Objectives and Overview

This paper discusses some of the recommendations that need to be performed to setup the HSP cable between two CPUs (cores) for campus and co-located CS1000E Servers.

This document is applicable to below CS1000 Processor Types and Releases.

- CS1000E and CS1000M processor Types with Release 5.0 onwards.

Terminologies

HSP ------ High speed pipe.
CAT5------ category 5 cable.
SS -------- Signaling Server.
HA -------- High Availability.
LAN ------ Local Area Network.

Abstract

This whitepaper gives more insights on how High Availability works and the different ways by which the CS1000 Call Server CPUs can be connected to each other.

It details the best practices to be followed to have a stable connectivity between the CPUs.
Figure: Dual-homed HA Call Server with HSP in Media Gateway

HA (High availability) of the Call Server includes the addition of the 410 HIGH_AVAIL HIGH AVAILABILITY package for CPPM/CPPIV servers. If the HA package is present in the keycode, the CP PM/CPPIV Call Server uses the HSP to detect the presence of the other CPU. If the other CPU is detected, both CPUs negotiate to determine which the active CPU is and which the standby CPU is. If the CP PM/CPPIV Call Server cannot detect the other CPU, it comes up as a single CPU system.
Introduction

HSP also known as High Speed Pipe is a 100/1000 BaseT network interface that provides standby Call Server Redundancy. By default this network interface is set to auto negotiate. To separate the redundant Call Servers, the ELAN subnet and the subnet of the High Speed Pipe (HSP) may be extended between the two processors using networking equipment that provides layer 2 end to end connectivity. The HSP uses network interfaces labelled "LAN 2" on the faceplate of the Processor on each of the CPUs.

If the two Call Servers are collocated, the HSP can be connected using a standard CAT5e or CAT6 crossover cable, limited to 100 meters in length.

The HSP provides:

- synchronization of the redundant Call Server's disk and memory subsystems
- sharing of "Health" information
- memory shadowing between the two Call Servers during graceful switchover operations.

Note:

The CP PM Co-res CS and SS does not support an HA configuration. For systems that require HA configuration, the VxWorks-based Call Server software must be deployed.

Heart Beat

The two CPUs exchange heartbeats to determine if the other CPU is reachable over the HSP. The heartbeat protocol also carries information regarding the health count of each CPU. If the HSP is disconnected then the heartbeat protocol attempts to traverse the ELAN instead. If the heartbeat cannot be communicated between the two CPUs meaning that connection over the HSP and ELAN is lost between the two CPUs then the redundant CPU warm starts to become active after a certain period of time.

By optimizing timeout and threshold parameters used in retries of the heartbeat mechanism, ungraceful switchover trigger time is reduced to less than 15 seconds. The optimization in the
timing leads to a change in the INI policy. When the active CPU warm starts, the inactive CPU also reboots, so no swapping of the CPUs takes place.

Configuration and usage

**High Speed Pipe (HSP) IP address management and setting up the hardware for side 0 and side 1 on the card.**

During the Call server SW install on the CPPM card, After the install menu option we get the option to set the hardware as CPU 0 or CPU 1.

Communication Server 1000 Software/Database/
BOOTROM RMD Install Tool
=================================================
This CS 1000 Call Processor is set to side 0
Please confirm that the side information is correct.
Please enter:
<CR> - > <y> - Yes, the side information is correct.
<n> - No, the side information is incorrect. Go on to Side Setting Menu.
Enter choice> <CR>

Similar when doing fresh SW install on the other card, it needs to be selected and identify as CPU 1.

This is important to identify and communicate with both the CPUs. Once both CPUs are up, now we need to assign ip address and other details.

**HSP configuration**
Initial installation

The HSP IP addresses are not configured during installation. Instead, they are configured in LD 117 after the system comes up. If HSP IP addresses have already been manually configured, then they are used as the system reboots. Otherwise, the default HSP addresses are used.

HSP recommendations and rules

The HSP can be connected using a cable directly between the two CPUs, or using networking equipment. CP PIV/CPPM requires the use of a crossover cable for HSP. When using networking equipment to connect, the HSP ports are assigned unique IP addresses.

This allows IP addresses to be configured for the HSP that do not conflict with other addresses in the customer's enterprise IP networks. These addresses are provisioned against a specific CPU (side 0 or side 1). Optionally, you may choose not to configure the HSP IP addresses and in this case the HSP interfaces use the following default IP addresses:

- 127.2.0.1 is bound to the Side 0 CPU.
- 127.2.0.2 is bound to the Side 1 CPU.

Note that the addresses are specific to a particular side.

When configuring an HSP in which the CPUs are connected through a data network, the IP addresses must be configured. The configuration of High Speed Pipe (HSP) IP addressing can optionally be performed after the installation process, if the default IP addresses are not appropriate for the customer network. Avaya strongly recommends allocation of a network IP address within the customer's address space, if the network is not dark fiber-driven by BayStack470 switches. Existing configuration procedures are used to provision these IP addresses. Specifically, Host Names are used to identify the HSP ports IP addresses.

The names used are:

- DEV_SIDE0_HSP - host name for the HSP on the Side 0 CPU
- DEV_SIDE1_HSP - host name for the HSP on the Side 1 CPU

The host names are not configurable; however, their parameters are configurable in LD 117. Changes to host name parameters require the use of the OUT and NEW commands; the CHG command is not allowed.
**Note:**

The HSP IP addresses and subnet mask are not activated until the SET HSP_IP command is used or the CPU reboots. The CPU should not be rebooted after changing but before issuing the SET HSP_IP command. Doing so may cause the HSP addresses between the active CPU and the redundant CPU to become out of sync.

**Example of HSP configuration**

`=> new host DEV_SIDE0_HSP 192.168.100.10
INET Data Added`

`=> new host DEV_SIDE1_HSP 192.168.100.11
Warning: HSP Subnet Mask not configured. Please enter HSP Subnet mask using the CHG HSP_MASK command
INET Data Added`

`=> chg hsp_mask 255.255.255.248
INET Data Changed`

`=> prt host
Call Server
ID Hostname XXXXX IP Address
1 LOCAL_PP_IF XXX137.135.192.4
2 REMOTE_PP_IF XXX 100.1.1.1
3 ACTIVE_CPU XXX 47.11.226.10
4 INACTIVE_CPU XXX 47.11.226.11
7 DEV_SIDE0_HSP XXX 192.168.100.10
8 DEV_SIDE1_HSP XXX 192.168.100.11`

`=> prt hsp_mask
HSP SUBNET MASK: "255.255.255.248"
OK`

`=> set hsp_ip
Activating HSP Addresses. Please wait ...
System is Redundant. Rebooting Inactive side to activate new HSP IP addresses.
24/03/2005 01:03:31 SRPT0118 CM: Server connection lost.`
SRPT118 CM: Server connection lost.
Side 0 HSP IP set to "192.168.100.10"
Side 1 HSP IP set to "192.168.100.11"
HSP subnet mask set to "255.255.255.248"
OK

**HSP IP address commands**

The NEW HOST command is used to configure the HSP IP addresses.

Syntax:

NEW HOST DEV_SIDE0_HSP <ip address>

or

NEW HOST DEV_SIDE1_HSP <ip address>

The PRT HOST and OUT HOST commands are used to display and remove the host entries for HSP ports.

**HSP IP address activation**

The SET HSP_IP command is introduced to LD 117 to activate the HSP IP addresses and subnet mask.

LD 117 HSP IP address activation command

Command Description :SET HSP_IP Activates the HSP IP addresses and subnet mask

The SET HSP_IP command first causes sanity checks to be performed on the configured HSP IP addresses and subnet mask. If the IP addresses and subnet mask are configured correctly, a warm Restart message is sent to the redundant side, if the system is redundant. Then the local HSP network interface is configured with the HSP IP address and subnet mask from the manually-provisioned parameters. Because the system is redundant, the HSP IP address parameters are copied to the redundant side, so that when the redundant side boots up, the new IP addresses and subnet mask are used.

If the system is not redundant, only the local interface is configured with the HSP IP address and subnet mask from the manually-configured values.

If the SET HSP_IP command is executed and the HSP IP addresses and subnet mask are the same as the IP addresses and subnet mask already in use, then this command has no effect.
Operating Parameters

The use of VLAN configurations and port priority settings to protect the ELAN and HSP network interfaces from harsh network conditions is required to ensure reliable operation. This minimizes the risk of unexpected network problems, such as heavy traffic conditions, broadcast storms, network stress caused by a virus, and Denial of Service attacks.

Fast Spanning Tree Protocol Learning (or disabling of Spanning Tree altogether), physical port-based priority, and VLANs must be supported by the networking products used to carry the HSP traffic.

Avaya recommends Multi-link Trunking to provide redundancy in the Connections between Avaya CS 1000E/CS1000M CPU locations.

The active Call Server's protected memory and disk subsystems are shadowed to the redundant Call Server using a synchronization protocol over the 100/1000 BaseT HSP interface. This ensures that the redundant Call Server can assume system control in case of failure of the active Call Server.

Network topology

The Avaya CS 1000E system provides the ability to distribute the redundant Call Server CPUs to two locations.

The initial offering of this feature in older releases (less than Release 4.5) made use of dark fiber driven directly by BayStack 470 Layer 2 switches.

This allowed the Avaya CS 1000E redundant Call Servers to be distributed to two locations that are separated by as much as 40 km.

Note: In case of big distances between redundant Call Servers, it is recommended to use 1Gbps link for HSP.

-This configuration, see Figure below : Call Server and Signaling Server (HSP and ELAN subnet) separated with Layer2 switching products, is still supported as the base offering.
The Campus Redundancy enhancements starting in Release 4.5 supports any vendor's switching product provided an installation test is run to measure packet loss, jitter, and delay.

**Note:** Campus Redundancy is not supported for Avaya CS 1000M Systems.

**Campus Redundancy Baystack 470 Bandwidth Use**

The Avaya Communication Server 1000E ELAN and HSP Ethernet links each require a dedicated 100 Mbps VLAN on the Baystack 470 1Gbps link (800 Mbps).

The requirements to use this extra bandwidth include:

- The extra bandwidth must be configured on a VLAN separate from the ELAN and HSP VLANs
- The ELAN and HSP VLANs must be configured with higher priority than the other VLANs to ensure they get bandwidth when required for an HSP Call Server switch over.
Avaya recommends that the actual configured aggregate bandwidth for the extra data traffic not exceed 800 Mbps. This further ensures that the ELAN and HSP ports always have enough bandwidth to complete their tasks.

L2 switch supports both the MLT (Multi Link Trunking), port based VLANs, and 802.1P priority configuration and is recommended for the HSP application.

**Third-party vendor switching equipment**

The HSP supports any vendor's switching equipment.

The following third party equipment has been tested:

- CISCO WS-3750G 24T-E GE ENH MULTILAYER CAYALYST (Layer 2 VLAN mode)
- 3C17203-3COM US/3COM 24-PORT 10/100TX SWITCH W/2
- 3COM 3C17304-US 3COM SS3 SWITCH 4228G 28PORTS EN
- 13240 EXTREME SUMMIT 200-24 SWITCH - 24 PORTS

**Note:**

The HSP cannot be routed. This means that the HSP cannot be extended through a layer 3 router unless that device supports a method of providing layer 2 end to end connectivity ie. layer 2 tunneling. Therefore, when passing through routing equipment, the HSP must remain in the same subnet from one Call Server to the other (for example, tunneling the HSP over the network).

The base marketing package NTHU53AA provides an NTRC17 crossover cable to connect the HSP ports of the two CP PM Call Servers.

**The following are recommendations and rules for configuring the HSP network interface and network when using network equipment to connect the HSP network interfaces of the two Call Servers.**

- The HSP must be connected through a cross-over cable or by a dedicated VLAN through switches.

- The HSP must be in its own IP subnet. It cannot be combined with the ELAN subnet.

- The minimum throughput of the HSP must be 100 MB. Therefore, the HSP port must be 100 MB and full duplex. This must be confirmed using the STAT HSP command in LD 137 after the
equipment is operational. This must also be verified on the network equipment to which the HSP is attached.

- The network switches must be capable of port mapping to 802.1p/Q.

- When running the HSP across network equipment, the HSP must be isolated in its own VLAN. Do not include other traffic in this VLAN. This VLAN must be given higher VLAN priority than any other traffic on the network, except for network control traffic (network control traffic is the traffic necessary to keep the network operational). The VLAN must be 802.1p/Q-capable and be configured to a very high setting so as not to starve the HSP.

Avaya strongly recommends 802.1p Level 7 (Network Control and OAM).

- When using third-party vendor network equipment that has not been validated by Avaya, a pre-test of the network must be performed. This test includes mixed traffic going across the networks in different VLANs. The network specifications should meet the round trip delay and packet loss requirements.

- The round trip delay of the HSP VLAN must be less than 30 msec and the packet loss of the HSP VLAN must be below .1 % packet loss.

- The HSP port on the CP PIV/CP PM is configured to auto-negotiate the link speed and duplex.

Therefore, the network equipment to which the CP PIV/CP PM is attached must also use auto negotiate.

Verify that both the CP PIV/CP PM and the network equipment speed and duplex are a match.

- Avaya recommends that MLT (Multi Link Trunking) be used across the enterprise IP network for the Campus Redundancy configuration.

**Caution:**

Duplex mismatches occur in the LAN environment when one side is configured to Auto Negotiate and the other is hard configured. The Auto Negotiate side adapts only to the speed setting of the fixed side. For duplex Operations, the Auto Negotiate side sets itself to half-duplex mode. If the forced side is fullduplex, a duplex mismatch occurs.
Customer validation

If the customer chooses to use network equipment between HSP ports, then the following must be done:

• Prior to installation, the network Service Level Agreement (SLA) for the HSP must meet minimum requirements.

• The network must meet the minimum requirements. See HSP recommendations and rules.

• Call processor graceful switchover must be tested after the CS 1000 installation.

Troubleshooting

If one of the following problems occurs:

• The Call Servers do not perform graceful switchover and/or come up as single CPUs

• Disk sync and mem sync take a long time (greater than 10 minutes)

Then check the following:

• If it is a CP PIV/CP PM processor, check the duplex and speed. Duplex mismatch is quite possible especially during an upgrade to CP PIV from CP PII using Baystack equipment. Duplex mismatch allows HSP to function, but packet loss is great.

• If it is a CP PII processor, verify that the Speed and duplex of the LAN equipment connected to the HSP is hard-coded to 100 Mbps full duplex.

• If the HSP traverses a network of switches make sure that the HSP is on its own VLAN. Verify that the 802.1 priorities are configured properly.

Campus Redundancy

With Campus Redundancy, customers can separate the Call Server pair across a campus IP network by extending the HSP over a network. As determined by software, the individual call processors are referred to as Call Server CPU 0 and Call Server CPU 1.
The ELAN subnet and the subnet of the High Speed Pipe (HSP) are extended between the two Call Servers using a dedicated Layer 2 Virtual LAN configured to meet specified network parameters.

The base marketing package NTHU53AA provides an NTRC17 crossover cable to connect the HSP ports of the two CP PM Call Servers.

Connecting co-located Servers

Follow Procedure 1 to connect co-located CP PM or CP PIV Servers.

Procedure 1
Connecting co-located Call Servers

1. Plug one end of the CAT5E RJ-45 crossover cable (NTRC17) into the HSP connector on the front of Server 0.
2. Plug the other end of the CAT5E RJ-45 NTRC17 crossover cable into the HSP connector on the front of Server 1.
Connecting Campus Redundant Call Servers

The port-based VLANs used in the Layer 2 switches operate in accordance with the IEEE 802.1Q tagging rules. VLAN ports are grouped into broadcast domains by assigning them to the same VLAN. Frames received in one VLAN can be forwarded only within that VLAN. For more information, see Communication Server 1000: System Redundancy (NN43001-507) NTP.

Procedure 2

Connecting Campus Redundant Call Servers

©2014 Avaya Inc. All Rights Reserved. Avaya and the Avaya logo are trademarks of Avaya Inc. and may be registered in certain jurisdictions. All trademarks identified by ® and ™ are registered trademarks or trademarks respectively, of Avaya Inc. All other registered trademarks or trademarks are property of their respective owners.
1. Connect the CAT5E RJ-45 HSP port of Call Server 0 to a 100BaseT ELAN network interface on the local Layer 2 switch.

2. Connect the CAT5E RJ-45 HSP port of Call Server 1 to a 100BaseT port on the remote Layer 2 switch.

3. Link the two switches with two high-speed single-mode fiber uplinks (1Gbps per link).

4. Assign three VLANs to the Layer 2 switch ports.
   a. VLAN 1 – Default
   b. VLAN 2 – HSP
      Two ports connect CP PM card HSP ports in Call Server 0 and Call Server 1.
      Four high-speed fiber uplinks (GBIC ports)
   c. VLAN 3 – ELAN
      Includes 2 ELAN network interfaces on the Call Servers, for example, for ELAN connections for Media Gateways, Avaya CallPilot™, Symposium and Element Manager.
      Four high-speed fiber uplinks (GBIC ports)
Figure: Dual-homed HA Call Server with HSP in Media Gateway
Conclusion

This white paper describes the configuration and recommended steps for setting up network with HSP cable for both co-located servers and campus redundancy setup for CS1000M and CS1000E systems.
Additional References

- The following documentation may be obtained from http://support.avaya.com.

  Please look into the below NTP for more details

  NN43001-507_05.02_System_Redundancy_Fundamentals.pdf
  NN43001-260_05.02_fundamentals_Data_Networking_with_VOIP.pdf
  NN43001-313_05.02_IP Peer Networking Installation and Commissioning.pdf
  NN43001-507_05.02_System_Redundancy_Fundamentals.pdf
  NN43041-220_05.02_1000E_planning_engineering.pdf