribers.

Note :

- This solution is only applicable for introduced Subscribers (that is, not for anonymous Subscribers) and assumes that the SCE databases are not fully populated so that they have some free space to work with until logouts starts to come from the SM.

During the MGSCP design process it is important to obtain information about the capacity of subscribers per SCE platform. The following example shows how to display the subscriber database counters:

SCE Subscriber Capacity Verification
<pre> SCE2020#>sh interface LineCard 0 subscriber db counters Current values: ===== Subscribers: 50 used out of 99999 max. Introduced/Pulled subscribers: 14. Anonymous subscribers: 36. Subscribers with mappings: 50 used out of 79999 max. IP mappings: 50 used. VLAN Entries: 0 used. </pre>

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Subscribers with open sessions: 50.
Subscribers with TIR mappings: 0.
Sessions mapped to the default subscriber: 77.

Peak values:

=====

Peak number of subscribers with mappings: 51
Peak number occurred at: 00:50:05 CET SAT February 17 2007
Peak number cleared at: 12:05:42 CET FRI February 9 2007

Event counters:

=====

Subscriber introduced: 0.
Subscriber pulled: 130.
Subscriber aged: 181.
Pull-request notifications sent: 210.
Pull-request by ID notifications sent: 0.
Subscriber pulled by ID: 0.
State notifications sent: 0.
Logout notifications sent: 116.
Subscriber mapping TIR contradictions: 0.

Subscriber state

Note that the preceding solution has the disadvantage of losing the updated subscriber state: the SM sends a Pull response to the requesting SCE platform (SCE-1) and only then sends the logout to the SCE platform (SCE-2) where the subscriber was previously located. This means that when the logout notification that includes the subscriber state arrives at the SM from SCE-2, it is too late to send the state information to SCE-1 as the Pull response was already sent.



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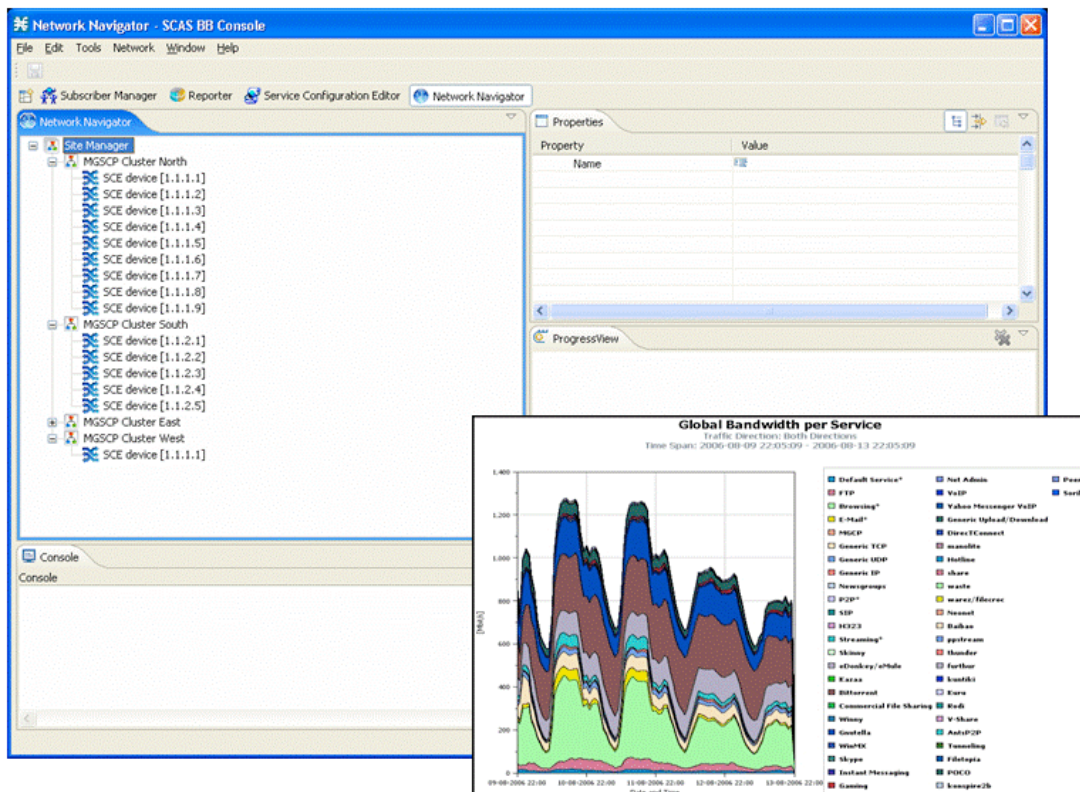
Management and Reporting

The SCA BB GUI (the Console) allows you to centrally and transparently manage an MGSCP cluster. This allows you to perform various configuration, monitoring, analysis, and reporting tasks.

The management and monitoring functions include the following:

- Generate a tech support file
- Display online status
- Apply an updated Dynamic Signature Pack
- Retrieve and apply service configuration files

These functions can be run on the entire MGSCP cluster.





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MGSCP Solutions Overview

The MGSCP solution provides different insertion points into SP networks. The following examples show possible configurations for a few of the scenarios occurring at customers deploying the solution:

- Single Cisco 7600 L2 switching link (SCE2000 Based)
- Dual Cisco 7600 L2 switching link (SCE2000 Based)
- Single Cisco 7600 L3 switching link (SCE2000 Based)
- Single Cisco 7600 L2 switching link (SCE8000 Based)

Additional options are supported and may be included in this document in the future.

Option 1—Single Cisco 7600 L2 Switching and EtherChannel Load Balancing

Solution Overview

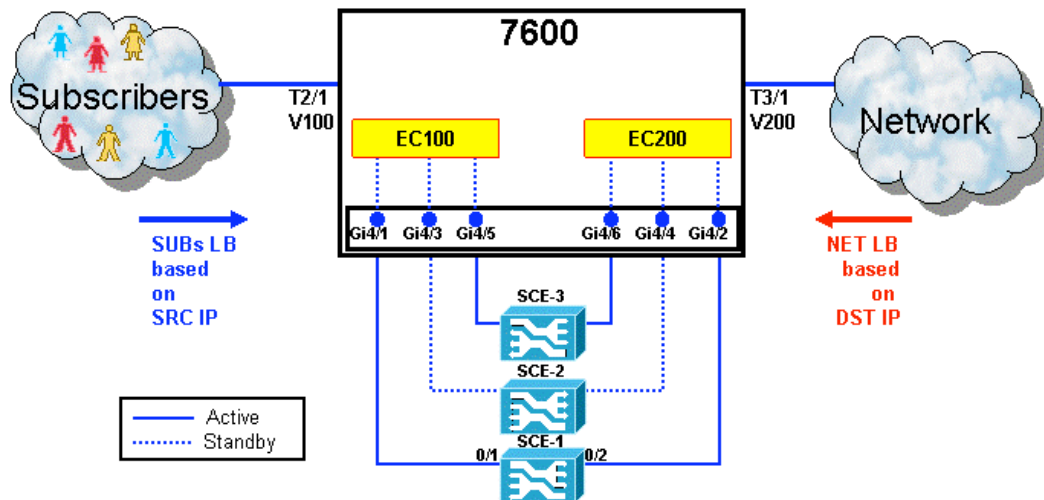
In this case the Cisco 7600 is providing Layer 2 functionality between the subscriber side and the network side. VLAN translation is used to intercept traffic and redirect it via the SCE cluster.

EtherChannel provides N+1 redundancy, and load balancing is used to ensure that every subscriber is statefully handled by the same SCE platform for both upstream and downstream flows.

To ensure that EtherChannel load balancing is performed properly, subscriber-side traffic goes via the Line Card in slot 2, which has a DFC included, network-side traffic goes via Line Card 3 that uses the Supervisor DFC, and load balancing is configured accordingly.



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Configuration

Cisco 7600–EtherChannel Load-Balancing Configuration

```
port-channel per-module load-balance
port-channel load-balance dst-ip
port-channel load-balance src-ip module 2
```

Cisco 7600–EtherChannel Configuration

```
interface Port-channel100
description <<< Subscriber Portchannel VLAN 100 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
no ip address
load-interval 30
spanning-tree bpduguard enable
lacp max-bundle 2
lacp direct-loadswap
!
interface Port-channel200
description <<< Network Portchannel VLAN 200 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
```



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```
switchport mode trunk
no ip address
load-interval 30
spanning-tree bpdupfilter enable
lacp max-bundle 2
lacp direct-loadswap
```

Cisco 7600–EtherChannel Subscriber-Side Configuration

```
interface GigabitEthernet4/1
description <<< Connected to SCE1 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 100 mode active
!
interface GigabitEthernet4/3
description <<< Connected to SCE2 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 100 mode active
!
interface GigabitEthernet4/5
description <<< Connected to SCE3 SUB >>>
```

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```
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 100 mode active
```

Cisco 7600–EtherChannel Network-Side Configuration

```
interface GigabitEthernet4/2
description <<< Connected to SCE1 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
spanning-tree bpduguard enable
channel-protocol lacp
channel-group 200 mode active
!
interface GigabitEthernet4/4
description <<< Connected to SCE2 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
```

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```
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 200 mode active
!
interface GigabitEthernet4/6
description <<< Connected to SCE3 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 200 mode active
```

Cisco 7600–Subscriber-Side Interface Configuration

```
interface TenGigabitEthernet2/1
description <<< Connected to SUB Side >>>
switchport
switchport access vlan 100
switchport mode access
no ip address
```

Cisco 7600–Network-Side Interface Configuration

```
interface TenGigabitEthernet3/1
description <<< Connected to NET Side >>>
switchport
switchport access vlan 200
switchport mode access
no ip address
```

SCE 1-3–Global Configuration

```
interface LineCard 0
link failure-reflection
connection-mode inline on-failure cutoff
subscriber aging anonymous timeout 1440
subscriber aging introduced
```

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subscriber aging introduced timeout 1440 subscriber anonymous-group name anonymous IP-range 0.0.0.0:0x00000000

SCE 1-3–Network-Side Configuration

interface GigaBitEthernet 0/1 auto-negotiate

SCE 1-3–Subscriber-Side Configuration

interface GigaBitEthernet 0/2 auto-negotiate

Note: For subscriber-aware environments, the SM configuration file should be configured as described in the [SM Support and Implementation](#) section.



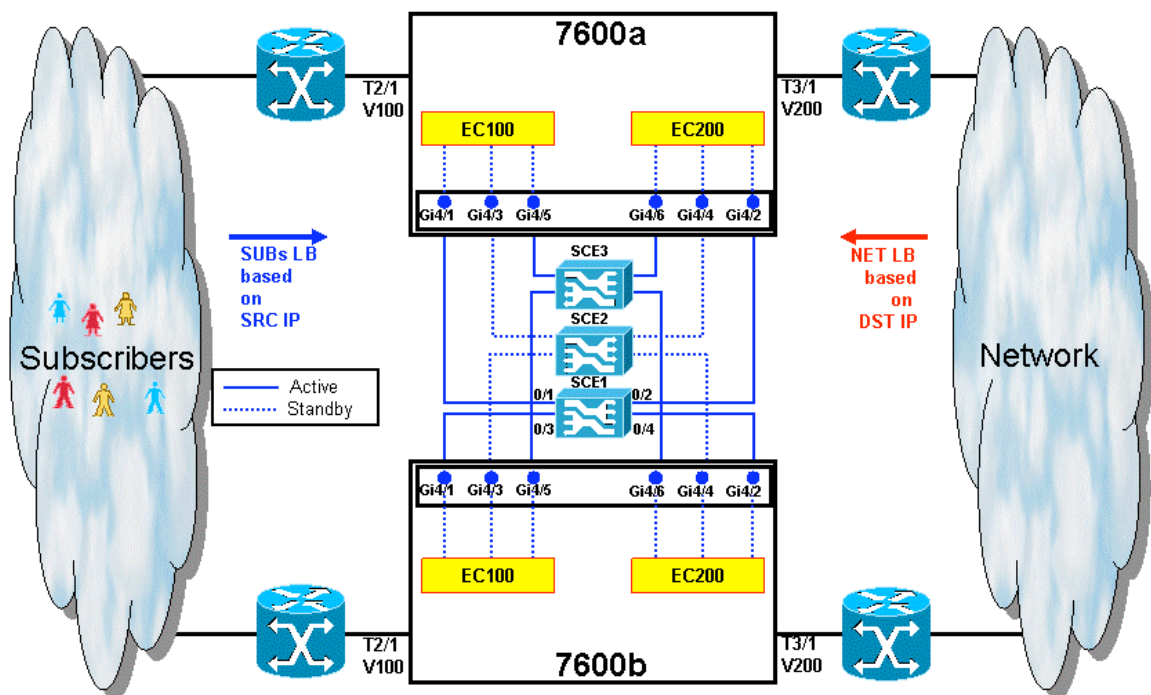
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Option 2–Dual-Homed Cisco 7600 L2 Switching and EtherChannel Load Balancing

This is an extension of the previous scenario that adds a fully redundant (dual-homed) solution. In this case the Cisco 7600 provides the Layer 2 functionality between the Subscriber side and the Network side and VLAN translation to redirect the traffic via the SCE cluster.

Two additional functionalities are used with this scenario:

- SCE link reflection on all ports—This ensures that a link failure on one SCE platform is reflected on both sides of the solution so that both Cisco 7600s are aware of the link failure and will rehash the traffic between the remaining SCE platforms in the cluster.
- Ensuring that the same Cisco 7600 ports are plugged from both sides to the correct/same SCE platform—This ensures that both Cisco 7600 traffic-hashing results give the same SCE platform, whichever Cisco 7600 the traffic came from (labeled 7600a and 7600b in the following graphic). To validate this, use the EtherChannel testing functionality described in the [EtherChannel Load Balancing](#) section.



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Configuration

Cisco 7600a & 7600b–EtherChannel Load-Balancing Configuration

```
port-channel per-module load-balance
port-channel load-balance dst-ip
port-channel load-balance src-ip module 2
```

Cisco 7600a & 7600b–EtherChannel Configuration

```
interface Port-channel100
description <<< Subscriber Portchannel VLAN 100 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
no ip address
load-interval 30
spanning-tree bpdufilter enable
lacp max-bundle 2
lacp direct-loadswap
!
interface Port-channel200
description <<< Network Portchannel VLAN 200 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no ip address
load-interval 30
spanning-tree bpdufilter enable
lacp max-bundle 2
lacp direct-loadswap
```

Cisco 7600a & 7600b–EtherChannel Subscriber-Side Configuration

```
interface GigabitEthernet4/1
description <<< Connected to SCE1 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
```

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```
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 100 mode active
!
interface GigabitEthernet4/3
description <<< Connected to SCE2 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 100 mode active
!
interface GigabitEthernet4/5
description <<< Connected to SCE3 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 100 mode active
```

Cisco 7600a & 7600b–EtherChannel Network-Side Configuration

[interface GigabitEthernet4/2](#)

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```
description <<< Connected to SCE1 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
spanning-tree bpduguard enable
channel-protocol lacp
channel-group 200 mode active
!
interface GigabitEthernet4/4
description <<< Connected to SCE2 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 200 mode active
!
interface GigabitEthernet4/6
description <<< Connected to SCE3 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
```

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```
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 200 mode active
```

Cisco 7600a & 7600b – Subscriber-Side Interface Configuration

```
interface TenGigabitEthernet2/1
description <<< Connected to SUB Side >>>
switchport
switchport access vlan 100
switchport mode access
no ip address
```

Cisco 7600a & 7600b – Network-Side Interface Configuration

```
interface TenGigabitEthernet3/1
description <<< Connected to NET Side >>>
switchport
switchport access vlan 200
switchport mode access
no ip address
```

SCE 1-3 – Global Configuration

```
interface LineCard 0
link failure-reflection on-all-ports
connection-mode inline on-failure cutoff
subscriber aging anonymous timeout 1440
subscriber aging introduced
subscriber aging introduced timeout 1440
subscriber anonymous-group name anonymous IP-range 0.0.0.0:0x00000000
```

SCE 1-3 – Network-Side Configuration

```
interface GigaBitEthernet 0/1
auto-negotiate
interface GigaBitEthernet 0/3
auto-negotiate
```

SCE 1-3 – Subscriber-Side Configuration

```
interface GigaBitEthernet 0/2
auto-negotiate
interface GigaBitEthernet 0/4
auto-negotiate
```



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Note: For subscriber-aware environments, the SM configuration file should be configured as described in [SM Support and Implementation](#) section.



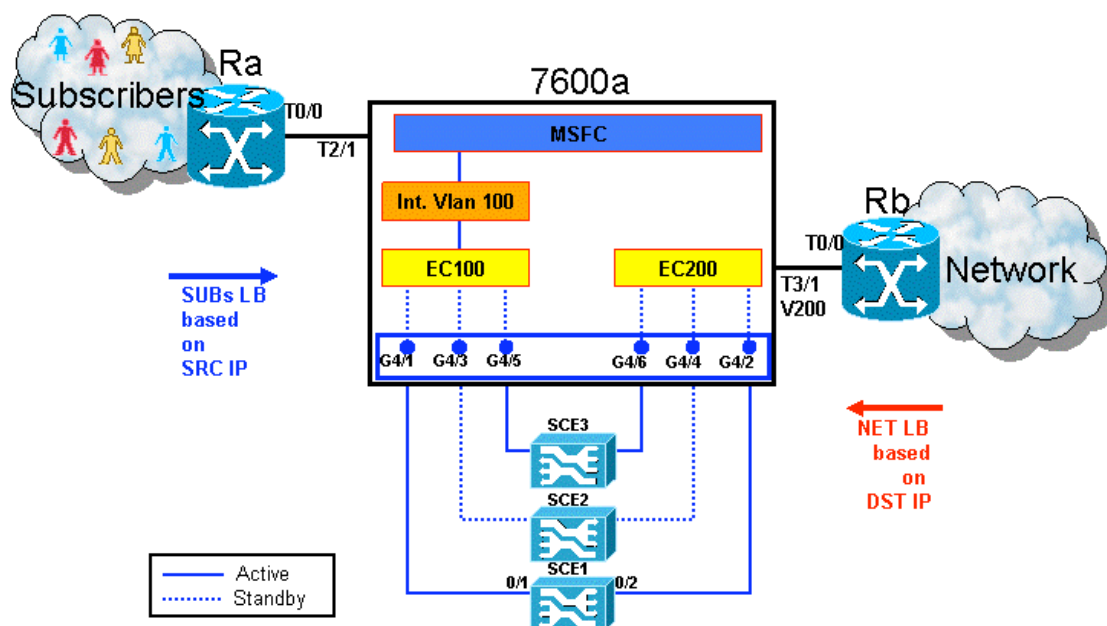
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Option 3—Single Cisco 7600 L3 Routing and EtherChannel Load Balancing

In this case the Cisco 7600 is providing Layer 3 functionality on the Subscriber side and Layer 2 functionality on the Network side, and VLAN translation is used to intercept traffic and redirect it via the SCE cluster.

EtherChannel provides N+1 redundancy and load balancing is used to ensure that every subscriber is statefully handled by the same SCE for both upstream and downstream flows.

To ensure that EtherChannel load balancing is performed properly, Subscriber-side traffic uses a routed interface and the Supervisor DFC sends the traffic to Port Channel 100, Network-side traffic goes to Line Card 3 that includes a DFC, and load balancing is configured accordingly.





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Configuration

Cisco 7600–EtherChannel Load-Balancing Configuration

```
port-channel per-module load-balance
port-channel load-balance src-ip
port-channel load-balance dst-ip module 3
```

Cisco 7600–EtherChannel Configuration

```
interface Port-channel100
description <<< Subscriber Portchannel VLAN 100 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
no ip address
load-interval 30
spanning-tree bpdupfilter enable
lACP max-bundle 2
lACP direct-loadswap
!
interface Port-channel200
description <<< Network Portchannel VLAN 200 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no ip address
load-interval 30
spanning-tree bpdupfilter enable
lACP max-bundle 2
lACP direct-loadswap
```

Cisco 7600–EtherChannel Subscriber-Side Configuration

```
interface GigabitEthernet4/1
description <<< Connected to SCE1 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
```

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```
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 100 mode active
!
interface GigabitEthernet4/3
description <<< Connected to SCE2 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 100 mode active
!
interface GigabitEthernet4/5
description <<< Connected to SCE3 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 100 mode active
```

Cisco 7600–EtherChannel Network-Side Configuration

```
interface GigabitEthernet4/2
```

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```
description <<< Connected to SCE1 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
spanning-tree bpduguard enable
channel-protocol lacp
channel-group 200 mode active
!
interface GigabitEthernet4/4
description <<< Connected to SCE2 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 200 mode active
!
interface GigabitEthernet4/6
description <<< Connected to SCE3 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
load-interval 30
```

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```
flowcontrol send off
no cdp enable
channel-protocol lacp
channel-group 200 mode active
```

Cisco 7600–Subscriber-Side Interface Configuration

```
interface TenGigabitEthernet2/1
description <<< Connected to SUB Side >>>
no switchport
ip address 172.16.100.254 255.255.255.0
!
interface Vlan100
ip address 172.16.200.254 255.255.255.0
```

Cisco 7600–Network-Side Interface Configuration

```
interface TenGigabitEthernet3/1
description <<< Connected to NET Side >>>
switchport
switchport access vlan 200
switchport mode access
no ip address
```

SCE 1-3–Global Configuration

```
interface LineCard 0
link failure-reflection
connection-mode inline on-failure cutoff
subscriber aging anonymous timeout 1440
subscriber aging introduced
subscriber aging introduced timeout 1440
subscriber anonymous-group name anonymous IP-range 0.0.0.0:0x00000000
```

SCE 1-3–Network-Side Configuration

```
interface GigaBitEthernet 0/1
auto-negotiate
```

SCE 1-3–Subscriber-Side Configuration

```
interface GigaBitEthernet 0/2
auto-negotiate
```

Router-a–Interface Configuration

```
interface TenGigabitEthernet0/0
ip address 172.16.100.1 255.255.255.0
```



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Router-b–Interface Configuration

<pre>interface TenGigabitEthernet0/0 ip address 172.16.200.1 255.255.255.0</pre>
--

Note: For subscriber-aware environments, the SM configuration file should be configured as described in the [SM Support and Implementation](#) section.



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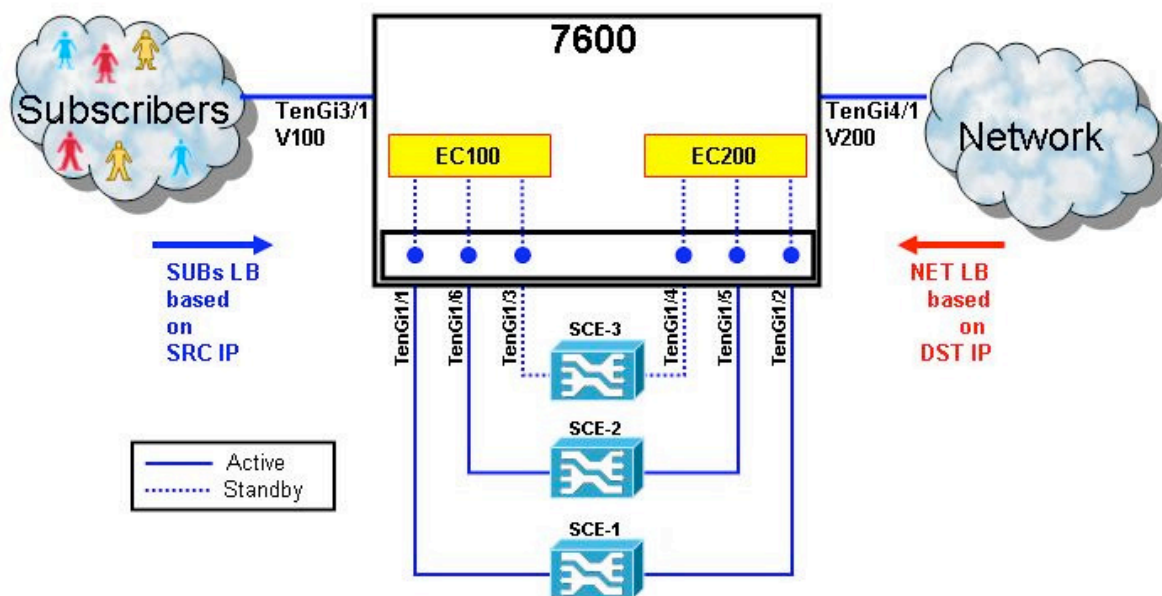
Option 4– 10G MGSCP - Single Cisco 7600 L2 Switching and EtherChannel Load Balancing

Solution Overview

In this case the Cisco 7600 provides Layer 2 functionality between the subscriber side and the network side. VLAN translation is used in order to intercept traffic and redirect it via the SCE8000 based cluster.

Etherchannel provides N+1 redundancy across SCE8000 with 10G Interfaces, and load balancing is used to ensure that every subscriber is statefully handled by the same SCE8000 platform for both upstream and downstream flows.

To ensure that Etherchannel load balancing is performed properly, subscriber-side traffic goes via the Line Card in slot 3, which has a DFC included, network-side traffic goes via Line Card 4 that uses the Supervisor DFC, and load balancing is configured accordingly.





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Configuration

Cisco 7600–EtherChannel Load-Balancing Configuration

```
port-channel per-module load-balance
port-channel load-balance src-ip
port-channel load-balance dst-ip module 4
```

Cisco 7600–EtherChannel Configuration

```
interface Port-channel100
description <<< Subscriber Portchannel VLAN 100 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
no ip address
spanning-tree bpdupfilter enable
lACP max-bundle 2
lACP direct-loadswap
port-channel port hash-distribution fixed
!
interface Port-channel200
description <<< Network Portchannel VLAN 200 >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no ip address
spanning-tree bpdupfilter enable
lACP max-bundle 2
lACP direct-loadswap
port-channel port hash-distribution fixed
!
```

Cisco 7600–EtherChannel Subscriber-Side Configuration

```
interface TenGigabitEthernet1/1
description <<< Connected to SCE1 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
```

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```
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 100 mode active
!
interface TenGigabitEthernet1/6
description <<< Connected to SCE2 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 100 mode active
!
interface TenGigabitEthernet1/3
description <<< Connected to SCE3 SUB >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 100
switchport trunk allowed vlan 100
switchport mode trunk
switchport vlan mapping enable
switchport vlan mapping 200 100
no ip address
flowcontrol send off
no cdp enable
lacp port-priority 65535
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 100 mode active
!
```



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Cisco 7600–EtherChannel Network-Side Configuration

```
interface TenGigabitEthernet1/2
description <<< Connected to SCE1 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
no ip address
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 200 mode active
!
interface TenGigabitEthernet1/5
description <<< Connected to SCE2 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
no ip address
flowcontrol send off
no cdp enable
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 200 mode active
!
interface TenGigabitEthernet1/4
description <<< Connected to SCE3 NET >>>
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 200
switchport trunk allowed vlan 200
switchport mode trunk
no switchport vlan mapping enable
no ip address
flowcontrol send off
no cdp enable
lacp port-priority 65535
```

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```
spanning-tree bpdupfilter enable
channel-protocol lacp
channel-group 200 mode active
!
```

Cisco 7600–Subscriber-Side Interface Configuration

```
interface TenGigabitEthernet3/1
description <<< Connected to SUB Side >>>
switchport
switchport access vlan 100
switchport mode access
no ip address
```

Cisco 7600–Network-Side Interface Configuration

```
interface TenGigabitEthernet4/1
description <<< Connected to NET Side >>>
switchport
switchport access vlan 200
switchport mode access
no ip address
```

SCE 1-5–Global Configuration

```
interface LineCard 0
link failure-reflection
connection-mode inline on-failure cutoff
subscriber aging anonymous timeout 1440
subscriber aging introduced
subscriber aging introduced timeout 1440
subscriber anonymous-group name anonymous IP-range 0.0.0.0:0x00000000
```

SCE 1-3–Network-Side Configuration

```
interface TenGigabitEthernet 3/0/0
```

SCE 1-3–Subscriber-Side Configuration

```
interface TenGigabitEthernet 3/1/0
```

Note: For subscriber-aware environments, the SM configuration file should be configured as described in the [SM Support and Implementation](#) section.



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Conclusion

The SCE platform is used to provide many services such as user authorization, reporting, and application bandwidth metering for broadband subscribers. As the number of broadband subscribers increases and service providers make more “last-mile” bandwidth available to each user, the bandwidth that an SCE-based solution needs to support also grows. For service providers it is important that a solution’s architecture and design allows the deployment to be scaled in the most modular and cost-efficient way possible. A robust solution design supporting load balancing, clustering, and redundancy is necessary to ensure that service control does not become a bottleneck of network growth for the service provider. The MGSCP solution combines Cisco's expertise in service control, routing, and broadband network design to offer service providers and their support staff a field-proven way to rapidly and reliably deploy service control at rates of 10 Gbps and beyond while ensuring a flexible network design that can cope with future network growth and evolution.



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Terminology

- **SCE**—Cisco Service Control Engine.
- **Cisco 7600**—In all cases described in this document a Cisco 6500 can replace a Cisco 7600, providing it runs IOS and works with a Sup 720 Supervisor card.
- **SM**—Subscriber Manager. A dedicated server for managing subscribers.
- **EC**—EtherChannel. A method employed by a switch to bundle a group of Ethernet ports into a single virtual channel.
- **STP**—Spanning Tree Protocol. A protocol used by Layer 2 switches to prevent loops in a Layer 2 network.
- **Subscriber Pull mode**—An SCE <-> SM operation mode. In this mode, subscriber information is pulled by the SCE platform from the SM the first time that the SCE platform handles their traffic, using their IP address.
- **Asymmetric routing**—A situation where the upstream and down stream of a given network flow (TCP or UDP session) are running over different links.
- **Split Flow**—A term used to describe the result of asymmetric routing. A given flow's upstream and downstream are running on different physical links.
- **SUP720b**—Supervisor card. This is the Cisco 7600 card that controls the chassis and manages the Line Cards.
- **DFC**—Distributed Feature Card. This card makes all forwarding decisions for each packet that enters the router on a DFC-enabled module.



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