PLANNING GUIDE

# 5620 SAM

9.0 R2

3HE 06557 AAAC TQZZA Ed.01

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# 1 Introduction

The *5620 SAM Planning Guide* details the following aspects of the Alcatel-Lucent 5620 SAM product:

- Product deployment overview
- Supported operating systems specifications
- Hardware platform requirements
- Network requirements
- Scaling guidelines
- Workstation configuration
- Firewall information

## 1.1 Purpose

This document consolidates the technical information related to the deployment of the Alcatel-Lucent 5620 SAM Release 9.0 product. This document does not focus on the functionality offered by 5620 SAM Release 9.0 but instead presents the reader with pre-installation information required to plan a successful deployment.

The 5620 SAM Planning Guide is not a comprehensive list of technologies supported or not supported by 5620 SAM or the platforms hosting it. The Alcatel-Lucent NSM Product Group should be consulted for clarification when uncertainty exists.

## 1.2 Intended audience

This document is intended for network engineers, planners and IT staff who are familiar with the functionality of the 5620 SAM and are planning a product deployment.

# 2 Alcatel-Lucent 5620 SAM documentation set

Alcatel-Lucent publishes additional documentation describing other aspects of the Alcatel-Lucent 5620 SAM product. The documents are available on product and are accessible from the Alcatel-Lucent Customer Support Center at http://www.alcatel-lucent.com/myaccess. If you are a new user and require access to this service, please contact your Alcatel-Lucent sales representative.

- *5620 SAM 3GPP OSS Interface Compliance Statements* describes the compliance of the 5620 SAM northbound interface with the 3GPP standard.
- *5620 SAM 3GPP OSS Interface Developer Guide* provides information about the components and architecture of the 3GPP OSS interface to the 5620 SAM. It includes procedures and samples to assist OSS application developers to use the 3GPP interface to manage LTE devices.
- *5620 SAM Installation and Upgrade Guide* details the procedures necessary to install or upgrade 5620 SAM. This guide also describes procedures for making changes to the configuration of the 5620 SAM deployment, such as adding SAM redundancy.
- *5620 SAM Integration Guide* provides information about the ability of the 5620 SAM to integrate with additional components.
- *5620 SAM LTE Alarm Reference* provides a list of LTE ePC and LTE RAN alarms that can be reported in the 5620 SAM GUI.
- *5620 SAM LTE ePC User Guide* provides information about LTE, a standard for wireless mobile broadband networks. LTE networks can offer higher data throughput to mobile terminals than other technologies. LTE is the accepted evolution path for GSM, WCDMA, and CDMA networks.
- *5620 SAM LTE Parameter Reference* provides a list of all LTE ePC and LTE RAN parameters supported in the 5620 SAM.
- *5620 SAM LTE RAN User Guide* provides information about how to discover, configure, and manage the eNodeB using the 5620 SAM. The guide is intended for LTE RAN network planners, administrators, and operators.
- *5620 SAM LTE Release Description* describes the LTE network element management features in the current release of the 5620 SAM.
- *5620 SAM Maintenance Guide* helps develop and schedule regular maintenance activities.
- *5620 SAM Network Element Compatibility Guide* contains information about which versions of NEs are manageable by what versions of 5620 SAM, including a description of any restrictions or limitations on 5620 SAM's management capabilities.
- *5620 SAM Optical Alarm Reference* provides a list of optical device alarms that can be reported in the 5620 SAM.
- *5620 SAM Optical Parameter Reference* provides a list of all optical device parameters supported in the 5620 SAM.
- *5620 SAM Optical User Guide* describes how to discover, configure, and manage optical devices using the 5620 SAM.
- *5620 SAM Parameter Guide* provides information about 5620 SAM configurable parameters, including descriptions, options, default values, XML equivalents, and dependencies.
- *5620 SAM Release Description* provides detailed description of the functionality offered by 5620 SAM.

- *5620 SAM Scripts and Templates Developer Guide* provides information about using the 5620 SAM client GUI to manage the service-aware network, including GUI basics, commissioning, system administration, service configuration, policy management, and fault management.
- *5620 SAM Statistics Management Guide* contains information about configuring the 5620 SAM to collect accounting and performance statistics, as well as descriptions of collected statistics.
- *5620 SAM Supervision Module User Guide* provides procedures for monitoring network resources through the web-based 5620 SAM Supervision Module.
- *5620 SAM System Architecture Guide* contains a high-level view of 5620 SAM communications, configuration, and security functionality.
- *5620 SAM Troubleshooting Guide* provides information to troubleshoot 5620 SAM-managed networks, services, applications and platforms.
- *5620 SAM User Guide* contains information about using the client GUI to perform network management functions, including the configurable parameters in the *5620 SAM Parameter Guide* to find definitions, ranges, dependencies, and defaults.
- *5620 SAM XML OSS Interface Developer Guide* contains information about using the XML OSS interface to create OSS applications, such as alarm monitoring and inventory controls.

# 3 Updates to the 5620 SAM Planning Guide

This section highlights the key differences between this release of the Planning Guide and the 5620 SAM 8.0 Planning Guide. Minor differences between the documents, such as updating release version references, are not listed.

- Removal of support of SAM Server and SAM database on Windows based platforms
- Removal of support of 2 CPU based workstations for SAM Server and SAM Database
- Removal of support of SPARC T-Series CPU based servers
- Update Oracle Database version
- Support for HP based servers running Solaris added
- Added SAM Supervisor information
- Firewall ports added for NEM, SAM Supervisor, and Auxiliary Servers
- Firewall ports modified for MME and DSC
- Updated minimum memory requirements
- Single 73GB disk installations no longer supported
- Increased memory requirements to support 3GPP
- Refined SAN requirements

# 4 Product deployment overview

## 4.1 5620 SAM architecture

Five types of platforms can be present in a 5620 SAM Release 9.0 deployment:

- 5620 SAM GUI Client workstation(s)
- 5620 SAM GUI Client Delegate workstation(s)
- 5620 SAM Server
- 5620 SAM Auxiliary (Statistics Collector and Call Trace Collector)
- 5620 SAM Database

5620 SAM Release 9.0 supports co-location of the 5620 SAM Server and 5620 SAM Database software on a single workstation when it runs the Solaris operating system.

5620 SAM Release 9.0 also supports a distributed deployment, whereby the 5620 SAM Server and the 5620 SAM Database software components are installed on two different workstations.

5620 SAM Release 9.0 supports the distribution of statistics collection and the collection of call trace information. A 5620 SAM Auxiliary can be configured for statistics collection or for call trace collection. It cannot be configured to perform both functions.

5620 SAM Release 9.0 supports redundancy of the 5620 SAM Server, 5620 SAM Database, and 5620 SAM Auxiliary workstations. This can be achieved with the 5620 SAM Server and Database being in a collocated or distributed configuration. The 5620 SAM Auxiliary can also be installed in a redundant configuration, but cannot be collocated on the same workstation with a 5620 SAM Server or 5620 SAM Database.

A 5620 SAM Auxiliary Statistics Collector must be installed on an independent workstation to reduce the burden of statistics handling from the 5620 SAM Server. The 5620 SAM Auxiliary Statistics Collector workstation can only be configured in a 5620 SAM distributed deployment.

A 5620 SAM Auxiliary Call Trace Collector must be installed on an independent workstation to collect the call trace information from eNodeB network elements. Up to two active 5620 SAM Auxiliary Call Trace Collector workstations can be installed to scale the collection of call trace information. Each active 5620 SAM Auxiliary Call Trace Collector workstation can be assigned to a redundant workstation. Call trace information is synchronized between the redundant pairs. The 5620 SAM Auxiliary Call Trace Collector workstations can be configured in either a 5620 SAM distributed or collocated deployment.

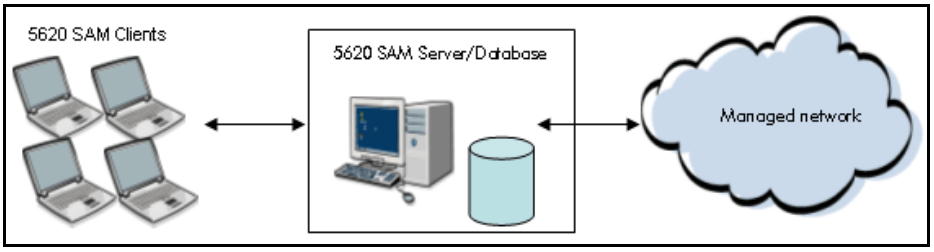
More details on redundancy in 5620 SAM can be found in Section 4.6

5620 SAM Release 9.0 supports IPv4 and IPv6 connectivity between the 5620 SAM Server/Auxiliary to the managed network. Connectivity between the 5620 SAM components uses IPv4 only.

A Network element can only be managed by one 5620 SAM standalone or redundant deployment. Having multiple 5620 SAM deployments managing the same network element is not supported, and will cause unexpected behaviour.

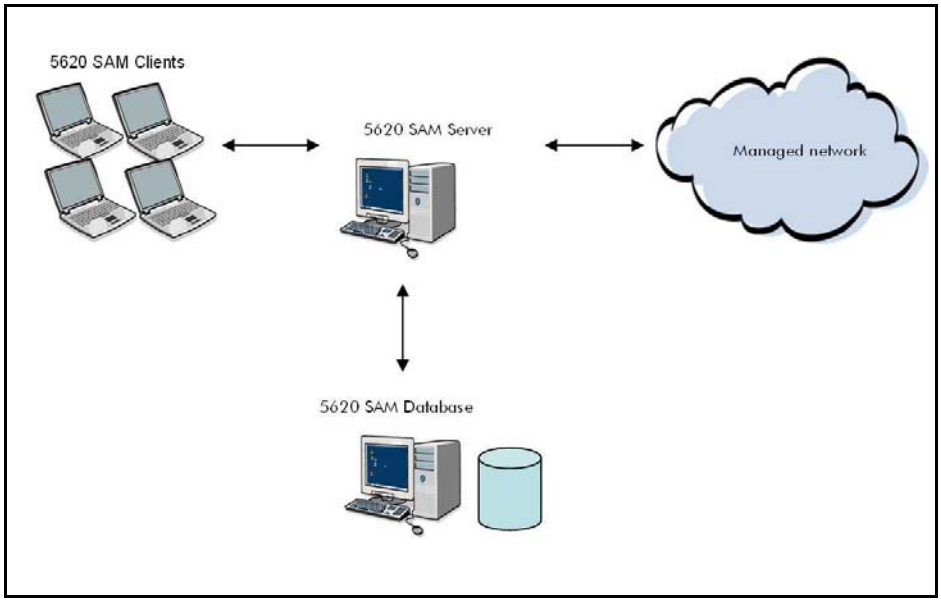
The following illustrates a typical deployment of 5620 SAM in standalone mode when the 5620 SAM Server and 5620 SAM Database platforms are collocated.

**Figure 1** 5620 SAM standalone deployment - collocated SAM Server/Database configuration



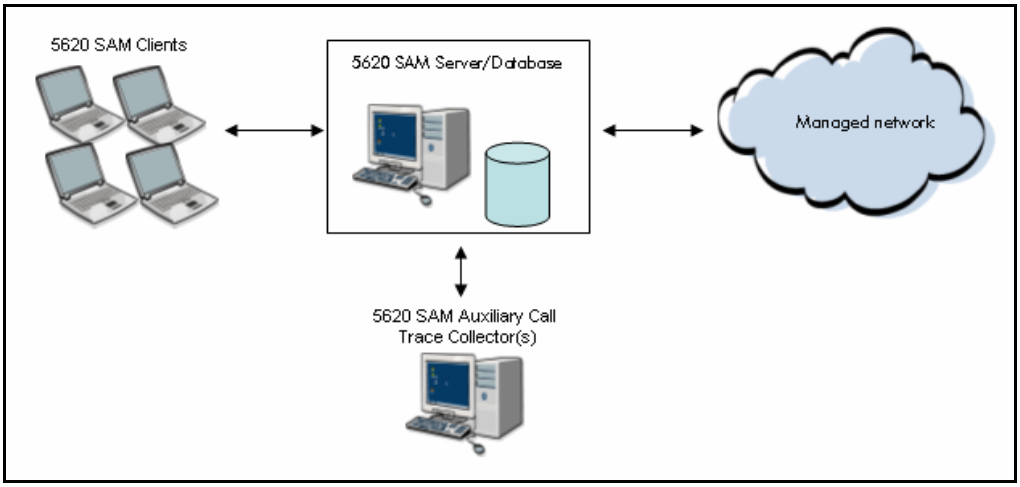

The following illustrates a typical deployment of 5620 SAM in standalone mode when the 5620 SAM Server and 5620 SAM Database platforms are not collocated.

**Figure 2** 5620 SAM standalone deployment – distributed 5620 SAM Server and 5620 SAM Database configuration.



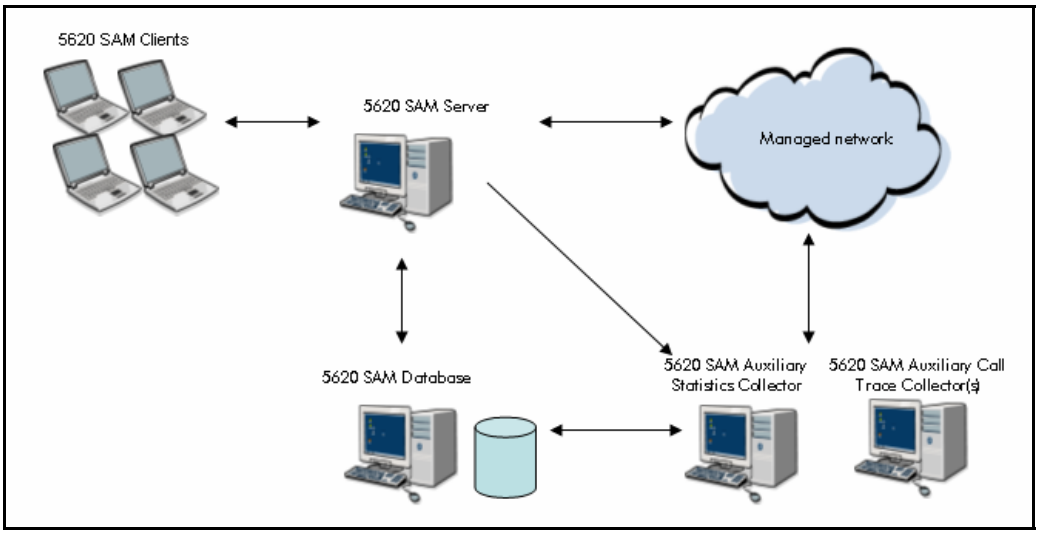

The following illustrates a typical deployment of 5620 SAM in standalone mode when the 5620 SAM Server and 5620 SAM Database platforms are collocated and a 5620 SAM Auxiliary Call Trace Collector is installed. The 5620 SAM Auxiliary Statistics Collector is not supported in this configuration.

**Figure 3** 5620 SAM standalone deployment – collocated 5620 SAM Server and 5620 SAM Database configuration and 5620 SAM Auxiliary Call Trace Collector installed




The following illustrates a typical deployment of 5620 SAM in standalone mode when the 5620 SAM Server and 5620 SAM Database platforms are in a distributed deployment and 5620 SAM Auxiliaries are installed. In this configuration there can be a single 5620 SAM Auxiliary Statistics Collector workstation or it could be configured redundant, and there can be one or two 5620 SAM Auxiliary Call Trace Collector workstations collecting call trace data from the network.

**Figure 4** 5620 SAM standalone deployment – distributed 5620 SAM Server and 5620 SAM Database configuration and 5620 SAM Auxiliary workstations installed




5620 SAM Server, 5620 SAM Auxiliary Statistics Collector, 5620 SAM Auxiliary Call Trace Collector and 5620 SAM Database software must be installed on workstations running the same Solaris operating system.

The 5620 SAM Server, 5620 SAM Auxiliary Statistics Collector, and 5620 SAM Database can run on Oracle based SPARC servers or x86 Intel, and x86 AMD based Oracle and HP workstations. The 5620 SAM Auxiliary Call Trace Collector can only run on an x86 Intel or x86 AMD based Oracle and HP workstations.

In a redundant configuration, the workstation architecture of the redundant pair must match. In the x86 case, CPU type (Intel or AMD) of the Oracle or HP x86 must match as well.

For example, a 5620 SAM Server can be installed on an Oracle x86 AMD workstation, while a 5620 SAM Database can be installed on an Oracle SPARC workstation. Their redundant pair must be Oracle x86 AMD and Oracle SPARC respectively

5620 SAM Client software may be installed on workstations running different operating systems from the 5620 SAM Server, 5620 SAM Auxiliary, and 5620 SAM Database. The 5620 SAM Client can be installed on Solaris or Windows.

All 5620 SAM workstations in the 5620 SAM management complex must maintain consistent and accurate time. It is recommended that NTP be used to accomplish this requirement.

## 4.2 5620 SAM Auxiliary Statistics Collector

5620 SAM Release 5.0 introduced the concept of the 5620 SAM Auxiliary Statistics Collector workstation. This type of 5620 SAM Auxiliary collects and processes performance and accounting statistics. This option enables customers to reduce the load of statistics collection from the 5620 SAM Server while allowing for increased statistics collection capabilities. A 5620 SAM Auxiliary Statistics Collector workstation should be used when statistics collection is expected to exceed the capacity of the 5620 SAM Server. Refer to Section 6 for scalability details of the 5620 SAM Server and dimensioning of the 5620 SAM Auxiliary Statistics Collector workstation.

The 5620 SAM Auxiliary Statistics Collector workstation can be configured as preferred or reserved for a given 5620 SAM Server (Active or Standby). This allows for a redundant 5620 SAM Auxiliary Statistics Collector configuration. Only one 5620 SAM Auxiliary Statistics Collector will collect statistics at any given time. Each 5620 SAM Auxiliary Statistics Collector is installed on a separate workstation. Information on the redundancy model of the 5620 SAM Auxiliary Statistics Collector can be found in section 4.6.

The 5620 SAM Server and the 5620 SAM Auxiliary Statistics Collector must maintain consistent and accurate time. It is encouraged to use an NTP service to achieve this. An alarm will be raised if the times are not within 30 seconds. Variations in time can cause the system to stop collecting statistics prematurely.

In networks where 5620 SAM Auxiliary Statistics Collector workstations are not configured, the 5620 SAM Server handles the statistics collection. In networks where the 5620 SAM Auxiliary Statistics Collector is configured, the 5620 SAM Server will never collect statistics – regardless of the availability of the 5620 SAM Auxiliary Statistics Collector workstations. At least one 5620 SAM Auxiliary Statistics Collector workstation must be available for statistics collection to occur.

The 5620 SAM Auxiliary Statistics Collector is only supported with a distributed 5620 SAM Server and 5620 SAM Database. The 5620 SAM Server and database platforms must be running on a supported Solaris based workstation.

For Collection of statistics from eNodeB network elements, NTP should be used to synchronize the network element and the 5620 SAM Server and 5620 SAM Auxiliary Statistics Collector to ensure the statistics are successfully retrieved.

## 4.3 5620 SAM Auxiliary Call Trace Collector

5620 SAM Release 8.0 R5 introduced the concept of the 5620 SAM Auxiliary Call Trace Collector workstation. This type of 5620 SAM Auxiliary collects call trace information from the eNodeB network elements.

Up to two 5620 SAM Auxiliary Call Trace Collectors can be configured to collect call trace information in 5620 SAM Release 9.0, and each of those collectors can be configured to be redundant. Each 5620 SAM Auxiliary Call Trace Collector is installed on a separate workstation. Each 5620 SAM Auxiliary Call Trace Collector workstation is configured as a preferred for the 5620 SAM Active Server and as a reserved for the 5620 SAM Standby Server. This allows for a redundant 5620 SAM Auxiliary Call Trace Collector configuration. Only one of the workstations in the 5620 SAM Auxiliary Call Trace Collector redundant pair will collect the call trace information from the network elements at any given time and the call trace information is synchronized between the Preferred and Reserved pair of workstations. Information on the redundancy model of the 5620 SAM Auxiliary Call Trace Collector can be found in section 4.6.

The 5620 SAM Server and the 5620 SAM Auxiliary Call Trace Collector workstation must maintain consistent and accurate time. It is encouraged to use an NTP service to achieve this. An alarm will be raised if the times are not within 30 seconds.

The 5620 SAM Auxiliary Call Trace Collector is only supported on an Oracle or HP x86 platform, in either a collocated or distributed 5620 SAM Server and Database configuration. The 5620 SAM Server and Database platforms must be running Solaris on either an Oracle SPARC or x86 based Oracle or HP platform.

## 4.4 5620 SAM Client Delegate

This option enables customers to launch multiple 5620 SAM GUI Clients from a single Solaris workstation. These GUI clients can be displayed using the X11 protocol to other Solaris desktops or native X displays. Displaying GUI clients to computers running X-emulation software is not currently supported.

The Client Delegate platform provides an option to consolidate multiple installations of the 5620 SAM GUI Client on a single Solaris workstation. Individual 5620 SAM Clients can be installed on the Client Delegate Platform. In Release 9.0, 5620 SAM Client also supports the ability for multiple users to share a single installation; however, each user must run the client with a unique UNIX Id.

Please note that on computers running Windows, only one instance of a 5620 SAM GUI Client can be running at any given time.

Information on dimensioning the 5620 SAM Client Delegate platform is given in section 6.1.

## 4.5 5620 SAM key technology overview

### Java Virtual Machine

The 5620 SAM Server, 5620 SAM Auxiliary, 5620 SAM Database, and 5620 SAM Client applications use Java technology. The installation packages contain a Java Virtual Machine which is installed with the software. This is a dedicated Java Virtual Machine and does not conflict with other Java Virtual Machines which may be installed on the same workstation.

5620 SAM Release 9.0 uses Java Virtual Machine version 6 from Oracle.

### Oracle database

The 5620 SAM Database embeds an installation of Oracle 11g Release 2 Enterprise Edition, which is installed on the 5620 SAM Database workstations. This database is used to store information about the managed network. The installation of Oracle is customized for use with the 5620 SAM application and must be dedicated to 5620 SAM. 5620 SAM database redundancy uses Oracle DataGuard, and is configured in maximum performance mode.

Alcatel-Lucent will not support any configuration deviations from the Oracle installation as performed by the 5620 SAM Database installation package, as it represents a 5620 SAM License Agreement Violation. Modifying the Oracle installation can impact system performance, stability and upgrades. Customer support agreements may be violated.

The Oracle Database is embedded with the 5620 SAM Product and because of this; Oracle requires all CPU licenses to be purchased from Alcatel-Lucent. This applies to customers with Oracle Site licenses as well.

## 4.6 Redundancy architecture

Redundancy between 5620 SAM Server and Database applications is used to ensure visibility of the managed network is maintained when one of the following failure scenarios occur:

- Loss of physical network connectivity between 5620 SAM Server and/or 5620 SAM Database and the managed network
- Hardware failure on workstation hosting the 5620 SAM Server and/or 5620 SAM Database software component

5620 SAM supports redundancy of the 5620 SAM Server and 5620 SAM Database components in the following workstation configurations:

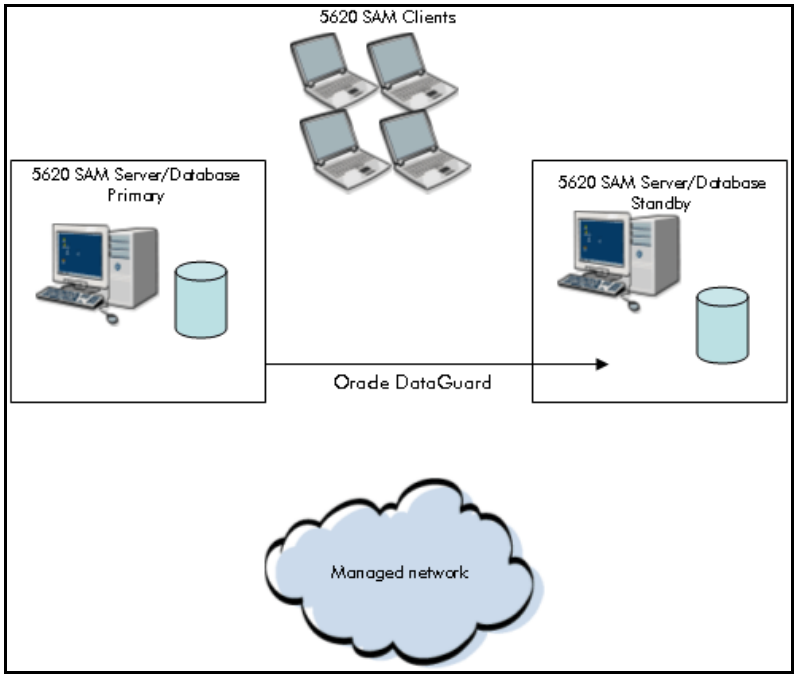
- 5620 SAM Server and 5620 SAM Database collocated and redundant (i.e. two workstations)
- 5620 SAM Server and 5620 SAM Database distributed and redundant (i.e. four workstations)

The 5620 SAM redundancy feature is only supported when the 5620 SAM Server and 5620 SAM Database software is installed on the Solaris operating system.

5620 SAM uses Oracle DataGuard configured in “maximum performance” and “Real-time apply” mode to implement the redundancy model.

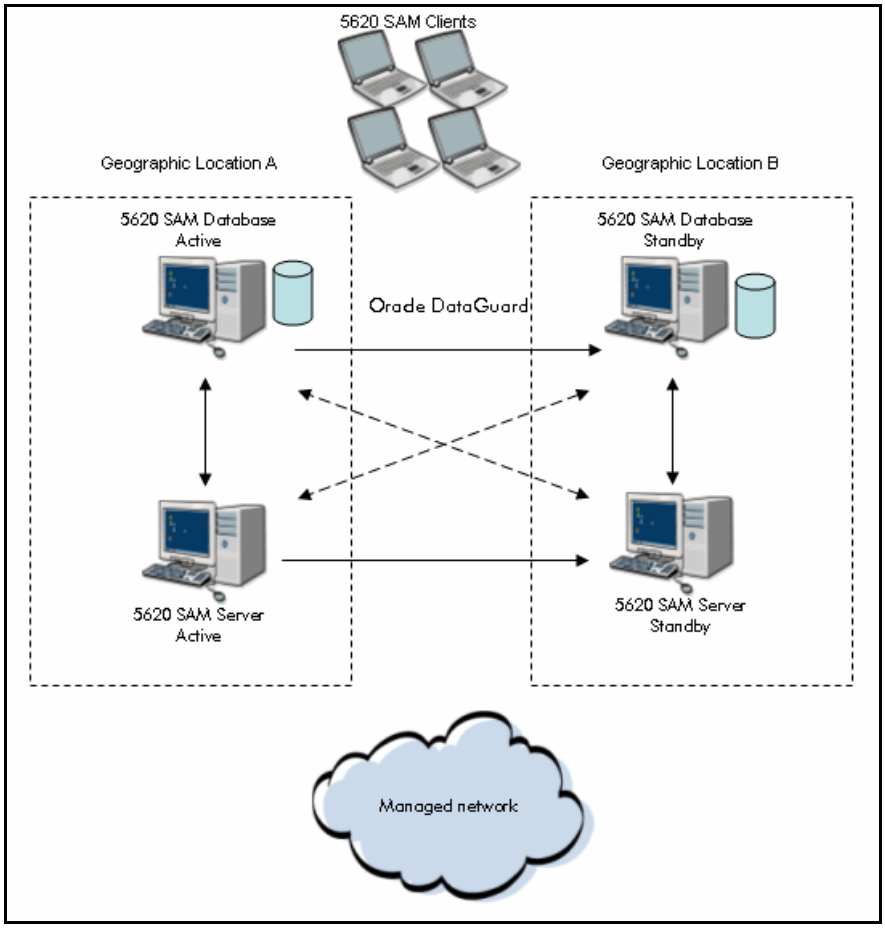
The following illustrates a 5620 SAM redundant installation when the 5620 SAM Server and 5620 SAM Database components are collocated on the same Oracle or HP x86 Solaris workstation.

**Figure 5** 5620 SAM collocated Server/Database redundancy deployment



The following illustrates a 5620 SAM redundant installation when the 5620 SAM Server and 5620 SAM Database components are located on different Solaris workstations.

**Figure 6** 5620 SAM distributed Server/Database redundancy deployment in a geographically redundancy setup.



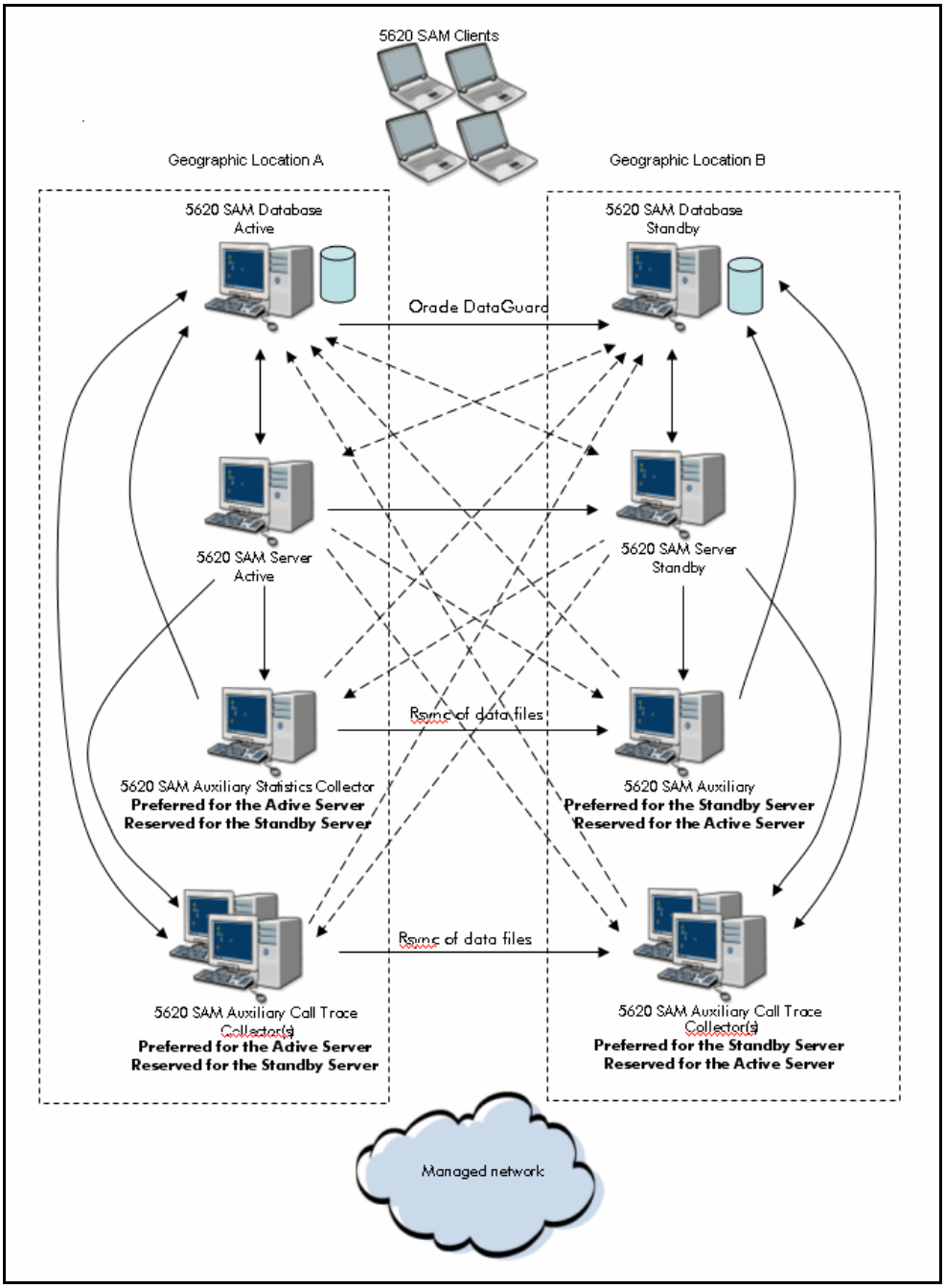
## Redundancy and 5620 SAM Auxiliary workstations

In customer networks where the statistics collection requirements exceed the scalability capabilities of a 5620 SAM Server, 5620 SAM Auxiliary Statistics Collector workstations can be used. As with other high availability components, 5620 SAM Auxiliary Statistics Collector can be configured to be redundant. Each 5620 SAM Server can be configured to have one preferred and one reserved 5620 SAM Auxiliary Statistics Collector.

In customer networks where Call Trace information is being collected from eNodeB network elements, a 5620 SAM Auxiliary Call Trace Collector must be used. The 5620 SAM Auxiliary Call Trace Collector workstations can be installed in a redundant pair. Up to two 5620 SAM Auxiliary Call Trace Collector redundant pairs can be installed..

In Figure 7 , there are workstations that are configured as 5620 SAM Auxiliary workstations. In the example where redundancy is geographic, there can be one 5620 SAM Auxiliary Statistics Collector and up to two 5620 SAM Auxiliary Call Trace Collector workstations configured in each geographic location. The Preferred/Reserved role of the 5620 SAM Auxiliary is dependant and configured on the 5620 SAM Server that is active. In both geographic locations, the 5620 SAM Server is configured such that the 5620 SAM Auxiliary in its geographic location is preferred. The 5620 SAM Auxiliary in the opposite geographic location is configured to be reserved. In this scenario, if the 5620 SAM Auxiliary for the active 5620 SAM Server were to no longer be available, the active 5620 SAM Server would use the reserved 5620 SAM Auxiliary in the opposite geographic location to collect statistics.

**Figure 7** 5620 SAM distributed Server/Database redundancy deployment with redundant 5620 SAM Auxiliaries that crosses geographically boundaries




Further information about 5620 SAM redundancy can be found in the *5620 SAM User Guide*.

## 4.7 Redundancy deployment considerations for 5620 SAM

Alcatel-Lucent supports the deployment of 5620 SAM using the Oracle Solaris IP multipathing (IPMP) feature. The support for IPMP is intended only to provide network interface redundancy configured in active-standby mode.

Probe-based IPMP fault detection and load spreading capability of IPMP are not supported.

Please refer to Oracle Solaris 10 documentation on how to configure IPMP.

### Redundancy deployment considerations for 5620 SAM workstations

When deploying 5620 SAM in a redundant configuration, the following items should be considered.

It is a best practice to keep the 5620 SAM Server, 5620 SAM Database, and 5620 SAM Auxiliary in the same geographic site to avoid the impact of network latency. When the 5620 SAM Database or 5620 SAM Server switches sites, the 5620 SAM auto-align functionality will ensure the SAM Server, 5620 SAM Auxiliary, and 5620 SAM Database are all aligned in the same geographic location. If the auto-align functionality is not enabled, a manual switch of the workstations is desirable.

### Redundancy with collocated 5620 SAM Server/Database:

- The operating systems installed on the primary and standby 5620 SAM Server/Database machines must be of the same versions and at the same patch levels.
- The layout and partitioning of the disks containing the 5620 SAM software, the Oracle software and the database data must be identical on the active and standby 5620 SAM Server/Database machines.
- The machine which will be initially used as the active 5620 SAM Server/Database must be installed or upgraded before the machine that will initially be used as the standby.
- The workstations hosting the 5620 SAM software should be connected in a way to prevent a single physical failure from isolating the two workstations from each other.
- Workstations running the 5620 SAM Server/Database software must be configured to perform name service database lookups on the local workstation before reverting to a name service database located on the network such as NIS, NIS+, or DNS. A root user must inspect and modify the /etc/nsswitch.conf file to ensure that files is the first entry specified for each database listed in the file.

### Redundancy with distributed 5620 SAM Server and 5620 SAM Database:

- The operating systems installed on the primary and standby 5620 SAM Server as well as the primary and standby 5620 SAM Database machines must be of the same versions and at the same patch levels.
- The layout and partitioning of the disks containing the 5620 SAM software, the Oracle software and the database data must be identical on the primary and standby 5620 SAM Database machines.
- The machines which are intended to be used as primary 5620 SAM Server and 5620 SAM Database should be installed on the same LAN as one another with high quality network connectivity.
- The machines which are intended to be used as standby 5620 SAM Server and standby 5620 SAM Database should be installed on the same LAN as one another with high quality network connectivity.
- The pair of workstations to be used as active 5620 SAM Server and 5620 SAM Database should be connected to the pair of workstations to be used as standby 5620 SAM Server and 5620 SAM Database in a way that will prevent a single physical failure from isolating the two workstation pairs from each other.
- Workstations running the 5620 SAM Server and 5620 SAM Database software must be configured to perform name service database lookups on the local workstation before reverting to a name service database located on the network such as NIS, NIS+, or DNS. A root user must inspect and modify the /etc/nsswitch.conf file to ensure that *files* is the first entry specified for each database listed in the file.

### Redundancy with distributed 5620 SAM Server and 5620 SAM Database and 5620 SAM Auxiliary workstations:

In addition to the rules stated above for distributed 5620 SAM Server and 5620 SAM Database, the following rules apply:

- The operating systems installed on the 5620 SAM Auxiliary workstations must be of the same versions and patch levels as the 5620 SAM Server and 5620 SAM Database workstations.
- 5620 SAM Auxiliary workstations are intended to be on the same high availability network as the 5620 SAM Server and 5620 SAM Database workstations. 5620 SAM Auxiliary workstations are intended to be geographically collocated with the Active and Standby locations of the 5620 SAM Server and 5620 SAM Database workstations.
- Workstations running the 5620 SAM Auxiliary software must be configured to perform name service database lookups on the local workstation before reverting to a name service database located on the network such as NIS, NIS+, or DNS. A root user must inspect and modify the */etc/nsswitch.conf* file to ensure that *files* is the first entry specified for each database listed in the file.

# 5 Operating systems specifications

This section provides the details of the operating systems that are supported by 5620 SAM Release 9.0, and any software requirements

## 5.1 Solaris (Oracle and HP platforms)

5620 SAM Release 9.0 is supported on Solaris 10 10/08 (Update 6) or later for the 5620 SAM Server, 5620 SAM Auxiliary, 5620 SAM Database and 5620 SAM Client. 5620 SAM Release 9.0 requires the following minimum base Solaris version (not updated using a Solaris Maintenance Update):

- Solaris 10 - 10/08 S10S_u6
- Solaris 10 - 05/09 S10S_u7
- Solaris 10 - 10/09 S10S_u8 (requires patch 142901-09 or newer)
- Solaris 10 - 09/10 S10S_u9

The Solaris support of the 5620 SAM Release 9.0 is applicable to SPARC platforms provided by Oracle and x86 AMD and Intel platforms provided by Oracle and HP only, with the exception of 5620 SAM Auxiliary Call Trace Collectors and the 5620 SAM-O 3GPP Interface that only operate on Oracle or HP x86 Intel or AMD platforms. Some systems may require specific versions of the Solaris OS. See Oracle's hardware compatibility list (HCL) on their website. 5620 SAM does not support all functionality introduced in Solaris 10 (for example zones or ZFS).

The redundancy feature of 5620 SAM is supported when the 5620 SAM Server, 5620 SAM Auxiliary and 5620 SAM Database software is installed on supported Solaris platforms. In this situation, the 5620 SAM Client software can be installed on Solaris or Windows platforms.

The Solaris operating system must be installed in 64-bit mode on workstations that will contain the 5620 SAM Server, 5620 SAM Auxiliary, 5620 SAM Database or 5620 SAM Client software. 32-bit mode is not supported.

The 5620 SAM Server, Auxiliary and Database workstation Solaris operating system must be installed in English. Multi-language Solaris is not supported.

5620 SAM can be installed in a collocated configuration, where the 5620 SAM Server and the 5620 SAM Database are installed on the same supported, Solaris based workstation.

Customers are solely responsible for securing Solaris support from Oracle for both HP and Oracle based platforms. Oracle may choose to modify Solaris support agreements for HP based platforms at any time in the future and is beyond the control of Alcatel-Lucent.

## 5.2 Microsoft Windows

As of 5620 SAM release 9.0, the Windows operating system is only supported for 5620 SAM Clients. The following 32-bit versions of Windows are supported:

- Windows 2000
- Windows 2003
- Windows XP Professional Edition
- Windows Vista Business/Enterprise and Ultimate
- Windows 7 Professional

The following 64-bit versions of Microsoft Windows are supported:

- Windows 7 Professional

When installing the 5620 SAM Client on a Windows computer platform, ensure that there is sufficient disk space as identified in the *Alcatel-Lucent Installation and Upgrade Guide* for the software.

Windows XP-SP2 will – by default – turn on the Windows Firewall functionality. This could cause difficulties with system operation. See section 10 for more details on specific ports that must be enabled for 5620 SAM operation.

## 5.3 Operating system summary

The following table summarizes the supported configurations for each of the Operating Systems supported by 5620 SAM Release 9.0.

**Table 1** 5620 SAM operating system support summary

| **5620 SAM application** | **Oracle SPARC or x86 64-bit**<br><br>**HP x86 64-bit**<br><br>**Solaris 10 10/08** | **Microsoft Windows** |
|---|---|---|
| 5620 SAM Server | Supported up to 5620 SAM Release 9.0 scalability limits | Not supported. |
| 5620 SAM Database | | |
| Collocated 5620 SAM Server/Database | | Not supported |
| 5620 SAM Client | Supported | Supported |
| 5620 SAM Auxiliary | Supported (Call Trace Collector only supported on x86) | Not supported |

| | | |
|---|---|---|
| 5620 SAM Redundancy (Server and Database) | Supported | Not supported |
| 5620 SAM Client Delegate | Supported | Not supported |

## 5.4 5620 SAM Client or Delegate software requirements.

5620 SAM clients can be launched, installed and uninstalled through a web browser (Web Launch, Install and Uninstall). To use this functionality, each client platform must have a system JRE (Java Runtime Environment) installed. The 5620 SAM web browser installer/launcher requires Java version 6.0 update 20 or greater for the system JRE. The system JRE needs to be already installed on the client platform. The system JRE is only used for the SAM client web browser installer/launcher, it is not required for installing, launching or running the 5620 SAM client when the web browser launch is not used.

5620 SAM 9.0 introduces support for SAM Supervisor that is launched from the 5620 SAM Client in a web browser. SAM Supervisor has the following requirements:

- Adobe Flash Player browser plug-in
- 32-bit Microsoft Internet Explorer 6 Browser

Additional Web Browsers may function with SAM Supervisor but they are not supported by Alcatel-Lucent.

# 6 Hardware platform requirements

This section defines the hardware platform requirements for successfully running the 5620 SAM Release 9.0 application. Following these platform guidelines is necessary to ensure the 5620 SAM Release 9.0 application performs adequately.

For new installations, Alcatel-Lucent encourages the use of Oracle x86 AMD or Oracle x86 Intel based workstations. Their performance exceeds similar sized SPARC workstations and have a more attractive price point.

5620 SAM 9.0 is also supported on HP supplied Intel based x86 workstations.

The following platforms are not supported:

- All Oracle UltraSPARC T-series based blades and servers
- Oracle M-Series Enterprise Servers
- AMD, and Intel systems by vendors other than Oracle or HP
- SPARC systems by vendors other than Oracle

For optimal disk I/O performance, the read cache must be enabled for each disk, through Solaris. Specific HBA controllers may be required for certain platforms to ensure that the read cache can be enabled. The platform manufacturer should be consulted to determine the correct HBA controller.

The 5620 SAM for redundant installations requires matching workstations for the active and inactive platforms. It is acceptable to have different platforms for the Server, Database, and auxiliaries but their redundant platform must be the same.

Applications that are not sanctioned by Alcatel-Lucent should not be running on any of the 5620 SAM server, auxiliary or database workstations.

The hardware platforms do not support running applications that are not specifically identified for that platform. For instance, a 5620 SAM client is not supported on the hardware platform for a distributed or collocated 5620 SAM Server as there is a significant memory requirement for the 5620 SAM client that will impact the behaviour of the 5620 SAM Server platform.

In order to support running a 5620 SAM GUI Client on a 5620 SAM server, a minimum of 16 GB RAM is required for a 5620 SAM Server in a distributed configuration, and 24 GB RAM is required for a 5620 SAM Server/Database in a collocated configuration.

5620 SAM does not support any form of virtualization.

## 6.1 Minimum hardware platform requirements

The following tables specify the minimum hardware platform requirements necessary to successfully operate the 5620 SAM Release 9.0 application. These minimum hardware platform requirements apply when the network being managed does not exceed any of the characteristics listed in the table below.

The minimum platform requirements also represent the smallest configurations suitable for lab evaluations and demonstrations of the 5620 SAM Release 9.0 product.

For installation purposes, a DVD-ROM is required. For easier management of the system, a graphics card is recommended.

## Minimum hardware platform requirements for Solaris

The table below lists the minimum hardware platform requirements for deployments of the 5620 SAM Release 9.0 product on the SPARC and x86 Solaris operating system.

Alcatel-Lucent continues to support deployments of 5620 SAM Release 9.0 on SPARC Solaris platforms from Oracle which are based on the UltraSPARC III Cu, UltraSPARC IIIi, UltraSPARC IV, and UltraSPARC IV+.

The minimum collocated platforms (for both x86 and SPARC) will deliver acceptable performance in situations in small network which are expected to be relatively static. If the rate of changes in the network or if the rate of transactions through the OSS application(s) are expected to exceed a few changes per second, the collocated minimum platform specified below will not be sufficient to deliver adequate performance. In that case, the distributed minimum platform is recommended.

Customers are solely responsible for securing Solaris support from Oracle for both HP and Oracle based platforms. Oracle may choose to modify Solaris support agreements for HP based platforms at any time in the future and is beyond the control of Alcatel-Lucent.

## Oracle or HP x86 hardware configuration:

**Table 2** 5620 SAM x86 minimum collocated platforms

| **For networks not exceeding:**<br>• **675 MDAs,**<br>• **1000 GNEs**<br>• **5 simultaneous 5620 SAM Clients (GUI or OSS)**<br>• **1000 elemental STM tests every 10 minutes**<br>• **50,000 performance or 100,000 accounting statistics records every 15 minutes** | |
|---|---|
| **5620 SAM application** | **Configuration** |
| 5620 SAM Server and Database (Collocated) | 2 * x86 Dual Core or 1 * x86 Quad Core<br><br>12 GB RAM minimum. 16GB RAM is recommended (24 GB RAM is recommended for Intel x86 based platforms)<br><br>4 SAS disk drives of size 146 GB is required for performance and storage capacity (minimum required: 2 SAS disk drives of size 73 GB).<br><br>Example platforms: Sun Fire X4200 or X4140 or X4170 Server / Proliant DL380 G6 |

**Table 3** 5620 SAM x86 minimum distributed platforms

| **For networks not exceeding:**<br>• **1875 MDAs**<br>• **Maximum of 5,000 GNEs**<br>• **5 simultaneous 5620 SAM Clients (GUI or OSS)**<br>• **2000 elemental STM tests every 10 minutes**<br>• **150,000 performance or 200,000 accounting statistics records every 15 minutes**<br>**OR**<br>• **1275 MDAs**<br>• **Maximum of 5,000 GNEs**<br>• **25 simultaneous 5620 SAM Clients (GUI or OSS)**<br>• **2000 elemental STM tests every 10 minutes**<br>• **150,000 performance or 200,000 accounting statistics records every 15 minutes** | |
|---|---|
| **5620 SAM application** | **x86 architecture** |
| 5620 SAM Server | 2 * x86 Dual Core or 1 * x86 Quad Core<br><br>12 GB RAM minimum. 16GB RAM is recommended (24 GB RAM is recommended for Intel x86 based platforms).<br><br>2 SAS disk drives of at least size 73 GB each in size<br><br>Example platform: Sun Fire X4200 or X4140 or X4170 Server / Proliant DL380 G6 |
| 5620 SAM Database | 2 * x86 Dual Core or 1 * x86 Quad Core<br><br>8 GB RAM minimum. 12 GB is recommended<br><br>4 SAS disk drives of size 146 GB is required for performance and storage capacity (minimum required: 2 SAS disk drives of size 73 GB)..<br><br>Example platform: Sun Fire X4200 or X4140 or X4170 Server / Proliant DL380 G6 |

## Oracle SPARC hardware configuration:

**Table 4** 5620 SAM SPARC Solaris minimum collocated platforms

| **For networks not exceeding:**<br>• **675 MDAs,**<br>• **1000 GNEs**<br>• **5 simultaneous 5620 SAM Clients (GUI or OSS)**<br>• **800 elemental STM tests every 10 minutes**<br>• **50,000 performance or 100,000 accounting statistics records every 15 minutes** | |
|---|---|
| **5620 SAM application** | **UltraSPARC III Cu/IIIi/IV/IV+ architecture** |
| 5620 SAM Server and Database (Collocated) | 4 * CPU @ 1 GHz or faster<br><br>12 GB RAM minimum. 16 GB RAM is recommended<br><br>4 SCSI disk drives of at least 73 GB in size is required for performance and storage capacity (minimum required: 2 SCSI disk drives of size 73 GB)<br><br>Example platform: Sun Fire v440/v445 Server or Sun Fire v490 Server |

**Table 5** 5620 SAM SPARC Solaris minimum distributed platforms

| **For networks not exceeding:**<br>• **1875 MDAs**<br>• **Maximum of 3,000 GNEs**<br>• **5 simultaneous 5620 SAM Clients (GUI or OSS)**<br>• **1000 elemental STM tests every 10 minutes**<br>• **100,000 performance or 200,000 accounting statistics records every 15 minutes**<br>**OR**<br>• **1275 MDAs**<br>• **Maximum of 3,000 GNEs**<br>• **25 simultaneous 5620 SAM Clients (GUI or OSS)**<br>• **1000 elemental STM tests every 10 minutes**<br>• **100,000 performance or 200,000 accounting statistics records every 15 minutes** | |
|---|---|
| **5620 SAM application** | **Ultra SPARC III Cu/IIIi/IV/IV+ architecture** |
| 5620 SAM Server | 4 * CPU @ 1 GHz or faster<br><br>12 GB RAM minimum. 16 GB RAM is recommended<br><br>2 SCSI disk drives that are at least 73 GB each in size<br><br>Example platform: Sun Fire v440/v445 Server/Sun or Fire v490 Server |
| 5620 SAM Database | 4 * CPU @ 1 GHz or faster<br><br>8 GB RAM minimum. 16 GB RAM is recommended.<br><br>4 SCSI disk drives of at least 73 GB in size is required for performance and storage capacity (minimum required: 2 SCSI disk drives of size 73 GB)<br><br>Example platform: Sun Fire v440/v445 Server/Sun or Fire v490 Server |

The minimum hardware platforms above are also applicable in situations where the 5620 SAM application is installed in a redundant configuration.

## Scaling limits for collocated platforms

Collocated platforms have been capped at the maximums described in Table 6 . Higher numbers may be achievable, but Alcatel-Lucent will only support the stated maximums. In the event that higher number of simultaneous 5620 SAM Clients is desired, the number of equivalent MDAs can be reduced. Note that all stated maximums may not be achievable simultaneously.

**Table 6** Scaling limits for collocated platforms

| Scaling parameter | Maximum |
|---|---|
| Number of MDAs | 1,875 |
| Number of Simultaneous 5620 SAM Clients (GUI or OSS) | 5 |
| Number of SAPs | 600,000 |
| Number of OAM tests per 10 minute interval | 1,000 |
| Performance Statistics per 15 minute interval | 50,000 |
| Accounting statistics per 15 minute interval | 200,000 |

## Minimum hardware platform requirements for 5620 SAM Auxiliary workstations

The 5620 SAM Auxiliary Call Trace Collector is limited to only the x86 architecture

**Table 7** 5620 SAM Auxiliary platforms

| Architecture | Supported 5620 SAM Auxiliary type | Configuration |
|---|---|---|
| Oracle SPARC | Statistics Collector | 4 * CPU @ 1.5 GHz or faster<br><br>8 GB RAM minimum. 16GB RAM is recommended.<br><br>4 SCSI disk drives of at least 73 GB in size (Multiple disks can be used to stripe the drives used to store files for the logToFile method of statistics collection)<br><br>Example platform: Sun Fire v440/v445 Server/Sun Netra 440 |
| Oracle or HP x86 | Statistics Collector | 2 * x86 Dual Core or 1 * x86 Quad Core<br><br>8 GB RAM minimum. 16GB RAM is recommended.<br><br>4 SAS disk drives of at least 73 GB each in size: Statistics collector uses 2 disks in a striped configuration to store files for the logToFile method of statistics collection.<br><br>Example platform: Sun Fire X4200 or X4140 or X4170 Server / Proliant DL380 G6 |
| Oracle or HP x86 | Call Trace Collector | 2 * x86 Quad Core Intel based HT<br><br>24 GB RAM minimum.<br><br>8 SAS disk drives of at least 146 GB each in size: Call Trace collector uses a striped configuration to store call trace files and debug trace files.<br><br>4 SAS disk drives of at least 146 GB each in size can be used, however, scale and performance will be reduced with this configuration<br><br>Example platform: Sun Fire X4170 M2 or X4270 M2 Server / Proliant DL380 G6 |

When a 5620 SAM Statistics Auxiliary Workstation is installed, the 5620 SAM Database workstation is required to have a minimum 16 GB RAM to accommodate the additional Oracle database sessions.

## Hardware platform requirements for 5620 SAM Client Delegate workstations

5620 SAM Release 9.0 allows multiple GUI clients to be installed on a single Oracle SPARC, Oracle x86, or HP x86 workstation running Solaris. This option enables customers to launch multiple 5620 SAM GUI Clients from a single Solaris workstation. These GUI clients can be displayed using a Citrix Client/Server, the X11 protocol to other Solaris desktops, or native X displays.

The Client Delegate platform provides an option to consolidate multiple installations of the 5620 SAM GUI Client on a single Solaris workstation or the option of installing one instance of the 5620 SAM GUI client run by many users (with unique Unix accounts). Regardless of the method of the client installation, the hardware platform requirements per client are the same.

Additional memory for each 5620 SAM Client will be required for management of the network elements described in section 8.12.

Additional memory for each 5620 SAM Client will also be required for a Web Browser if SAM Supervisor is to be used.

The 5620 SAM Client Delegate configuration is only supported for Oracle SPARC, Oracle x86, or HP x86 workstations running Solaris. Platforms running Windows can only run one instance of a 5620 SAM GUI Client at any given time.

The table below describes platforms requirements for this type of workstation.

**Table 8** 5620 SAM Client Delegate Workstations hardware platform requirements

| Number of simultaneous 5620 GUI Clients on platform | Number of CPU cores required | Amount of RAM required | Example platforms |
|---|---|---|---|
| 15 | 4 | 16 GB | Sun Fire X4200 or X4140 or X4170 Server / Proliant DL380 G6<br>or<br>Sun Fire v440/v445 Server / Netra 440 |
| 30 | 8 | 32 GB | Sun Fire X4140 or X4170 Server / Proliant DL380 G6<br>or<br>Sun Fire v490 Server |

For situations where more than 30 simultaneous GUI sessions are required, Alcatel-Lucent recommends deploying multiple 5620 SAM Client Delegate workstations.

Displaying GUI clients to computers running X-emulation software is not currently supported. In cases where the GUI client is to be displayed to a PC computer running Windows, Alcatel-Lucent supports installing the GUI client directly on the PC.

5620 SAM supports using Citrix for remote display of 5620 SAM Clients. Supporting Citrix on the delegate platform will require extra system resources that will need to be added to those that are required by the 5620 SAM delegate. Refer to Citrix documentation to determine the additional Citrix resource requirements. The following Citrix software has been tested:

- Citrix Server - XenApp Presentation Server 4.0 with Feature Pack 1 for Solaris x86
- Citrix Client - Version 8.50.117422 for Solaris x86

## 6.2 5620 SAM-O 3GPP Interface

5620 SAM-O 3GPP Interface is used by management systems that need to access 5620 SAM information collected from mobile networks. The 5620 SAM-O 3GPP Interface is supported as of 5620 SAM Release 8.0 R5. It is only available on Oracle or HP x86 platforms.

5620 SAM-O 3GPP Interface requires a separate JVM to be installed on the 5620 SAM Server, and is only supported on 5620 SAM Servers with a minimum 16 GB RAM in a distributed configuration or 5620 SAM Server/Databases with a minimum 24 GB RAM in a collocated configuration.

## 6.3 5620 SAM GUI Client hardware platform requirements

Alcatel-Lucent recommends 1 GB of dedicated RAM – regardless of the operating systems. In cases where other applications are running on the same platform as the 5620 SAM Client, it is important to ensure 1 GB RAM is available to the 5620 SAM Client. While the minimum required RAM can be 512 MB, performance will be diminished if network or user activity cause GUI memory growth.

Additional memory for each 5620 SAM Client will be required for web management of the network elements described in section 8.12.

The table below provides the minimum requirement for the hardware that will host 5620 SAM GUI client software.

**Table 9** 5620 SAM GUI hardware platform requirements

| 5620 SAM GUI Client hardware platform requirements | |
|---|---|
| **Oracle SPARC and x86 platforms** | **Microsoft Windows** |
| 1 CPU @ 1 GHz or higher (UltraSPARC III Cu or IIIi)<br>1 GB dedicated RAM<br>1 GB available disk space<br>1280*1024 Display resolution<br>Example platform:<br>Sun Ultra 45 Workstation | 1 CPU @ 2 GHz or higher<br>1 GB dedicated RAM<br>1 GB available disk space<br>1280*1024 Display resolution |

## 6.4 Determining hardware platform requirements for larger networks

5620 SAM Release 9.0 may require larger computer workstations in order to successfully manage networks that exceed any of the dimensions supported by the minimum hardware platforms. In order to determine which computer resources are required to successfully manage a larger networks, the following information is required:

- Expected number and types of Network Elements to be managed

- Expected number of MDAs in the network to be managed
- Expected number of services and SAPs in the network to be managed.
- Expected number of Dynamic LSPs to be deployed in the network.
- Maximum expected number of 5620 SAM Clients (GUI) simultaneously monitoring the network
- Expected number of OSS applications that will connect as clients to the 5620 SAM-O interface
- Expected number of subscribers, specifically for triple-play network deployments
- Expected performance and accounting statistics collection
- Expected number of STM tests
- Expected number of managed GNEs.
- Whether 5620 SAM redundancy is to be utilized
- Whether NEBS compliance is required.

The information above must then be sent to an Alcatel-Lucent representative who can provide the required hardware specifications.

Ensure that any projected growth in the network is taken to account when specifying the expected network dimensioning attributes. For existing 5620 SAM systems, the user may determine the number of MDAs deployed in the network using the help button on the 5620 SAM GUI. It is also possible to determine the number of statistics being handled by the system by looking at the 5620 SAM GUI's "Statistics Collection" information window. Select the "Tools", then "Statistics", then "Server Performance" Menu. List the "Statistics Collection" objects. From this list window, check the "Scheduled Polling Stats Processed Periodic" and the "Accounting Stats Processed Periodic" columns for the performance and accounting stats that your system is currently processing within the time interval defined by the collection policy (15 minutes by default).

Oracle licensing is dependent on the configuration of the 5620 SAM Database workstation required to support the scaling requirements. Extra licenses could be required for both the primary and standby 5620 SAM Database workstations.

## 6.5 Solaris workstation disk configuration

This section provides information on configuring workstations that will host 5620 SAM Release 9.0 software. These recommendations are specific to Solaris workstations.

Specific partition sizes and configuration procedures are available in the *Alcatel-Lucent 5620 SAM Installation and Upgrade Guide*.

Solaris UFS is the required file system. 5620 SAM does not support the ZFS file system .

While Alcatel-Lucent identifies areas of the disk that are not specifically required for 5620 SAM and are partitionable for customer use, workstation resources are expected to be dedicated for 5620 SAM. As such, these "Remainder" portions of the disks should only be used for static storage purposes. Consideration should also be made to the expected growth of the network. If the "Remainder" is not to be used, then it should not be created.

For most network sizes, Alcatel-Lucent recommends the use of 4 disks on workstations running the 5620 SAM Database. This disk configuration allows for better performance by distributing database onto multiple disks. A storage array may be required for larger network deployments or where large scale statistics

collection is required. Request a formal platform sizing for further details. NAS disk configurations are not supported.

A single-disk configuration greatly limits the 5620 SAM system performance, managed-network size, and data storage capacity, and is therefore only supported for lab trials.

Refer to section 9.2 for statistics collection recommendations.

In 5620 SAM upgrade scenarios, previous disk configurations may still be valid.

To alter existing disk configurations, a migration plan is available. Consult with Alcatel-Lucent personnel.

### Using RAID technologies

Alcatel-Lucent supports the use of RAID 0 (striping) only on supported Solaris based workstations. Alcatel-Lucent does not recommend using software RAID 0. Alcatel-Lucent will provide disk layout and configuration details for customers requiring a Storage Array. The increased disk I/O performance offered by RAID 0 is only required for 5620 SAM database with a high rate of changes/updates.

Alcatel-Lucent supports the use of RAID 1 (Mirroring) only on supported Solaris based workstations. Deployments requiring increased resiliency are encouraged to use SAM platform redundancy rather than RAID 1 because 5620 SAM's performance may be impacted. If RAID 1 is required, a platform providing hardware RAID 1 and that has sufficient number of disk to meet SAM Planning Guide Recommendations should be selected.

NOTE: Alcatel-Lucent is not responsible for installation, administration or recovery of RAID on a SAM platform.

### Using SAN storage

As of 5620 SAM Release 8.0 R5, Alcatel-Lucent supports the use of SAN storage only on supported Solaris based workstations. SAN connectivity must consist of 4Gb or faster optical connections with dedicated Fiber Channel connections between the hosts and storage arrays. The SAN must be available to 5620 SAM without interruption in a low latency environment.

Refer to Table 10 for required mount points and performance targets when using 5620 SAM with a SAN. Note that certain mount points may not be required due to deployment options. Refer to the IUG for required mount points based upon the type of 5620 SAM workstations deployed.

**Table 10** SAN Mount Points and performance requirements

| Mount Point | Average IOPS | Average Read (KB/s) | Peak Read (KB/s) | Average Write (KB/s) | Peak Write (KB/s) |
|---|---|---|---|---|---|
| /opt/5620sam | 100 | 3,000 | 90,000 | 7,000 | 30,000 |
| /opt/5620sam/server/xml_output | 450 | 6,000 | 100,000 | 18,000 | 90,000 |
| /opt/5620sam/auxserver/xml_output | 450 | 6,000 | 100,000 | 18,000 | 90,000 |
| /opt/5620sam/dbbackup | 450 | 6,000 | 100,000 | 18,000 | 90,000 |
| /opt/5620sam/dbbackup/staging | 100 | 3,000 | 90,000 | 7,000 | 30,000 |
| /opt/5620sam/samdb/tablespace | 950 | 7,000 | 150,000 | 18,000 | 90,000 |
| /opt/5620sam/samdb/tablespace/statstbs01 | 950 | 7,000 | 150,000 | 18,000 | 90,000 |
| /opt/5620sam/samdb/redolog | 450 | 6,000 | 100,000 | 18,000 | 90,000 |
| /opt/5620sam/samdb/archivelog | 100 | 3,000 | 90,000 | 7,000 | 30,000 |
| /opt/5620sam/calltrace | 1900 | 24,000 | 72,000 | 21,000 | 85,000 |
| /opt/5620sam/debugtrace | 1900 | 24,000 | 72,000 | 21,000 | 85,000 |
| /opt/5620sam/lte | 450 | 6,000 | 100,000 | 18,000 | 90,000 |

The *Alcatel-Lucent 5620 SAM Installation and Upgrade Guide* should be consulted for recommended partition sizes.

NOTE: Alcatel-Lucent is not responsible for installation, administration or recovery of SANs on a 5620 SAM platform.

# 7 Mechanisms to maintain current state of network elements

5620 SAM uses several mechanisms to maintain and display the current state of the network elements it manages. These mechanisms can include:

- IP connectivity (ping) verification
- SNMP connectivity verification
- SNMP traps
- SNMP trap sequence verification
- Scheduled SNMP MIB polling

These mechanisms are built into the Alcatel-Lucent 7450, 7750, 7450, 7710, and 7705 Network Elements and the 5620 SAM network element interaction layers.

## 7.1 IP connectivity (ping) verification

5620 SAM can be configured to ping all network elements at a configurable interval to monitor IP connectivity. If the network element is unreachable, an alarm will be raised against the network element. Details of the alarm are the following:

- Severity: Critical
- Type: communicationsAlarm
- Name: StandbyCPMManagementConnectionDown, OutOfBandManagementConnectionDown or InBandManagementConnectionDown
- Cause: managementConnectionDown.

Ping verification is disabled by default.

## 7.2 SNMP connectivity verification

5620 SAM performs an SNMP communication check every 4 minutes. If 5620 SAM can not communicate via SNMP with a network element, 5620 SAM will raise a communications alarm against that network element. 5620 SAM will also color the network element red on the map to indicate the communication problem. 5620 SAM will clear the alarm and color the network element as green once 5620 SAM detects SNMP connectivity to the network is re-established. Details of the alarm are the following:

- Severity: Major
- Type: communicationsAlarm
- Name: SnmpReachabilityProblem
- Cause: SnmpReachabilityTestFailed

This behavior occurs by default and is not configurable.

## 7.3 SNMP traps

5620 SAM listens to SNMP traps to receive changes from the network elements. 5620 SAM configures the trap log ID on each network element when it is first discovered. The network element then uses that trap log ID to send all configuration changes and updates to 5620 SAM. 5620 SAM will react to the traps it receives and make appropriate changes to the database, alarms and related object as required.

## 7.4 SNMP trap sequence verification

5620 SAM retrieves the last trap sequence number sent from all network elements at a configurable interval. This interval is configurable on a per resource group basis. Resource groups allow the user to configure the communications behaviour of a group of network elements. By default, the core resource group includes all network elements, and verifies the trap sequence number every 4 minutes. 5620 SAM compares that sequence number with the sequence number of the last trap it received from that network element. If they do not match, 5620 SAM will request only the missing traps from the network element. If at any point 5620 SAM realizes that it is missing more than 200 traps from a network element, or if the network element no longer has the missed trap, SAM will request a full resynchronization on that network element rather than just request the missing traps. The SNMP trap sequence verification was added in 5620 SAM Release 3.0

This behavior occurs by default and is not configurable.

## 7.5 Scheduled SNMP MIB polling

5620 SAM can poll all data SNMP MIBs from the network elements at a configurable interval. Starting in 5620 SAM Release 7.0 R1, the Poller policy is disabled by default. This behavior is configurable via the *Poller Policies* Manager.

## 7.6 Network outages

When an Alcatel-Lucent 7x50-based network element looses visibility of the 5620 SAM Network Manager, it is unable to send traps to the network manager, and the traps are queued on the network element. Section 7.4 describes 5620 SAM behaviour with regards to trap handling. When a network outage occurs, the network element configuration in 5620 SAM will be made consistent with the network element, but any event notifications, such as SNMP traps, that occurred during the network outage will not have been processed. This will cause intermediate state change alarms to not be reflected in 5620 SAM during the network outage.

# 8 Network requirements

The network interconnecting the 5620 SAM systems, network elements, and OSS systems is of significant importance to the effective management of the network. The following sections describe the requirements for the network links between 5620 SAM workstations and the connection to the network being managed. Alcatel-Lucent recommends that sufficient bandwidth be made available to the 5620 SAM workstations within the Data Communication Network.

A network card that allows jumbo frames may be required if the network is to be managed without packet fragmentation. For SNMP management of Alcatel-Lucent network elements, all network segments that carry SAM management traffic must allow the successful transmission of 9216 byte SNMP packets. The 5620 SAM Troubleshooting Guide contains more information on packet fragmentation issues.

Be sure to include the tables with the bandwidth required for statistics collection in the total bandwidth required between the 5620 SAM workstations, as they are in separate tables.

The tables do not specify the underlying infrastructure required to support these bandwidth requirements.

See Section 11 for information on configuring the 5620 SAM workstations with multiple interfaces.

## 8.1 Connectivity to the network elements

5620 SAM Release 9.0 supports both IPv4 and IPv6 connectivity to network elements. The following network elements may be managed by 5620 SAM using IPv6:

- 7750 6.1, 7.0, 8.0 and 9.0
- 7450 7.0, 8.0 and 9.0
- 7710 6.1, 7.0, 8.0 and 9.0
- eNodeB LA 2.0 and LA 3.0

## 8.2 Bandwidth requirements for collocated 5620 SAM installations

The following table lists the bandwidth requirements for the connections between the components of a 5620 SAM Collocated installation. It is a good practice to measure the bandwidth utilization between the various components to determine a suitable bandwidth. There are a number of factors that could require an increase above our bandwidth utilization recommendations – including: GUI activity, OSS activity, network events, number of network elements being managed. .

**Table 11** 5620 SAM collocated Server/Database bandwidth requirements

| Available bandwidth required from primary 5620 SAM Server/Database workstation | Recommended bandwidth: excluding statistics and call trace bandwidth requirements |
|---|---|
| 5620 SAM Client (GUI) | 512 kbps |
| 5620 SAM-O Client (The bandwidth will depend on the OSS application) | 1 Mbps |
| Between primary and standby 5620 SAM Server/Database workstation<br><br>NOTE: When network element database backup synchronization is enabled, the bandwidth requirement between the 5620 SAM Servers will vary significantly depending on the size of the network element backup file sizes. | 5-10 Mbps (sustained)<br><br>16-26 Mbps (during re-instantiation or database backup synchronization) |

## 8.3 Bandwidth requirements for distributed 5620 SAM installations

The following tables list the requirements for the connections between the components of a 5620 SAM Distributed installation. It is a good practice to measure the bandwidth utilization between the various components to determine a suitable bandwidth. There are a number of factors that could require an increase above our bandwidth utilization recommendations – including: GUI activity, OSS activity, network events, number of network elements being managed.

**Table 12** 5620 SAM distributed Server/Database bandwidth requirements

| Available bandwidth requirements for 5620 SAM | Recommended bandwidth: excluding statistics and call trace bandwidth requirements |
|---|---|
| 5620 SAM Server to a 5620 SAM Database<br><br>NOTE: This depends on GUI changes and lists, # of changes occurring in the network, and network objects managed. | 5 to 10 Mbps (3 Mbps minimum) |
| 5620 SAM Server to a 5620 SAM Client | 512 Kbps |
| 5620 SAM Server to a 5620 SAM-O Client (The bandwidth will depend on the OSS application) | 1 Mbps |
| Between a primary and a standby 5620 SAM Server<br><br>NOTE: When network element database backup synchronization is enabled, the bandwidth requirement between the 5620 SAM Servers will vary significantly depending on the size of the network element backup file sizes. | 1 Mbps |
| 5620 SAM Server to a 5620 SAM Auxiliary Statistics Collector | 1 Mbps |
| Between primary and standby 5620 SAM Databases<br><br>NOTE: The higher bandwidth is required to handle re-instantiation and is also required immediately after a database backup when database backup synchronization is enabled. | 6 Mbps (sustained)<br><br>15-25 Mbps (during re-instantiation or database backup synchronization)<br><br>3 Mbps (minimum) |

The size of the network and the number of statistics that are collected will impact the recommended bandwidth between the following workstations:

- 5620 SAM Auxiliary Statistics Collector and 5620 SAM Database
- Active and Inactive 5620 SAM Database workstations

The following tables should be used to determine how much additional bandwidth will be required between the 5620 SAM workstations when statistics collection is added to the system. The bandwidths of connections not listed do not change dramatically with the addition of statistics.

The registerLogToFile method of retrieving statistics can be compressed or uncompressed. Using the compressed option will require additional CPU requirements on the workstation that is collecting the statistics (either 5620 SAM Server or 5620 SAM Auxiliary Statistics Collector). In this case, the bandwidth required will be reduced.

**Table 13** Additional bandwidth requirements for accounting statistics collection.

| Bandwidth requirements for installations collecting accounting statistics. | Additional bandwidth per 200,000 accounting statistics records |
|---|---|
| 5620 SAM Server to a 5620 SAM-O Client if using findToFile.<br><br>OR<br><br>5620 SAM Server to 5620 SAM-O Client if using an uncompressed registerLogToFile (5620 SAM Auxiliary Statistics Collector is NOT installed).<br><br>OR<br><br>5620 SAM Auxiliary Statistics Collector to 5620 SAM-O Client if using an uncompressed registerLogToFile. | 3.5 Mbps |
| 5620 SAM Server to 5620 SAM Database workstation if the 5620 SAM Server is collecting the statistics<br><br>OR<br><br>5620 SAM Auxiliary Statistics Collector to 5620 SAM Database workstation if the 5620 SAM Auxiliary Statistics Collector is collecting the statistics | 2.2 Mbps |
| Between the 5620 SAM Database workstations<br><br>NOTE: The higher bandwidth is required to handle re-instantiation during statistics collection | 3.2 Mbps (sustained)<br><br>18 Mbps (during re-instantiation or database backup synchronization) |

**Table 14** Additional bandwidth requirements for performance statistics collection.

| Bandwidth requirements for installations collecting performance statistics. | Increased Bandwidth per 200,000 performance statistics records |
|---|---|
| 5620 SAM Server to a 5620 SAM-O Client if using findToFile<br><br>NOTE: a higher bandwidth may be desirable | 3.5 Mbps |
| 5620 SAM Server to 5620 SAM Database workstation SUM the following bandwidths:<br><br>If the 5620 SAM Server is collecting the statistics:(5620 SAM Auxiliary Statistics Collector is NOT installed)<br><br>If the 5620 SAM-O Client is using findToFile to collect all statistics data | <br><br>5.4 Mbps<br><br>5.4 Mbps |
| 5620 SAM Auxiliary Statistics Collector to 5620 SAM Database workstation if the 5620 SAM Auxiliary Statistics Collector is collecting the statistics | 5.4 Mbps |
| Between the 5620 SAM Database workstations – required for sufficient bandwidth for database re-instantiations<br><br>NOTE: The higher bandwidth is required to handle re-instantiation during statistics collection | 14.4 Mbps (sustained)<br><br>72 Mbps (during re-instantiation or database backup synchronization) |

When a 5620 SAM Auxiliary Statistics Collector is installed, the bandwidth requirements between two geographic locations will need to reflect the state where a 5620 SAM Auxiliary Statistics Collector in geographic location A may send information to the active 5620 SAM Server in geographic location B which will - in turn – send information back to the 5620 SAM Database in geographic location A. For this reason, the bandwidth between geographic location A and B must be the sum of the bandwidth requirements between the 5620 SAM Auxiliary Statistics Collector to 5620 SAM Server and 5620 SAM Server to 5620 SAM Database. It is also a best practice to ensure that the 5620 SAM Auxiliary Statistics Collector, 5620 SAM Server, and 5620 SAM Database are all collocated in the same geographic site.

## 5620 SAM Auxiliary Call Trace Collectors

When a 5620 SAM Auxiliary Call Trace Collector is installed, there are a number of bandwidth requirements listed below. Any bandwidths not listed are not impacted significantly by call trace data collection.

To handle the redundant pairs appropriately, the bandwidth requirements between two geographic locations will need to reflect the state where a 5620 SAM Auxiliary Call Trace Collector in geographic location A may need to provide information to the 5620 SAM-O Client in geographic location B. The synchronization of call trace and debug trace files will be impacted by the number client application ftp sessions retrieving call trace and debug trace files. To minimize this impact, it is recommended to limit the number of ftp sessions.

Due to the potential high bandwidth requirements of Call Trace and Debug Trace data, it is recommended to use multiple network interfaces on the Auxiliary Call Trace server. See Section 11.3 for recommendations when using multiple network interfaces on an Auxiliary Call Trace server.

**Table 15** Additional bandwidth requirements for call trace collection.

| Bandwidth requirements for installations with call trace collection | Bandwidth usage characterization |
|---|---|
| 5620 SAM Server to a 5620 SAM-O Client | Low bandwidth OSS requests and responses |
| 5620 SAM-O Client to 5620 SAM Auxiliary Call Trace Collector workstation<br><br>NOTE: a higher bandwidth may be desirable | Higher bandwidth to retrieve via FTP the call trace files from the 5620 SAM Auxiliary |
| 5620 SAM Auxiliary Call Trace Collector Preferred workstation it's Reserved redundant pair.<br><br>NOTE: a higher bandwidth may be desirable | Higher bandwidth to ensure timely synchronization of call trace files |

## 8.4 Bandwidth requirements for 5620 SAM GUI Clients

The bandwidth specifications provided above for 5620 SAM GUI Clients are based on the fact that information about changes in the network is forwarded to the 5620 SAM GUI Clients. The 5620 SAM Client updates information visible to the user based on recent changes in the network.

A few examples of network changes which will be reported to 5620 SAM include status changes of physical equipment, status changes of Layer 2 or Layer 3 interfaces, configuration of network elements, provisioning of new equipment or services, status changes in services or any attributes thereof, configuration changes of routing protocols and several others.

In situations where the frequency of changes sent to the 5620 SAM GUI is significant and exceeds the bandwidth specification, the performance of the 5620 SAM Client will degrade, and there is a possibility that the connection to the server will be dropped. A 5620 SAM GUI restart will be required to reconnect to the server to receive change notifications.

## 8.5 Bandwidth requirements for displaying 5620 SAM GUI Clients on X displays

5620 SAM GUI Clients can be displayed remotely on terminals using the X11 protocol for graphical displays. In these cases, it is important to ensure the bandwidth availability between the workstation running the 5620 SAM Client and the host displaying the 5620 SAM Client be at least 512 Kbps. Also, it is important to ensure the roundtrip network latency between these two hosts is quite low (20-30ms). To achieve acceptable performance on bandwidth limited links, X-compression should be used by using the ssh -XC command. If not using compression, it is recommended that the minimum bandwidth be 1024Kbps. Situations where the available bandwidth is lower or the network latency is higher will result in poor usability of the 5620 SAM GUI Client.

Extra bandwidth may be required to support the network elements described in section 8.12.

Note that 5620 SAM GUI Client startup may be impacted when using minimum bandwidth links.

## 8.6 Bandwidth requirements for 5620 SAM-O OSS Clients

There are two main factors affecting the bandwidth requirements between the 5620 SAM Server and a 5620 SAM-O OSS Client:

- Design and behavior of the application using the 5620 SAM-O OSS
- Rate of changes in the network

Applications which listen to network changes via the JMS interface provided by 5620 SAM-O or applications which retrieve large pieces of information via 5620 SAM-O, such as statistics information or network inventory information, will require access to dedicated bandwidth from the machine hosting the application to the 5620 SAM Server according to the tables above. Applications which do not require real time event and alarm notification may operate with acceptable performance when the bandwidth between the machine hosting the application and the 5620 SAM Server is less than the quantity specified in the tables above.

It is a best practice to minimize event and alarm notifications using a JMS filter to reduce bandwidth requirements and the possible effects of network latency.

In an environment where network changes are infrequent, it is possible to successfully operate an application using the 5620 SAM-O when the bandwidth between the machine hosting this application and the 5620 SAM Server is less than the quantity specified in the tables above, possibly as little as 128 kbps. However, in situations where the frequency of network changes increases, the performance or responsiveness of the application will degrade.

## 8.7 Bandwidth requirements for the 5620 SAM Auxiliary Statistics Collector workstation

The main factors impacting communication to and from the 5620 SAM Auxiliary Statistics Collector workstation are:

- Number of performance statistics being collected. The 5620 SAM Server needs to tell the 5620 SAM Auxiliary Statistics Collector which statistics to collect every interval.
- Number of performance and accounting statistics collected from the network elements.
- Number of performance and accounting statistics written to the 5620 SAM Database.

The more performance statistics are collected, the more significant the bandwidth utilization between the 5620 SAM Server and the 5620 SAM Auxiliary Statistics Collector. Similarly, this will require more significant bandwidth utilization between the 5620 SAM Auxiliary Statistics Collector and the 5620 SAM Database workstations. The bandwidth requirements are not dependent on network activity.

## 8.8 Bandwidth requirements for the 5620 SAM Auxiliary Call Trace Collector workstation

The main factors impacting communication to and from the 5620 SAM Auxiliary Call Trace Collector workstation are:

- Number of eNodeBs where Call Traces are enabled
- Number of Cells managed by a eNodeB
- Size of files being retrieved by the 5620 SAM OSS client requesting the Call trace

The more call traces that are enabled, the higher the bandwidth requirement from the eNodeB network elements to the 5620 SAM Auxiliary Call Trace Collector. Enable and Disable messages are sent to the 5620 SAM Auxiliary Call Trace Collector from the 5620 SAM Server. 5620 SAM OSS Clients can ask the 5620 SAM Server for the list of 5620 SAM Call Trace Collector workstations, and ftp connect directly to the 5620 SAM Auxiliary Call Trace Collector to retrieve the call trace log files.

**Table 16** Additional bandwidth requirements for eNodeB trace collection.

| Bandwidth requirements for installations with trace collection for a single 3 cell eNodeB with 100 calls | Recommended Bandwidth |
|---|---|
| Call Trace | 5.0 Mbps |
| Debug Trace | 23 Mbps |

## 8.9 5620 SAM bandwidth requirements for communicating with network elements

In order to effectively manage the network, 5620 SAM must have access to sufficient bandwidth between the 5620 SAM Server(s), 5620 SAM Auxiliary(s) and the network elements.

This bandwidth will be used to carry the management traffic between 5620 SAM and the network element. The following table describes the bandwidth requirements for a particular network element.

**Table 17** 5620 SAM Server to network bandwidth requirements

| Number of MDAs/CMAs | Network element Example | Bandwidth requirement from 5620 SAM Server(s) to the network element |
|---|---|---|
| 2 | 7450 ESS-1<br>Telco T5C<br>7250 | 200 kbps |
| N/A | OmniSwitch 6400, 6850, 6855, 9000 Series | 600 kbps |
| N/A | 9500 MPR | 200 kbps |
| 10 | 7450 ESS-7 (fully loaded) | 1 Mbps |
| 8 | 7705 SAR (fully loaded) | 200 kbps – 400 kbps |
| 20 | 7750 SR-12 (fully loaded) | 2 Mbps |
| 12 | 7710 C-12 (fully loaded) | 600 kbps |
| 1 | 7210 SAS E | 200-300 kbps |
| N/A | 9471 MME | 200 kbps |
| N/A | 5780 DSC | 200 kbps |
| N/A | eNodeB (3 Cell) | 600 kbps (Estimate)* |

* Figure does not include bandwidth required for trace (call and debug) collection.

## Details on the bandwidth requirements

The recommended bandwidth described above is a conservative figure that is meant to ensure that the performance of 5620 SAM and its ability to manage successfully each network element will not be affected by unusual network conditions.

Specifically, the bandwidth recommendation ensures that 5620 SAM can fully discover (or resynchronize) all of the objects contained in the network element, within a reasonable amount of time, usually no more than a few minutes for a densely populated network element.

The following are the main operations that result in significant amounts of information being exchanged between 5620 SAM and the network elements. These factors are therefore the principal contributors to the bandwidth requirements.

- Network Element Discovery: Upon first discovery of the network element, a significant amount of data is exchanged between 5620 SAM and the network element.

- SNMP traps: SNMP traps do not result directly in significant data being sent from the network element to the 5620 SAM. Several of the SNMP traps however do not contain all of the information required for 5620 SAM to completely represent the new status of the network element. As a result, 5620 SAM will subsequently perform a poll of a certain number of the SNMP MIBs to obtain the required information from the network element. Consequently, SNMP traps do result in a certain quantity of data and therefore cause bandwidth utilization. The exact quantity of bandwidth utilized will vary based on the number and the type of trap that is sent from the network element. In the worst case however, this bandwidth utilization will be less than that utilized during a network element discovery.
- SNMP polling: It is possible to configure 5620 SAM to poll the SNMP MIBs on the network elements at various intervals. By default, 5620 SAM will perform a complete poll of the SNMP MIBs every 24 hours on non-SR–OS based network elements. During the polling cycle, the amount of data transferred between 5620 SAM and the network element is equivalent to the amount of data transferred during the network element discovery.
- Statistics collection: It is possible to configure 5620 SAM to poll the SNMP MIBs on the network elements that contain performance statistics information. During the polling cycle, the amount of data transferred between 5620 SAM and the network element is less than the amount of data transferred during the network element discovery. With the configuration of a 5620 SAM Auxiliary Statistics Collector, the communication from and to the network elements will be distributed between the 5620 SAM Server and a 5620 SAM Auxiliary Statistics Collector.
- Network element backup: It is possible to configure 5620 SAM to request a backup of the network element at specified interval. During the NE backup cycle, the amount of data transferred between 5620 SAM and the network element is less than half of the amount of data transferred during the network element discovery.
- Provisioning of services and deployment of configuration changes: When network elements are configured or when services are provisioned via the 5620 SAM GUI or via application using the 5620 SAM-O interface, a small quantity of network bandwidth is utilized. The amount of data transferred is significantly less than during the network element discovery.
- Initiation and collection of STM tests and their results: When STM tests are initiated, the 5620 SAM Server sends individual requests per elemental test to the network elements. Once the test is complete, the network elements report back using a trap. The 5620 SAM server then requests the information from the network element, and stores it in the database. This can result in a significant increase in network traffic to the network elements.
- Call Trace Information collection: When Call Trace information is collected from the eNodeB, the 5620 SAM Auxiliary Call Trace Collector initiates a Call Trace collection with the eNodeB. The eNodeB responds with a stream of UDP traffic to the 5620 SAM Auxiliary Call Trace Collector that is interpreted and placed on the local hard disk. A third-party client will collect the information from the 5620 SAM Auxiliary Call Trace Collector.

For some network elements, management of the NE includes methods other than standard MIB/SNMP management – for example web-based tools. These network elements may require additional bandwidth above the bandwidth levels stated in Table 17 .

### Possible consequences of insufficient bandwidth

In situations where there is less than the recommended bandwidth between the 5620 SAM and the network element, the following are possible consequences:

- The length of time required to perform a network element discovery will increase
- The length of time required to perform a SNMP poll of the network element will increase
- The length of time required to retrieve statistics from the network element will increase
- The proportion of SNMP traps that will not reach 5620 SAM because of congestion will increase. This is significant since 5620 SAM will detect it has missed traps from the network element and will result in 5620 SAM performing additional SNMP polling to retrieve the missing information. This will result in additional data being transferred, which will increase the bandwidth requirements, possibly exacerbating the situation.

### Determining total bandwidth requirements for 5620 SAM-managed networks

The amount of bandwidth required for each of the network elements should be obtained from the table above.

The total amount of bandwidth that is required for 5620 SAM to manage the complete network will vary based on the topology of the infrastructure that is used to carry the management traffic. From 5620 SAM's perspective, there must be sufficient bandwidth (as per the table above) between itself and each of the network elements that is under management.

In cases where the management traffic is carried over physical point-to-point links between the 5620 SAM Server and 5620 SAM Auxiliary network and each of the network elements, sufficient bandwidth must be reserved on the physical links, as per the table above. The 5620 SAM Server complex can simultaneously communicate to several NEs for the following functions:

- NE Discovery, NE Resync, Resyncing for Trap Processing
- NE Backups, NE Software Downloading, and sending configurations to NEs
- Collecting Performance Statistics
- Collecting Accounting Statistics
- Initiating STM Tests on NEs
- Retrieve STM Test Results - also via FTP
- NE Reachability checks and NE trap gap checks
- Enabling Call Trace on eNodeB NEs

Rarely are all of the above performed simultaneously so it is recommended to assume for link aggregation points that SAM can communicate with a minimum of 20-30 NEs simultaneously – this can increase to 60-70 NEs on a 16 CPU core 5620 SAM Server workstation. For Networks of over 1,000 NEs or where a SAM Auxiliary Statistics Collector is being used, that number should be increased by 20-30 NEs. Higher bandwidth maybe required under special cases where above average data is attempted to be transferred between SAM and the network elements. For example, large statistics files, NE backups, or software images.

## 8.10 Network latency considerations

Network latency can potentially impact the performance of the 5620 SAM workstations. The following are known impacts of latency between the various 5620 SAM workstations:

- 5620 SAM Server to 5620 SAM Clients (GUI/OSS): event notification rates of network changes
- 5620 SAM Auxiliary Statistics Collector to the network elements: ftp connection for statistics collection and SNMP stats collection
- 5620 SAM Auxiliary Call Trace Collector to the eNodeB network elements: UDP call trace information received from the eNodeB
- 5620 SAM Server to the network elements: resync times, provisioning, ftp connections for statistics and network element backups, trap handling, and SNMP stats collection (See Section 9.2 for more information on latency impact on SNMP stats collection)
- 5620 SAM Server and 5620 SAM Auxiliary to 5620 SAM Database: 5620 SAM performance is sensitive to latency in this area. The roundtrip latency must be no longer than 1 ms. Performance of network, GUI, and OSS changes are significantly impacted.

### Common geographical location of 5620 SAM workstations

It is ideal to ensure that all 5620 SAM workstations and the 5620 SAM OSS clients are collocated within a geographical site on a high availability network to avoid the impact of network latency.

In cases where geographic redundancy is configured, all active 5620 SAM workstations (server, auxiliary, and database) should be located within a geographical site on a high availability network to avoid the impact of network latency. When a 5620 SAM workstation (server, auxiliary, or database) switchover or failover occurs, a manual intervention may be required to align the workstations on the same geographical site to minimize the performance impact of network latency.

### Optimizing throughput between 5620 SAM workstations

In high-speed, high-latency networks the TCP socket buffer size controls the maximum network throughput that can be achieved. If the TCP socket buffer is too small it will limit the network throughput, despite the fact that the available bandwidth might support much higher transfer rates.

Adjusting the TCP socket buffer size to achieve optimal network throughput may be necessary if the network bandwidth is more than 10mbps and roundtrip latency is higher than 25msec.

The optimal TCP socket buffer size is the bandwidth delay product (BDP). The bandwidth delay product is a combination of the network bandwidth and the latency, or round-trip time (RTT); basically, it is the maximum amount of data that can be in transit on the network at any given time.

For example, given a 20Mbps network with a RTT of 40ms the optimal TCP socket buffer size would be computed as follows:

```
BDP = 20 Mbps * 40ms
= 20,000,000 bps * .04s
= 800,000 bits / 8
= 100,000 bytes

socket buffer size = BDP
= 100,000 bytes
```

In Solaris 10, the default TCP socket buffer size is 49,152 bytes and Alcatel-Lucent supports a maximum value of 500,000 bytes. The buffer size can be modified at the operating system level by changing the value of the *tcp_recv_hiwat* and *tcp_xmit_hiwat* system parameters. To make this change persistent across system reboots, the commands must be added to a system startup script; this can be achieved by executing the following commands as the root user:

```
# cd /etc/init.d
# cat <<"EOF" > increase_tcp_buffer
> #!/sbin/sh
> #
> # Tune the TCP buffer size to improve network throughput
>
> case "$1" in
> start)
>    /usr/sbin/ndd -set /dev/tcp tcp_xmit_hiwat 100000
>    /usr/sbin/ndd -set /dev/tcp tcp_recv_hiwat 100000
>    ;;
> stop)
>    ;;
> *)
>    echo "Usage: $0 { start | stop }"
>    exit 1
>    ;;
> esac
> exit 0
> EOF
# chmod 0744 increase_tcp_buffer
# chown root:sys increase_tcp_buffer
# ln increase_tcp_buffer /etc/rc1.d/K70increase_tcp_buffer
# ln increase_tcp_buffer /etc/rc2.d/S70increase_tcp_buffer
```

It is important to note that increasing the TCP socket buffer size directly affects the amount of system memory consumed by each socket. When tuning the TCP socket buffer size at the operating system level, it is imperative to ensure the current amount of system memory can support the expected number of network connections with the new buffer size.

## Additional 5620 SAM Database throughput optimizations

In addition to the optimizations above, the 5620 SAM Database workstation requires changes to the sqlnet.ora and listener.ora files that are contained in the oracle/network/admin directory. The lines with the SEND_BUF_SIZE and RECV_BUF_SIZE should be uncommented (delete the "#" character), and set to 3 times the BDP value calculated above. The database should be shutdown when this change is made.

## 8.11 Network reliability considerations

### Reliability between 5620 SAM components

The 5620 SAM requires reliable network communications between all the SAM Components:

- 5620 SAM Servers
- 5620 SAM Databases
- 5620 SAM Auxiliaries
- 5620 SAM GUI Clients and 5620 SAM Delegate GUI server
- 5620 SAM OSS Clients

The performance and operation of 5620 SAM can be significantly impacted if there is any measurable packet loss between the 5620 SAM workstations. Significant packet loss can cause 5620 SAM reliability issues.

### 5620 SAM Server to NE network reliability

The 5620 SAM Server requires reliable network connectivity between the 5620 SAM Server/Auxiliary to the managed network elements. The mediation layer in 5620 SAM is designed to recover from lost packets between the 5620 SAM Server and the network elements; however, these mechanisms come with a cost to performance. Any measurable packet loss will degrade performance of 5620 SAM's ability to manage the Network Elements. The loss of packets between SAM and NE will have an impact on (but not limited to):

- Any SNMP operations to the network elements:
    - SNMP Trap processing performance
    - Provisioning performance
    - Provisioning failures
    - Performance statistics collection (possibly to the point where statistics collection will be incomplete)
    - STM test operation (initiating test and collecting results retrieval)
    - NE discovery and resync performance
    - NE discovery and resync failures
    - scheduled polling for reachability checks
- Accounting Statistics retrieval (possibly to the point where statistics collection will be incomplete)
- CLI session operation
- NE backup retrieval and software download performance

The following example will highlight the significant impact of lost packets. It only considers the SNMP communication times with one network element. With the default mediation policy configured with an SNMP retry timeout of 10 seconds, and an average round trip latency of 50 ms between 5620 SAM Server and the network element, 5620 SAM will spend a total of 25 seconds sending and receiving 1000 packets (500 SNMP gets and 500 SNMP responses). With a 0.1 % packet loss (1 packet out of the 1,000) the 5620 SAM Server will wait for the retry timeout (10 seconds) to expire before retransmitting. This will cause the time to complete the 500 SNMP gets to increase by 10 seconds – for a total of 35 seconds of communication time, or an increase of 40% over the time with no packet loss. With 0.5 % packet loss, the 500 SNMP gets would increase by 50 seconds – for a total of 75 seconds to complete or an increase of 200%.

## 8.12 GNE, Alcatel-Lucent OmniSwitches, 7250 SAS, Telco T5C, 9471 MME, eNodeB and 5780 DSC considerations

5620 SAM Clients support the web-based WebView functionality on Omni-switch family of switches.

5620 SAM Clients support web-based clients on the GNEs, 7250 SAS, and Telco T5C network elements.

The 5780 DSC and 9471 MME are treated as network elements within 5620 SAM.

The 5780 DSC is managed via a web interface that is run through the browser that is installed on the 5620 SAM Client workstation or 5620 SAM Delegate workstation. It requires a direct c0nnection from the 5620 SAM Client to the 5780 DSC. As such, unique firewall rules are required. There are also increased memory requirements on the 5620 SAM Client and/or 5620 SAM Delegate workstations for the Web Browser.

The 9471 MME requires two management tools to be configured: the MME MI tool, and the Client. Their management includes communication directly from the 5620 SAM Client to the 9471 MME platforms.

The eNodeB NEM is installed along with the 5620 SAM Client and communicates with the eNodeB elements in the network through a UDP proxy configured on the 56020 SAM Server. NEM runs within a separate JVM requiring additional memory resources on the 5620 SAM Client workstation. Please consult the NEM User Guide for up-to-date memory requirements for NEM.

# 9 Scaling guidelines

The following table (Table 18 ) represents the scalability limits for Release 9.0 . Note that:

- These limits require particular hardware specifications and a specific deployment architecture.
- Scale limits for network elements including GNEs, 7705s, and 7210s assume a maximum sustained trap rate of 40 traps/ second for the entire network.

Section 6 contains information on identifying the correct hardware platform for a particular network configuration. To achieve these scale limits, a distributed Solaris configuration is required, and may also require a 5620 SAM Auxiliary Statistics Collector and a storage array for the 5620 SAM database workstation. NAS disk configurations are not supported.

Consult Alcatel-Lucent personnel to ensure you have the correct hardware platform and configuration for your network size.

**Table 18** 5620 SAM Release 9.0 R2 scalability limits

| Attribute of managed network | Distributed configuration |
|---|---|
| Maximum number of managed MDAs | 25,000 |
| Maximum number of Network Elements (excluding GNEs) | 12,000 |
| Maximum number of GNEs (See Note Below) | 18,000 |
| Maximum number of managed services | 2,000,000 |
| Maximum number of SAPs | 6,000,000 |
| Maximum number of simultaneous 5620 SAM GUI | 150 |
| Maximum number of simultaneous active 5620 SAM-O HTTP applications | 30 |
| Maximum number of simultaneous active 5620 SAM-O JMS applications | 10 |
| Maximum number of outstanding alarms | 50,000 |
| Maximum number of Alarms (equivalent to 1 month retention assuming 50,000 per day) | 2,000,000 |

NOTE: The number of interfaces on a GNE and the traps that may arise from them is the key factor determining the number of GNE devices that can be managed. As GNE devices are expected to be access devices the sizing is based on an average of 10 interfaces of interest on each device (10 x 18,000 = 180,000 interfaces). Processing of traps from interface types that are not of interest can be turned off in 5620 SAM. Under high trap load, 5620 SAM may drop traps.

5620 SAM Release 9.0 uses the number of MDAs as the fundamental unit of network dimensioning. To determine the current or eventual size of a network, the number of deployed or expected MDAs, as opposed to the capacity of each router, must be calculated.

**Table 19** Network element maximums and equivalency.

| Network element Type | Maximum number of network elements supported | MDA equivalency |
|---|---|---|
| 7250 SAS (or Telco T5C CLE) | 2,500 | 5,000 |
| 7705 | 12,000 | 12,000 |
| 7210 | 5,000 | 5,000 |
| OMNISwitch 6000 series (each shelf in the stackable chassis) | 6,000 | 6,000 |
| OMNISwitch 9000 series (each NI) | 1,000 | 1,000 |
| 9500 MPR | 6,000 | 6,000 |

The 5780 DSC and the 9471 MME have an MDA equivalency of 1 MDA per blade.

The IMM card has an MDA equivalency of 2 MDAs per card.

The CMA card has an MDA equivalency of 1 MDA per card.

## 9.1 Scaling guidelines for 5620 SAM OSS Clients

There can be a maximum of 10 5620 SAM OSS-JMS Clients.

The number of 5620 SAM OSS-HTTP Clients supported by a 5620 SAM Server workstation is 2 times the number of CPU cores with at least 10 and at most 30 clients supported.

The maximum number of concurrent findToFile operations supported is 5.

### 5620 SAM OSS Clients using JMS

5620 SAM OSS Clients using JMS durable connections have a lower maximum message rate compared to non-durable clients.

Network latency between the 5620 SAM Server and a 5620 SAM OSS Client will reduce the JMS message rate. For durable JMS clients, the *Duplicate OK* method will allow for a higher message rate than the *Auto Acknowledge* method. Refer to the *5620 SAM-O OSS Interface Developer Guide* for more information.

The 5620 SAM is able to deliver hundreds of messages per second to a non-durable 5620 SAM OSS client. 5620 SAM OSS Clients may need to use non-durable connections to the SAM Server in order to keep up with high message rates.

**Table 20** JMS durable messaging rates

| JMS messaging | Roundtrip latency from the OSS Client to the 5620 SAM Server | | |
|---|---|---|---|
| | 0ms | 20ms | 40ms |
| Durable connection with Auto-acknowledge | 42 | 21 | 15 |
| Durable with Duplicates-OK | 49 | 42 | 26 |

NOTE: Higher durable messaging rates can be achieved by dedicating striped disks for redo logs and tablespaces when there is no latency.

### 5620 SAM 3GPP OSS Client

5620 SAM 3GPP OSS Clients connect to the 3GPP interface provided on the 5620 SAM Server. The 3GPP Interface uses a CORBA interface. Network latency between the 5620 SAM Server and a 5620 SAM 3GPP OSS Client will reduce the message rate.

**Table 21** 3GPP OSS JMS messaging rates

| CORBA messaging | Roundtrip latency from the OSS Client to the 5620 SAM Server | | |
|---|---|---|---|
| | 0ms | 20ms | 40ms |
| 3GPP OSS connection | 74 | 68 | 53 |

## 9.2 Scaling guidelines for statistics collection

5620 SAM provides the ability to collect statistics information from the network elements. This section provides guidelines that can be used to determine the extent to which Statistics Collection can be retrieved from the network.

### Statistics collection definitions:

*Performance statistics:* These statistics are associated with various network objects such as ports, interfaces, channels and network elements (routers). These statistics are retrieved by 5620 SAM using SNMP polling according to the MIB policies that are configured by the user.

*Accounting statistics:* These statistics are associated with Services, Subscribers, and Network Interfaces and contain data that can be used for accounting, billing and SLA management purposes. These statistics are collected on the 7x50 and retrieved by 5620 SAM via a file that is transferred via ftp.

*Statistics Item:* An individual statistics counter, such as RxOctets or TxFrames.

*Statistics Record:* A collection of statistics items which is retrieved from the router and stored in the 5620 SAM database as an atomic operations. In the various statistics forms on the 5620 SAM GUI Client, a statistics record appears to the user as a single row which contains the collection or retrieval timestamp and a set of individual statistics items. In the case of performance statistics, a statistics record corresponds to a row in the MIB table.

## Determining the number of statistics records that will be collected

In 5620 SAM Release 5.0 and above, statistics can be collected and processed by the 5620 SAM Server or by the 5620 SAM Auxiliary Statistics Collector for dedicated statistics handling. The 5620 SAM Auxiliary Statistics Collector provides a dedicated workstation for statistics collection. The following sections should be used to determine the maximum performance and accounting statistics for different hardware setups..

## Performance statistics

Refer to the *5620 Statistics Management Guide* to find the steps required to configure 5620 SAM to retrieve and process performance statistics. Note that two steps are required to enable the collection of performance statistics from the network. First, a policy is defined which specifies a set of polling periods for various MIBs. Second, the policy is applied to a number of network elements.

In general, enabling the statistics collection of a MIB will result in one statistics record being collected, at the specified polling period, for each network object to which the MIB applies.

For example, consider a policy is created with only the rtr.L2AccessDhcpRelayCfgStats MIB enabled for collection at 15-minute intervals. That policy is assigned to only two network elements which each contain 500 L2 Access Interfaces. As a result of this action, 5620 SAM will collect 1,000 statistics records from the network every 15 minutes.

The quantity of resources which are allocated to the retrieval and processing of performance statistics does not depend significantly on the number of CPUs available to the 5620 SAM Server software. The following table shows the maximum number of performance statistics that can be retrieved and processed by the 5620 SAM Server or 5620 SAM Auxiliary Statistics Collector every 15 minutes.

**Table 22** Maximum number of performance statistics records processed on a 5620 SAM Server

| Number of CPU cores on 5620 SAM Server workstations | Maximum number of performance statistics records per 15-minute interval | | |
|---|---|---|---|
| | Collocated configuration | Distributed configuration | Distributed configuration with Auxiliary Statistics Collector |
| 4 or greater SPARC | 50,000 | 100,000 | 500,000 |
| 4 or greater x86 | 50,000 | 150,000 | 500,000 |

To compute the number of CPU cores available on the workstation, the following Solaris command can be used:

/usr/bin/kstat -p cpu_info:::core_id | /usr/bin/awk '{print $NF}' | */usr/bin/sort -u* | */usr/bin/wc -l*

In situations where the 5620 SAM Server is asked to collect more performance statistics than it can process in the specified polling period, the *PollerDeadlineMissed* alarms will start appearing. These alarms indicate to the user that the polling mechanisms within 5620 SAM cannot retrieve the requested information within the specified polling period. Should this situation arise, the polling period for statistics should be increased or the number of objects that are applied to Statistics Poller Policies should be reduced.

To achieve the increased performance statistics retention, the 5620 SAM Database workstation must be configured with multiple tablespaces at 5620 SAM Database installation time. With a multiple tablespace installation and enough disk space, 32 GB of data space can be used for the performance statistics records, which equates to approximately 40-45 Million records.

## Performance statistics collection and network latency

5620 SAM collection of performance statistics from a single network element may be limited due to the round trip delay caused by network and network element latency. 5620 SAM collects performance statistics records using SNMP. One record is collected at a time to limit the load on the network element. Therefore, round trip latency will directly impact the maximum number of performance statistics records collected. As an example, if the round trip latency is 100ms, and we target a completion time of 75% of the collection interval (to allow for processing variances and other system impacts), the maximum number of performance statistics records that can be collected from one network element in a 15 minute interval would be 6750 records (75% of 900 seconds divided by 100 ms latency).

## Accounting statistics

Refer to the *5620 Statistics Management Guide* to find the steps required to configure 5620 SAM to retrieve and process accounting statistics.

The quantity of resources which are allocated to the retrieval and processing of accounting statistics within the 5620 SAM Server are set at the installation time and depend on the number of CPUs available to the 5620 SAM Server software. The number of CPUs available to the 5620 SAM Server depends on the number of

CPUs on the workstation and whether the 5620 SAM Database software is collocated with the 5620 SAM Server software on the same workstation.

An accounting statistic record is the statistic for one queue for one SAP. For example, if 2 ingress and 2 egress queues are configured per SAP, the "Combined Ingress/Egress" statistic represents 4 5620 SAM accounting statistic records.

It is recommended that the Accounting Policy Interval and the File Policy Interval be aligned to the same period. Misalignment of the policy periods can cause 5620 SAM resource contention for both performance and accounting statistics processing.

The following tables provide the maximum number of accounting statistics records that can be retrieved and processed by the 5620 SAM Server or 5620 SAM Auxiliary Statistics Collector in various situations.

To reach the peak accounting statistics from the 5620 SAM Auxiliary Statistics Collector workstation, the 5620 SAM Database workstation requires a customized configuration that can be obtained from Alcatel-Lucent personnel.

**Table 23** Maximum number of accounting statistics records to be processed by a 5620 SAM Server workstation

| Number of CPU cores on 5620 SAM Server workstations | Maximum number of accounting statistics records per 15-minute interval | | |
|---|---|---|---|
| | Collocated configuration | Distributed configuration | Distributed configuration with Auxiliary Statistics Collector |
| 4 | 100,000 | 200,000 | 800,000 |
| 8 or greater | 200,000 | 400,000 | 10,000,000 (8 CPU core and 16 GB RAM Oracle or HP x86 Auxiliary Statistics Collector platform required) |

## 5620 SAM Database hardware platform requirements

To collect large numbers of statistics, there are RAM and disk drive requirements for the 5620 SAM Database workstation. The following table highlights these requirements.

**Table 24** 5620 SAM Database workstation hardware requirements for a distributed configuration

| Maximum number of simultaneous statistics records per 15-minute interval | | 5620 SAM Auxiliary Statistics Collector | Requires the following 5620 SAM Database workstation setup |
|---|---|---|---|
| Accounting statistics records | Performance statistics records | | |
| 400,000 | 0 | No | 4 CPU cores<br>4 disk<br>16 GB RAM |
| 0 | 150,000 | No | |
| 800,000 | 0 | Yes | |
| 0 | 200,000 | Yes | |
| 10,000,000 | 500,000 | Yes | 8 CPU cores<br>Storage array<br>32 GB RAM |

To compute the number of CPU cores available on the workstation, the following Solaris command can be used:

/usr/bin/kstat -p cpu_info:::core_id | /usr/bin/awk '{print $NF}' | */usr/bin/sort -u* | */usr/bin/wc -l*

In situations where the 5620 SAM Server is asked to collect more accounting statistics records than it can process in the specified retrieval period, the extra statistics will not be retrieved from the network.

There are two methods to export accounting statistics from 5620 SAM: registerLogToFile, and findToFile. The registerLogToFile method is the preferred method and is required for situations where more than 400,000 statistics records are retrieved in 15 minutes. This recommendation also minimizes collection latency and reduces system load.

## Simultaneous collection of performance and accounting statistics records

5620 SAM can collect both performance and accounting statistics records simultaneously. However, it is important to consider that enabling the collection of one type of statistics will reduce the capability of 5620 SAM to collect and process the other type of statistics. It is therefore not possible to achieve the maximum stated limits for both performance and accounting statistics records simultaneously. Table 24 shows an example of simultaneous collection.

### Determining the number of performance and accounting statistics records being collected by 5620 SAM

To ensure the number of performance and accounting statistics records that 5620 SAM is asked to collect and process every 15 minutes remains below the stated scalability guidelines, it is important to carefully assess the impact of creating and assigning statistics policies. Review the number of objects that are assigned to statistics policy and ensure the polling and retrieval periods are set such that the numbers will remain below the stated guidelines.

Using SAM performance statistics, 5620 SAM can assist in determining how many polled and accounting statistics are being collected.

5620 SAM performance can be adversely affected by increasing the number of historical statistics entries recorded by the 5620 SAM. 5620 SAM system impacts include increased time listing log records from the GUI and OSS clients, increased Oracle tablespaces, and increased database backups times.

## 9.3 Scaling guidelines for scheduled tests (STM)

5620 SAM provides the ability to generate, manage and schedule STM tests within the network. This section provides guidelines that can be used to determine the extent to which STM tests can be scheduled and launched within a network.

There are a number of factors which will influence 5620 SAM's ability to concurrently manage and schedule a large number of tests. 5620 SAM keeps track of how many tests are running concurrently. This is to limit the initiation of the tests, and the processing of the results without interfering with the system's other functions.

To understand the STM guidelines, the following terminology is required:

*Elemental Test*: An OAM test to be sent to a router such as an LSP ping

*Lightweight Test*: An OAM test that is initiated in the default manner, however, will no longer record individual test and probe results in SAM unless the test has failed.

*Accounting file Test*: An OAM test that is initiated in the default manner, however, the test results are retrieved from the network element via FTP on a periodic basis.

*Test Policy*: A definition or configuration that tells 5620 SAM the specifics about how to generate a test. A test policy can contain multiple test definitions. The policies are used by test suites.

*Test Suite*: A collection of elemental tests that can be assigned to a specific schedule. There are three defined sections in which tests can be placed within a test suite: First run, Generated and Last run. The tests are executed in order by these sections. It is possible to configure the execution order of tests within the First Run and Last Run sections to be parallel or sequential. The tests in the Generated position are run by the system as concurrently as possible. If the Generated section contains tests from several different test definitions, then all the tests belonging to one definition will be executed before the tests of the next definition begin. Within a definition, the system will attempt to execute the tests as concurrently as possible. This is important to note, as a test suite containing a large number of tests in the Generated section (or in the First Run/Last Run sections set to parallel) may tax the system. Part of the increased stress placed on the system by concurrent tests is a result of the need for the system to use greater amounts of resources in order to initiate,

wait for and process many tests concurrently. As well, tests that result in a large amount data to be returned from the routers will place increased demands on the 5620 SAM.

*Schedule:* A start time that can have a test suite or test suites assigned to it to produce scheduled tasks. When the schedule's start time is reached, the suite or suites assigned to it will commence. The schedule may be set to continuously repeat after a configurable period of time.

*Scheduled Task:* An instance of a test suite assigned to a schedule

**Table 25** Maximum number of STM elemental tests

| 5620 SAM platform | Maximum (regular or lightweight) STM tests in a 10 minute period | Maximum accounting file STM tests in a 10 minute period |
|---|---|---|
| Distributed Oracle or HP x86 platforms with minimum 8 CPU Core 5620 SAM Server | 6,000 | 50,000 |
| Distributed Oracle or HP x86 platform.<br><br>NOTE: It may be possible to achieve higher numbers depending on the 5620 SAM Server activity and hardware platform | 2,000 | 15,000 |
| Minimum distributed SPARC platform (5620 SAM Server and 5620 SAM database on 4 core v440/v445 Server)<br><br>OR<br><br>Minimum Collocated Supported Solaris x86 platforms<br><br>NOTE: It may be possible to achieve higher numbers depending on the 5620 SAM Server activity and hardware platform | 1,000 | 1,000 |
| Minimum SPARC platform (collocated 5620 SAM Server and 5620 SAM database on a single 4 core v440/v445 Server) | 800 | 800 |

## Guidelines for maximizing STM test execution:

By default, 5620 SAM will only allow test suites with a combined weight of 80,000 to run concurrently. The test suite weights are identified in the 5620 SAM GUI's Test Suites List window. Running too many tests that start at the same time will cause the system to exceed the previously mentioned limit, and the test will be skipped. Ensuring the successful execution of as many STM tests as possible requires planning the schedules, the contents, and the configuration of the test suites. The following guidelines will assist in maximizing the number of tests that can be executed on your system:

- When configuring Tests or Test Policies, do not configure more packets (probes) than necessary, as they increase the weight of the Test Suite.
- A test suite with a high weight (i.e.: greater than half of the concurrent weight limit) will continue to consume the system's available weight until the test suite has completed executing or until the test suite has timed-out. Test Suite's with a smaller weight will typically complete more quickly, and allow other test suites to execute concurrently. The weight of the test suite is determined by the number of tests in the test suite, and the number of probes that are executed by each test.
- Assign the time-out of the test suite in such a way that if one of the test results has not been received it can be considered missed or failed without stopping other test suites from executing.
- Rather than scheduling a Test Suite to execute all tests on one network element, tests should be executed on multiple network elements to allow for concurrent handling of the tests on the network elements. This will allow the test suite results to be received from the network element and processed by 5620 SAM more quickly freeing up available system weight more quickly.
- Rather than scheduling a test suite to run sequentially, consider duplicating the test suite and running the test suites on alternating schedules. This allows each test suite time to complete or timeout before the same test suite is executed again. Remember that this may cause double the system weight to be consumed until the alternate test suite has completed.
- Test that can be NE persistent should use NE persistence to reduce the interactions between 5620 SAM and the network elements when initiating a test.
- Create test suites that contain less than 200 elemental tests. This way you can initiate the tests at different times by assigning the test suites to different schedules thereby having greater control over how many tests are initiated or in progress at any given time.
- Prioritize which tests you wish to perform by manually executing the test suite to determine how long it will take in your network. Use that duration with some added buffer time to help determine how much time to leave between schedules or repetitions of a schedule and how to configure the test suite timeout.
- A test suite timeout needs to be configured to take effect before the same test suite is scheduled to run again, or it will not execute if it does not complete before the timeout.
- 5620 SAM Database backups can impact the performance of STM tests.
- The Maximum STM Test Results should be configured to be the minimum required number of results. The default is 1,000,000. The maximum is 20,000,000. The more tests that are retained, the slower the 5620 SAM server access to the database will be.
- Attempting to delete tests or test suites manually with large numbers of test results will result in STM test execution delays. The 5620 SAM Server will remove test results as the total number of test results stored exceeds the user configured Maximum STM Test Results. They will age-out.

## Lightweight STM test configuration

In 5620 SAM Release 6.0 R3, the concept of lightweight STM test execution was introduced. To take advantage of lightweight test execution, the tests must be NE schedulable with "Lightweight Execution" and "Ignore Probe results" selected. While this can reduce the load on the 5620 SAM Database workstation, it may not increase the maximum number of allowable tests to be executed. Test Suite Results will continue to be produced for each Test Suite execution.

## Accounting file STM test configuration

In 5620 SAM Release 7.0 R4, the concept of accounting file collection of STM test results was introduced. This feature requires 7750 and 7450 network elements that are version 7.0 R4 and above. To take advantage of accounting file STM test execution, the test policy must be configured to be NE schedulable with "Accounting file" selected. This will produce STM tests that will be executed on the network element, while the test results will be returned to 5620 SAM by way of an accounting file in a similar way to accounting Statistics.

## Examples of STM test configuration

Example 1:

Assume there is a network with 400 LSPs and that the objective is to perform LSP pings on each LSP as frequently as possible. The following steps are to be followed:

1. Create 4 test suites each containing 100 elemental LSP ping tests
2. One at a time, execute each test suite and record the time each one took to complete. Assume that the longest time for executing one of the test suites is 5 minutes.
3. Create a schedule that is ongoing and has a frequency of 10 minutes. This doubles the time taken for the longest test suite and ensures that the test will complete before it is executed again. Assign this schedule to the 4 test suites.
4. Monitor the test suite results to ensure that they are completing. If the tests are not completing (for example getting marked as "skipped"), then increase the frequency time value of the schedule.
5. In the above case, there are 200 elemental tests configured to be executed each 10 minutes.

Example 2:

Assume there are eight test suites (T1, T2, T3, T4, T5, T6, T7 and T8), each containing 50 elemental tests. Assume the test suites individually take 5 minutes to run. Also, assume the objective is to schedule them so that the guideline of having less than 200 concurrently running elemental tests is respected.

The recommended approach for scheduling these tests suites is as follows:

- Test suites T1, T2, T3, T4 can be scheduled on the hour and repeat every 10 minutes
- Test suites T5, T6, T7, T8 can be scheduled on the hour + 5 minutes and repeated every 10 minutes

This will ensure no more than 200 elemental tests are scheduled to run concurrently.

## Factors impacting the number of elemental tests that can be executed in a given time frame.

The following factors can impact the number of elemental tests that can be executed during a given time frame:

- The type of tests being executed. Each type of elemental test takes varying quantities of time to complete (e.g. a simple LSP ping of an LSP that spans only two routers may take less than 2 seconds; an MTU ping could take many minutes).
- The amount of data that is generated/updated by the test within the network elements. 5620 SAM will have to obtain this information and store it in the 5620 SAM database. The quantity of data depends on the type of tests being performed and the configuration of the objects on which the tests are performed.
- The number of test suites scheduled at or around the same time
- The number of tests in a test suite
- The number of routers over which the tests are being executed. Generally, a large number of tests on a single router can be expected to take longer than the same number of tests distributed over many routers.
- A 5620 SAM Database backup may temporarily reduce the system's ability to write test results into the database.
- The workstation used to perform the tests will dictate how many physical resources 5620 SAM can dedicate to executing elemental tests. On the minimum supported Solaris workstation (collocated 5620 SAM Server and 5620 SAM Database on a single Sun Fire v440/v445 Server), the number of concurrent tests must be limited to 1000.

### Possible consequences of exceeding the capacity of the system to perform tests

5620 SAM will exhibit the following symptoms if the number of scheduled tests exceeds the system's capacity.

### Skipped tests:

If a test suite is still in progress at the time that its Schedule triggers again, then that scheduled task will be marked as skipped and that test suite will not be attempted again until the next scheduled time.

### Failed tests (time-out):

Tests may timeout and get marked as failed. If any of the tests take more than 15 minutes it may get purged from an internal current test list. For example, a test may be successfully sent to a router and the system does not receive any results for 15 minutes. The system marks the test as failed and purges its' expectation of receiving a result. However, later, the system could still receive the results from the router and update its result for the test to success.

### Disk space requirements for STM test results:

STM test results are stored in the tablespace DB partition. The STM database partitions start with a total size of 300MB of disk space. When the maximum number of test results is configured at 20,000,000 (maximum), the disk space requirement for the STM tests may increase by up to 40GB. A larger tablespace partition should be considered.

The maximum number of test results stored in the database reflects the sum of the aggregate results, test results, and probe results.

Running 10 tests with 1 probe each versus 1 test with 10 probes consumes the same amount of disk space.

## 9.4 Scaling Guidelines for Call Trace

5620 SAM provides the ability to collect call trace and debug trace data from eNodeB network elements through the use of 5620 SAM Auxiliary Call Trace Collector workstations.

Call Trace scale support in 5620 SAM is dependent upon the following dimensions:

- The network bandwidth required between the 5620 SAM Auxiliary Call Trace server and the eNodeB. This will be determined by the size of the call Trace files and the frequency in which they are collected.
- The network bandwidth required between the Preferred 5620 SAM Auxiliary Call Trace server and the Reserved 5620 SAM Auxiliary Call Trace server.
- The network bandwidth required between the Preferred 5620 SAM Auxiliary Call Trace server and the 9958 WTA.
- Disk I/O on the 5620 SAM Auxiliary Call Trace server.
- Disk space on the 5620 SAM Auxiliary Call Trace server to meet the retention requirements.

Call Trace Scaling guidelines are based upon the FDD Outdoor M2 call model which uses a traffic mix of 50% data and 50% voice.

A single 5620 SAM Auxiliary Call Trace Collector workstation or redundant pair can collect up to 50 call traces and two dynamic debug traces concurrently, when deployed in an eight disk configuration. A call trace, in this context, represents the data collected from a single 3 cell eNodeB with 100 calls.

### Disk space requirements for Call Trace and Debug Trace

Call Traces and debug Traces retrieved from eNodeBs are stored as files on the 5620 SAM Auxiliary Call Trace Collector. Table 26 lists the required disk space to store one hour worth of Call Trace and Debug Trace data from a single 3 cell eNodeB with 100 calls. The disks containing the Call Trace and Debug Trace data must be configured with hardware RAID o, or disk striping.

**Table 26** Disk space requirements for trace data.

| Disk space requirements for installations with trace collection for a single 3 cell eNodeB with 100 calls for 1 hour of data | Required Disk Space |
|---|---|
| Call Trace | 650 MB* |
| Debug Trace | 9200 MB |

* Worst case as data is compressed and better compression rates may be achieved

# 10 Securing 5620 SAM

Alcatel-Lucent recognizes the importance of deploying important software such as the 5620 SAM in secure environments and, as such, supports the use of security techniques to enhance the security of the 5620 SAM.

5620 SAM communications can be secured using SSL, SNMPv3 and HTTPs. Refer to the 5620 SAM User Guide for configuration procedures.

Alcatel-Lucent recommends the following steps to achieving 5620 SAM workstation security:

- Install a clean Solaris 10 operating system environment with the minimum required packages documenting in the *Alcatel-Lucent 5620 SAM Installation and Upgrade Guide*
- Install the latest Solaris Recommended Patch Cluster from Oracle (available at www.oracle.com)
- Enable Solaris Secure by Default feature as described in section 10.1
- Implement firewall rules for the 5620 SAM Servers to control access to ports on 5620 SAM platforms as described in section 10.4
- Installation of 5620 SAM with a secure configuration described in section 10.2
- Network Element connection configuration as described in section 10.3

## 10.1 Operating system installation for 5620 SAM workstations

Alcatel-Lucent supports customers applying Solaris or Windows patches provided by Oracle or Microsoft which will include security fixes as well as functional fixes. If a patch is found to be incompatible with the 5620 SAM, the patch may need to be removed until a solution to the incompatibility is provided by Oracle, Microsoft, or Alcatel-Lucent. Consult the *Alcatel-Lucent 5620 SAM Release 9.0 Release Notice* documents for up-to-date information about the recommended Solaris maintenance update and patch levels.

5620 SAM is supported on Solaris installed with the list of required Solaris Packages and Ports documented in the *Alcatel-Lucent 5620 SAM Installation and Upgrade Guide*.

Additional efforts to secure the system could impact 5620 SAM's operation or future upgrades of the product. Customer's should perform some level of basic testing to validate additional platform hardening does not impact 5620 SAM's operation. Also, the 5620 SAM Product Group makes no commitment to make 5620 SAM compatible with a customer's hardening requirements.

### Required Solaris services

The installation of Solaris 10 leaves many network services enabled by default. To reduce the security risk to a 5620 SAM Server running on Solaris 10, the Solaris "Secure by default" feature can be used to disabled all network services other than SSH. Enabling of this feature is done using the `netservices limited` command. This command should only be executed when the SAM Software is shut down because it will cause some processes to restart.

The only Solaris network services that the 5620 SAM requires are:

- SSH - secure shell
- network time protocol service (ntp) - or some time synchronization service

See Solaris documentation for more information on "Secure by Default".

## 10.2 5620 SAM software installation

Alcatel-Lucent recommends the following steps when installing the 5620 SAM Servers:

- Configure the 5620 SAM Server IP validation during the 5620 SAM database installation to ensure that only the specified IP address can communicate with the 5620 SAM database. This is documented in the *Alcatel-Lucent 5620 SAM Installation and Upgrade Guide*
- Configure SSL for secure communication between the 5620 SAM Server and 5620 SAM Clients (OSS and UI) as documented in the *Alcatel-Lucent 5620 SAM User Guide*

Alcatel-Lucent recommends the configuration (as documented in the *Alcatel-Lucent 5620 SAM User Guide*) of the following options to secure communication with the 5620 SAM Client UI and 5620 SAM Client OSS interfaces:

- Password history count
- Password expiry periods
- Client timeouts
- Security statements
- Scope of command and Span of Control
- Client IP validation

## 10.3 5620 SAM network element communication

The following configurations are documented in the *Alcatel-Lucent 5620 SAM User Guide*, and help secure communication between the network elements and 5620 SAM server installations:

- SNMPv3
- SSH for remote access to the network elements
- SCP/SFTP for secure file transfer

## 10.4 5620 SAM and firewalls

A firewall can be deployed to protect the 5620 SAM server from the managed network and to protect the server from the network hosting the 5620 SAM clients. The diagrams below illustrate this and show the communications services that are required through the firewalls.

NOTE: For the network elements described in Section 8.12 there is a requirement for the 5620 SAM GUI client to communicate directly with the specialize configuration tools.

**Figure 8** Firewalls and 5620 SAM standalone deployments

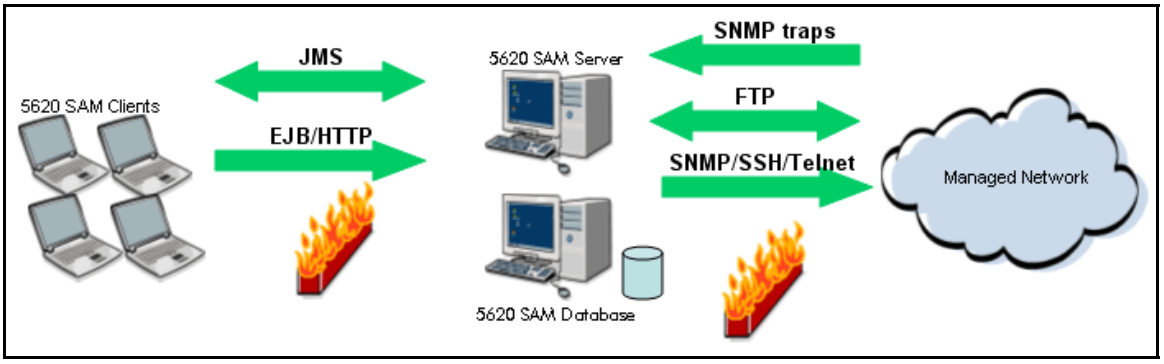
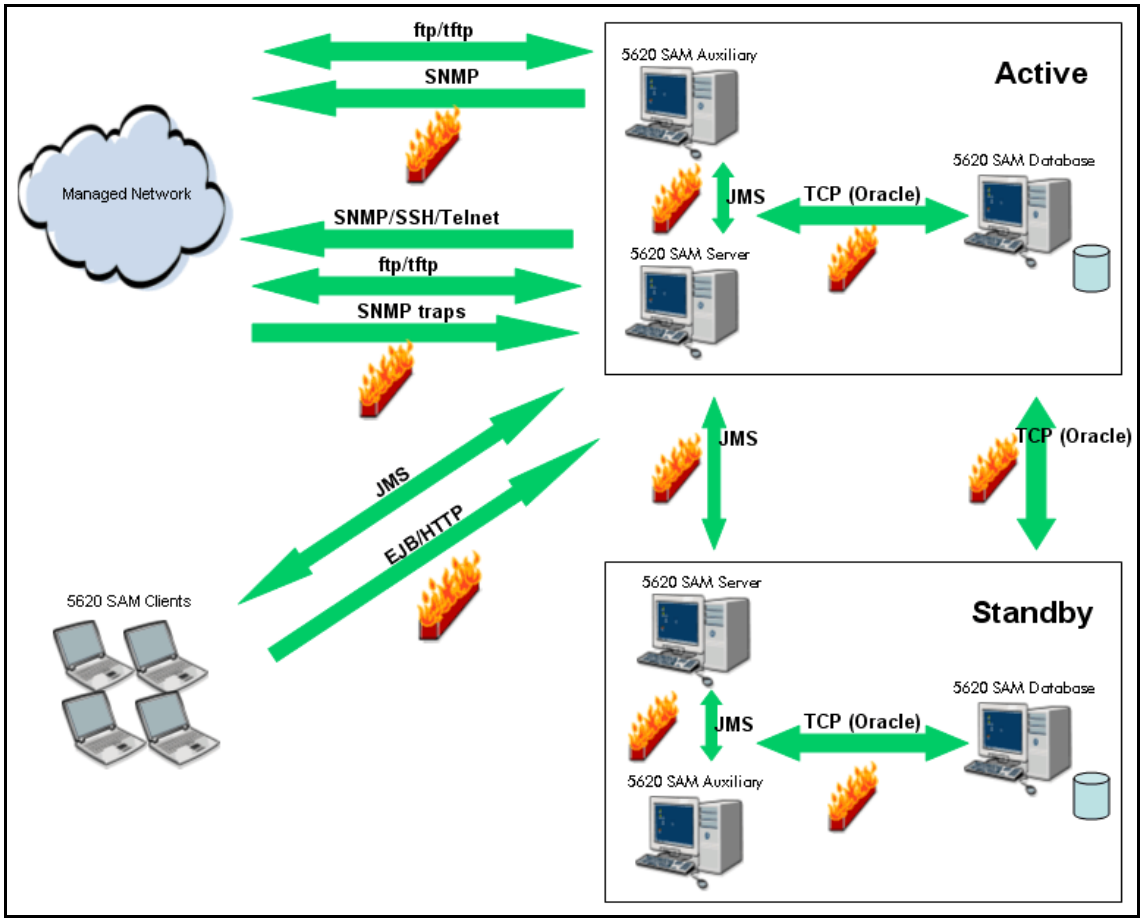



**Figure 9** Firewalls and 5620 SAM redundant deployments



## 10.5 List of ports required for firewalls

The following table describes the ports which must be opened in order for the application components to communicate effectively using firewalls.

**Table 27** 5620 SAM firewall requirements

| Component | Default port | Type | Description |
|---|---|---|---|
| 5620 SAM Server and 5620 SAM Auxiliary | N/A | ICMP | ICMP Ping<br><br>The active 5620 SAM Server will periodically ping the 5620 SAM Delegate Server to ensure reachability. |
| | 21<br><br>Ports from 1023 - 65536 | TCP | FTP (Passive)<br><br>This port is used to enable ftp communication from a 5620 SAM-O Client to either the 5620 SAM Server or Auxiliary. Ftp is used by the 5620 SAM-O Client to retrieve logToFile statistics or findToFile results. (See section 10.6)<br><br>SCP or SFTP could be used instead for increased security. |
| | 22 | TCP | SSH/SCP/SFTP<br><br>This port is used for remote access, rsync between 5620 SAM Servers, rsync between 5620 SAM Auxiliary Call Trace Collectors, rsync between the 5620 SAM Databases, and scp/sftp to 5620 SAM OSS clients. |
| | 162 | UDP | SNMP traps<br><br>By default, this port on the 5620 SAM Server receives SNMP traps from the network elements. This item is specified during the installation of the server and can be changed.<br><br>(Not required by the 5620 SAM Auxiliary) |
| | 1094,1095, 4448, 4449 | TCP | Internal system communications protocol (JBoss messaging)<br><br>These ports are used by commands on the 5620 SAM Auxiliary workstation to adjust the 5620 SAM Auxiliary behaviour. (Example: adjusting log levels, shutting down the auxiliary server, etc) |

| Component | Default port | Type | Description |
|---|---|---|---|
| | 1096,1097, 4446, 4447 | TCP | Internal system communications protocol (JMS naming/messaging service)<br><br>Used by the 5620 SAM Client (GUI and OSSI) and 5620 SAM Server and 5620 SAM Auxiliary applications to register for JMS notifications and messages. This is used to ensure that the Client, Server, and Auxiliary are aware of system events (i.e.: database changes or alarm notifications, etc)<br><br>NOTE: OSS clients should not use 1097 to access 5620 SAM. They should use 1099 or 1100. |
| | 1098 | TCP | Internal system communications protocol (JBoss Naming Service - JNDI)<br><br>This port is required to ensure successful communication between the 5620 SAM Server and the 5620 SAM GUI and OSS clients.<br><br>5620 SAM GUI and OSS clients use this port to look up items provided by the 5620 SAM Server. The items looked up are functions that the clients use to get or send information to and from the server.<br><br>When there are redundant servers, this port is also used between the two servers to trade information on which items are available for look up. |
| | 1099 | TCP | Internal system communications protocol (JBoss Naming Service - JNDI)<br><br>This port is required to ensure the 5620 SAM GUI and OSS clients properly initialize with the 5620 SAM Server.<br><br>When initially logging into the 5620 SAM Server, 5620 SAM GUI and OSS clients use this port to find the various services that are available. This port is also used by the 5620 SAM GUI and OSS clients to register with the 5620 SAM Server to receive notification of network changes. |

| Component | Default port | Type | Description |
|---|---|---|---|
| | 1100 | TCP | Internal system communications protocol (JBoss High Availability JNDI)<br><br>This port is required to ensure the 5620 SAM GUI and OSS clients properly initialize with the 5620 SAM Server when there are redundant servers. This port is used when 5620 SAM is installed in a redundant configuration.<br><br>When initially logging into the 5620 SAM Server, 5620 SAM GUI clients use this port to find the various services that are available. This port is also used by the 5620 SAM GUI and OSS clients to register with the 5620 SAM Server to receive notification of network changes. |
| | 4444, 4450 | TCP | Internal system communications protocol (JBoss messaging)<br><br>During run-time operations, the 5620 SAM GUI clients use this port to send and receive information to and from the 5620 SAM Server. These ports can be encrypted.<br><br>For example, GUI user operations, such as clicking "apply" on a configuration form, will result in information being transmitted to the server using this port.<br><br>Note that 5620 SAM can be configured to use a different port for this purpose. The procedure is available from Alcatel-Lucent Personnel. |
| | 6100-6119 | UDP | NEM Proxy<br><br>Used to provide NEM eNodeB access from SAM Clients. |
| | 8080 | TCP | HTTP<br><br>This port provides an HTTP interface for 5620 SAM-O clients to access the 5620 SAM server. Port 8443 can be used instead for secure communications. |
| | 8085 | TCP | HTTP<br><br>This port provides an HTTP interface for 5620 SAM client. The 5620 SAM Client uses this port to verify the existence of the server. Port 8444 can be used instead for secure communications. |
| | 8093, 8094 | TCP | JMS (Java Message Service)<br><br>This port is used by the 5620 SAM server to send real-time notifications of changes that have happened in the network such as alarms or newly created configurations to the 5620 SAM GUI clients and registered 5620 SAM-O OSS applications. The messages are sent using the JMS protocol (over TCP). |

| Component | Default port | Type | Description |
|---|---|---|---|
| | 8400 | TCP | HTTP<br><br>This port provides an HTTP interface for SAM Supervision. Port 9400 can be used instead for secure communications. |
| | 8443 | TCP | HTTPS<br><br>This port provides an HTTPS (secure HTTP) interface for 5620 SAM-O clients that wish to use this protocol to access the 5620 SAM server |
| | 8444 | TCP | HTTPS<br><br>This port provides an HTTPS (secure HTTP) interface for 5620 SAM Client. This is a secure version of port 8085. Used only if 5620 SAM Client is connecting via SSL. |
| | 9010 | TCP | This port is used to synchronize Call Trace and Debug Trace files between redundant Call Trace Auxiliary Servers |
| | 9400 | TCP | HTTPS<br><br>This port provides an HTTPS (secure HTTP) interface for SAM Supervision. This is a secure version of port 8400. Used only if 5620 SAM Client is connecting via SSL. |
| | 9735 | TCP | Corba Interface<br><br>This port is used by 5620 SAM-O 3GPP-compliant clients to access the 5620 SAM-O 3GPP Corba interface |
| | 11800<br><br>Ports from 32768 - 65536 | TCP | Internal system communications protocol (JBoss Clustering)<br><br>This port is required to ensure that redundant 5620 SAM Servers can monitor each other. |
| | 12800 | TCP | Internal system communications protocol (JBoss clustering)<br><br>During run-time operations, the 5620 SAM Auxiliary use this port to send and receive information to and from the 5620 SAM Server.<br><br>The number of required ports depends on the number of 5620 SAM Auxiliary workstations that are installed.<br><br>Note that 5620 SAM can be configured to use a different port for this purpose. The procedure is available from Alcatel-Lucent Personnel. |

| Component | Default port | Type | Description |
|---|---|---|---|
| Managed Devices | 21<br><br>Ports from 1023 - 65536 | TCP | FTP (Passive)<br><br>This port is used to enable ftp communication between the 5620 SAM Server and the managed routers. Ftp occurs to transfer information from the routers to the 5620 SAM Server such as accounting statistics. See section 10.6 for a more detailed description of ftp requirements. |
| | 22 | TCP | SSH / SFTP<br><br>This port used by clients to request a SSH session to a managed router.<br><br>Used by eNodeBs to transfer software loads from the 5620 SAM Server. |
| | 23 | TCP | Telnet<br><br>This port used by clients to request a telnet session to a managed router. |
| | 69 | UDP | TFTP<br><br>This port is used to do ftp when managing 7250 SAS or Telco T5C equipment. If there are no 7250 SAS or Telco T5C nodes in the network, this port is not required |
| | 80 | TCP | HTTP<br><br>This port is required for the 5620 SAM Client to communicate with the network element Web GUIs. See Section 8.12 for the network elements that require this port. |
| | 161 | UDP | SNMP<br><br>By default, 5620 SAM server sends SNMP messages, such as configuration requests and service deployments, to this port on the network elements. |
| | 443 | TCP | HTTPS<br><br>This port is required for the 5620 SAM Client to be able to communicate with the 9471 DSC. |

| Component | Default port | Type | Description |
|---|---|---|---|
| | 830 | TCP | SSH for eNodeB<br><br>This port is used by the eNodeB network element for SSH traffic. |
| | 1099 | TCP | RMI<br><br>This port is required for the 5620 SAM Client to be able to communicate with the 9471 MME MI. |
| | 1234 | TCP | Search-agent<br><br>This port is required for the 5620 SAM Client to be able to communicate with the 9471 MME MI. |
| | 1235 | TCP | Mosaicsysscv1<br><br>This port is required for the 5620 SAM Client to be able to communicate with the 9471 MME MI. |
| | 4567 | TCP | Tram<br><br>This port is required for the 5620 SAM Client to be able to communicate with the 9471 MME MI. |
| | 5001 | TCP | Proprietary Java socket connection<br><br>This port is used by CPAM to communicate with the 7701 CPAA to obtain control plane information. |
| | 8001 | UDP | SNMP<br><br>This port is used for SNMP communication with the 9471 MME MI |
| | 8443 | TCP | HTTPS<br><br>This port is required for the 5620 SAM Client to be able to communicate with the 9471 MME MI. |
| | 9683 | TCP | HTTPS<br><br>This port is required for the 5620 SAM Client to be able to communicate with the 9471 MME MI. |

| Component | Default port | Type | Description |
|---|---|---|---|
| | 57074<br>57075 | UDP | Call Trace Data<br><br>This port is required by the 5620 SAM Auxiliary Call Trace Collector to retrieve the Call Trace information from the eNodeB.<br><br>Port 57075 is only required by authorized Alcatel-Lucent personnel for debugging purposes. |
| | N/A | ICMP | ICMP<br><br>Only used if the Ping Policy is enabled as part of network element mediation. |
| 5620 SAM Database | 22 | TCP | SSH<br><br>This port used by 5620 SAM for an optional resync feature between 56230 SAM Databases. |
| | 1523 | TCP | Oracle SQL*Net Listener<br><br>This port is used by the 5620 SAM Server to connect to and communicate with the 5620 SAM Database. When there are redundant databases, this port is also used by Oracle DataGuard to keep the databases in sync. The data on this port is encrypted. |
| | 9002<br><br>Ports from 32768 - 65536 | TCP | 5620 SAM Database Proxy<br><br>This port is used by the 5620 SAM Server to monitor disk usage on a remote 5620 SAM Database. When there are redundant databases, it is also allows the 5620 SAM Server to initiate database switchovers and failovers.<br><br>Ports are allocated dynamically and temporarily in the range to satisfy the initial requests that arrive on port 9002 (the listener port). |
| | 9003<br><br>Ports from 32768 - 65536 | TCP | Database file transfer Port<br><br>This port is used by the 5620 SAM Database workstations in a redundant workstation configuration. This port allows Database transfers between the primary and standby databases. For example: when the standby database is re-instantiated, or when the standby database is installed for the first time.<br><br>Ports are allocated dynamically and temporarily in the range to satisfy the initial requests that arrive on port 9003 (the listener port). |

## 10.6 FTP between the 5620 SAM Server and 5620 SAM Auxiliary Statistics Collector and the managed network

5620 SAM Server and 5620 SAM Auxiliary Statistics Collector will use FTP for several purposes.

The 5620 SAM Server will use FTP to receive backup images of managed devices, to send new software images to the managed devices and to receive accounting statistics from the managed devices.

If a 5620 SAM Auxiliary Statistics Collector workstation is installed, FTP will only be used to retrieve accounting statistics from managed devices.

If STM Accounting tests are being executed, the 5620 SAM Server will retrieve the test results from the managed devices by FTP.

The FTP communication is configured as an extended *passive* FTP connection, with the managed devices serving as the FTP servers and the 5620 SAM Server and 5620 SAM Auxiliary acting as the FTP client.

Extended passive FTP connections use dynamically-allocated ports on both sides of the communication channel, and are ephemeral in nature. As such, the data sent from the managed devices will be sent from a port in the range of 1024-65536. This data will be sent to the 5620 SAM Server on a port in the range of 1024-65536. Support for EPSV/EPRT ftp commands (commands that can replace PASV/PORT commands) must be enabled for connections to the 7x50 family of routers.

## 10.7 Firewall and NAT rules

Firewall rules are applied to the incoming network interface traffic of the 5620 SAM workstations. As a rule, firewall rules are not applied to the outgoing network interface traffic.

It is imperative that all rules are considered completely for the 5620 SAM systems to interoperate correctly. The following tables will define the rules to be applied to each 5620 SAM workstation. Within the section there will be a number of conditions that indicate whether or not that particular table needs to be applied.

### 5620 SAM Server firewall and NAT rules

When there is a firewall at the 5620 SAM Server(s) interface that reaches the managed network (NIC 2 on Figure 11 ), the following firewall rules need to be applied.

**Table 28** Firewall rules for traffic between the 5620 SAM Server(s) and the managed network

| Protocol | From port | On | To port | On | Notes |
|---|---|---|---|---|---|
| SNMP Communications: NOTE: Due to the size of SNMP packets, IP fragmentation may occur in the network. Ensure the firewall will allow fragmented packets to reach the server(s). | | | | | |
| UDP | Any | Managed Network | 162 | Server(s) | SNMP trap initiated from the NE |
| UDP | >32768 | Server(s) | 161 | Managed Network | SNMP request |
| TCP | Any | Server(s) | 8001 | Managed Network | SNMP for 9471 MME |

| | | | | | |
|---|---|---|---|---|---|
| UDP | 161 | Managed Network | > 32768 | Server(s) | SNMP response |
| Telnet / FTP | | | | | |
| TCP | >32768 | Server(s) | 23 | Managed Network | Telnet request |
| TCP | 23 | Managed Network | > 32768 | Server(s) | Telnet response |
| TCP | Any | Server(s) | 21 | Managed Network | FTP requests (example: STM, Accounting Statistics, NE backups) |
| TCP | 21 | Managed Network | Any | Server(s) | FTP responses |
| TCP | > 1023 | Managed Network | > 1023 | Server(s) | Passive FTP ports for data transfer |
| SSH / SFTP / SCP | | | | | |
| TCP | Any | Server(s) | 22 | Managed Network | SAM SSH request |
| TCP | 22 | Managed Network | Any | Server(s) | SAM SSH response |
| TCP | Any | Managed Network | 22 | Server(s) | eNodeB SFTP request |
| TCP | 22 | Server(s) | Any | Managed Network | eNodeB SFTP response |
| TCP | > 32768 | Server(s) | 830 | Managed Network | SSH request for eNodeB |
| TCP | 830 | Managed Network | > 32768 | Server(s) | SSH response for eNodeB |
| 7250 SAS or Telco T5C | | | | | |
| UDP | Any | 7250 SAS or Telco T5C | 69 | Server(s) | TFTP initiated by NE |
| UDP | Any | 7250 SAS or Telco T5C | Any | Server(s) | TFTP transfer |
| Other | | | | | |
| ICMP | N/A | Managed Network | N/A | Server(s) | Only used if Ping Policy is enabled. |
| TCP | 5001 | 7701 CPAA Elements | > 32768 | Server(s) | |

When there is a firewall at the interface that reaches the 5620 SAM Client(s) (NIC 3 on Figure 11 ) the following rules need to be applied.

**Table 29** Firewall rules for traffic coming into the 5620 SAM Server(s) from the 5620 SAM Client(s) (GUI/OSS)

| Protocol | From port | On | To port | On | Notes |
|---|---|---|---|---|---|
| TCP | Any | SAM-O Client | 21 | Server(s) | If FTP is required |
| TCP | Any | SAM-O Client | 22 | Server(s) | If SFTP/SCP is required |
| TCP | > 1023 | SAM-O Client | > 1023 | Server(s) | If FTP is required |
| TCP | Any | SAM-O/SAM GUI Client | 1096-1097 | Server(s) | JMS |
| TCP | Any | SAM-O/SAM GUI Client | 1098 | Server(s) | JNDI |
| TCP | Any | SAM-O/SAM GUI Client | 1099 | Server(s) | JNDI |
| TCP | Any | SAM GUI Client | 4444,4450 | Server(s) | JBoss |
| TCP | Any | SAM-O/SAM GUI Client | 4446-4447 | Server(s) | JMS |
| UDP | Any | SAM GUI Client | 6100-6119 | Server(s) | NEM Proxy |
| TCP | Any | SAM-O Client | 8080 | Server(s) | HTTP |
| TCP | Any | SAM GUI Client | 8085 | Server(s) | HTTP |
| TCP | Any | SAM GUI Client | 8400 | Server(s) | HTTP |
| TCP | Any | SAM-O/SAM GUI Client | 8093, 8094 | Server(s) | JMS |
| TCP | Any | SAM-O Client | 8443 | Server(s) | HTTPS |
| TCP | Any | SAM GUI Client | 8444 | Server(s) | HTTPS |
| TCP | Any | SAM GUI Client | 9400 | Server(s) | HTTPS |
| TCP | Any | SAM-O 3GPP-compliant Client | 9735 | Server(s) | Corba |

When there is a firewall at the interface that reaches the 5620 SAM Client(s) (NIC 3 on Figure 11 ) AND redundant 5620 SAM Servers are used the following rules need to be applied. Configuration needs to be in both directions to handle an activity switch.

**Table 30** 5620 SAM Server interface to Client firewall rules for setups with redundant 5620 SAM Servers

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Client | 1100 | Servers |

When there is a firewall configured, and there are redundant 5620 SAM Servers, the following rules need to be applied to the appropriate interface. If multiple interfaces are used for communication to the clients (GUI and OSS) and auxiliary servers, the network traffic from the 5620 SAM Servers and 5620 SAM Auxiliaries could pass through the SAM client interface (NIC 3 on Figure 11 ) or the SAM network interface (NIC 1 on Figure 11 ) on the 5620 SAM Server. Configuration needs to be in both directions to handle an activity switch.

**Table 31** 5620 SAM Server-to-Server firewall rules for setups with redundant 5620 SAM Servers

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Servers | 1098 | Servers |
| TCP | Any | Auxiliary Servers | 1100 | Servers |
| TCP | Any | Servers | 1100 | Servers |

When there is a firewall configured, and there are redundant 5620 SAM Auxiliary workstation(s), the following rules need to be applied to the appropriate interface. If multiple interfaces are used for communication to the clients (GUI and OSS) and auxiliary servers, the network traffic from the 5620 SAM Servers and 5620 SAM Auxiliaries could pass through the SAM client interface (NIC 3 on Figure 11 ) or the SAM network interface (NIC 1 on Figure 11 ) on the 5620 SAM Server.

**Table 32** Firewall rules for traffic coming into the 5620 SAM Server(s) from the 5620 SAM Auxiliary Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Server(s) | 1096-1097 | Server(s) |
| TCP | Any | Auxiliary Server(s) | 1098 | Server(s) |
| TCP | Any | Auxiliary Server(s) | 1099 | Server(s) |
| TCP | Any | Auxiliary Server(s) | 4444 | Server(s) |
| TCP | Any | Auxiliary Server(s) | 4446-4447 | Server(s) |
| TCP | Any | Auxiliary Server(s) | 4450 | Server(s) |
| TCP | Any | Auxiliary Server(s) | 8093 | Server(s) |

| | | | | |
|---|---|---|---|---|
| TCP | Any | Auxiliary Server(s) | 8094 | Server(s) |

When a firewall and NAT are configured to the 5620 SAM Server at the SAM client interface (NIC 3 on Figure 11 ) the following rules need to be applied to allow the OSS clients to retrieve the logToFile accounting statistics information. Services require the use of public addresses. An xml tag (ftpServerIpAddress) in nms-server.xml is used to indicate where the OSS client can pickup the logToFile files in the event that the clients cannot reach the published public address of the 5620 SAM Server.

**Table 33** Additional firewall rules required to allow services on the 5620 SAM client(s) to communicate with the 5620 SAM Server if NAT is used.

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Server Public Address | 21 | Server Private Address |
| TCP | 21 | Server Public Address | Any | Server Private Address |
| TCP | > 1023 | Server Public Address | > 1023 | Server Private Address |

When a firewall and NAT are configured to the 5620 SAM Server the following rules need to be applied to the appropriate interface. If multiple interfaces are used for communication to the clients (GUI and OSS) and auxiliary servers, the network traffic could pass through the SAM client interface (NIC 3 on Figure 11 ) or the SAM network interface (NIC 1 on Figure 11 ) on the 5620 SAM Server. The following rules are required to allow services on the 5620 SAM Server to communicate with other services on the same server. Services require the use of public addresses.

**Table 34** Additional firewall rules required to allow services on the 5620 SAM Server to communicate with other services on the same server if NAT is used on the 5620 SAM Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Server Public Address | 1096-1097 | Server Private Address |
| TCP | Any | Server Public Address | 1098 | Server Private Address |
| TCP | Any | Server Public Address | 1099 | Server Private Address |
| TCP | Any | Server Public Address | 4444 | Server Private Address |
| TCP | Any | Server Public Address | 4446-4447 | Server Private Address |
| TCP | Any | Server Public Address | 4450 | Server Private Address |
| TCP | Any | Server Public Address | 8093 | Server Private Address |
| TCP | Any | Server Public Address | 8094 | Server Private Address |
| TCP | Any | Server Public Address | > 32768 | Server Private Address |

When there is a firewall at the interface that reaches the SAM management network (NIC 1 on Figure 11 ), the following rules apply.

**Table 35** Firewall rules for traffic coming into the 5620 SAM Server(s) from the 5620 SAM Database Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | 1523 | Database Server(s) | Any | Server(s) |
| TCP | 9002 | Database Server(s) | Any | Server(s) |
| TCP | > 32768 | Database Server(s) | > 32768 | Server(s) |

When there is a firewall at the SAM management interface (NIC 1 on Figure 11 ) and 5620 SAM Server redundancy is configured, then the following rules need to be applied. Configuration needs to be in both directions to handle an activity switch.

**Table 36** Firewall rules for setups with redundant 5620 SAM Servers.

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Servers | 22 | Servers |
| TCP | 22 | Servers | Any | Servers |
| TCP | Any | Servers | 11800 | Servers |
| TCP | 11800 | Servers | Any | Servers |
| TCP | > 32768 | Servers | > 32768 | Servers |

When there is a firewall at the SAM management interface (NIC 1 on Figure 11 ) and 5620 SAM Auxiliary Servers are configured, then the following rules need to be applied:

**Table 37** Firewall rules for traffic coming into the 5620 SAM Server(s) from the 5620 SAM Auxiliary Server(s).

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Server(s) | 12800 | Server(s) |
| TCP | 12800 | Auxiliary Server(s) | Any | Server(s) |

When there is a firewall at the SAM management interface (NIC 1 on Figure 11 ) and NAT is configured, then the following rules need to be applied. Services require the use of public addresses.

**Table 38** Additional firewall rules required to allow services on the 5620 SAM Server(s) to communicate with other services on the same server if NAT is used on the 5620 SAM Server(s).

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Server Public Address | 11800 | Server Private Address |
| TCP | Any | Server Public Address | 12800 | Server Private Address |
| TCP | Any | Server Public Address | > 32768 | Server Private Address |

### 5620 SAM Database firewall and NAT rules

When there is a firewall at the interface that reaches the SAM management network (NIC 1 on Figure 11 ), the following rules apply.

**Table 39** Firewall rules for traffic coming into the 5620 SAM Database Server(s) from the 5620 SAM Server(s) and 5620 SAM Auxiliary Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Server(s) & Auxiliary Server(s) | 1523 | Database Server(s) |
| TCP | Any | Server(s) & Auxiliary Server(s) | 9002 | Database Server(s) |
| TCP | > 32768 | Server(s) & Auxiliary Server(s) | > 32768 | Database Server(s) |

When there is a firewall at the interface that reaches the SAM management network (NIC 1 on Figure 11 ) and redundancy is configured, the following rules apply. Configuration needs to be in both directions to handle an activity switch.

**Table 40** Firewall rules for traffic between the 5620 SAM Database Servers (redundant only)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Database Servers | 22 | Database Servers |
| TCP | 22 | Database Servers | Any | Database Servers |
| TCP | Any | Database Servers | 1523 | Database Servers |
| TCP | 1523 | Database Servers | > 32768 | Database Servers |

| | | | | |
|---|---|---|---|---|
| TCP | Any | Database Servers | 9002 >32768 | Database Servers Ports are allocated dynamically and temporarily in the range to satisfy the initial requests that arrive on port 9002. |
| TCP | 9002 | Database Servers | > 32768 | Database Servers |
| TCP | Any | Database Servers | 9003 > 32768 | Database Servers Ports are allocated dynamically and temporarily in the range to satisfy the initial requests that arrive on port 9003. |
| TCP | 9003 | Database Servers | > 32768 | Database Servers |

When there is a firewall at the interface that reaches the SAM management network (NIC 1 on Figure 11 ) and NAT is configured, the following rules apply.

**Table 41** Additional rules that are required to allow Oracle services to communicate if NAT is used on the 5620 SAM Database Server(s).

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Database Server Public Address | > 32768 | Database Server Private Address |

## 5620 SAM Auxiliary Server firewall and NAT rules

When there is a firewall at the interface that reaches the managed network (NIC 2 on Figure 11 ), the following rules apply.

**Table 42** Firewall rules for traffic coming into the 5620 SAM Auxiliary Statistics Collector Server(s) from the Managed Network

| Protocol | From port | On | To port | On | Notes |
|---|---|---|---|---|---|
| SNMP Communications: NOTE: Due to the size of SNMP packets, IP fragmentation may occur in the network. Ensure the firewall will allow fragmented packets to reach the server(s). | | | | | |
| UDP | >32768 | Auxiliary Server(s) | 161 | Managed Network | SNMP request |
| UDP | 161 | Managed Network | > 32768 | Auxiliary Server(s) | SNMP response |
| SSH/Telnet Communications | | | | | |
| TCP | >32768 | Auxiliary Server(s) | 22-23 | Managed Network | SSH/SCP/Telnet request |
| TCP | 22-23 | Managed Network | > 32768 | Auxiliary Server(s) | SSH/SCP/Telnet response |
| FTP. Only required for 5620 SAM Auxiliary Statistics Collector | | | | | |
| TCP | Any | Auxiliary Server(s) | 21 | Managed Network | FTP requests (example: STM, Accounting statistics, NE backups)) |
| TCP | 21 | Managed Network | Any | Auxiliary Server(s) | FTP responses |
| TCP | > 1023 | Managed Network | > 1023 | Auxiliary Server(s) | Passive FTP ports for data transfer (See Section 10.6) |

**Table 43** Firewall rules for traffic coming into the 5620 SAM Auxiliary Call Trace Server(s) from the Managed Network

| Protocol | From port | On | To port | On | Notes |
|---|---|---|---|---|---|
| SNMP Communications: NOTE: Due to the size of SNMP packets, IP fragmentation may occur in the network. Ensure the firewall will allow fragmented packets to reach the server(s). | | | | | |
| UDP | >32768 | Auxiliary Server(s) | 161 | Managed Network | SNMP request |
| UDP | 161 | Managed Network | > 32768 | Auxiliary Server(s) | SNMP response |

| | | | | | |
|---|---|---|---|---|---|
| Call Trace Data from eNodeB network elements. | | | | | |
| UDP | Any | Managed Network | 57074,57075 | Auxiliary Server(s) | Call Trace Data |

When there is a firewall at the interface that reaches the 5620 SAM Client(s) (NIC 3 on Figure 11 ), the following rules apply for FTP access to the 5620 SAM Auxiliary by the OSS Client.

**Table 44** Firewall rules for OSS Client communication to the 5620 SAM Auxiliary Server(s)

| Protocol | From port | On | To port | On | Notes |
|---|---|---|---|---|---|
| TCP | 21 | SAM-O Client | Any | Auxiliary Server(s) | FTP requests (logToFile statistics, and call trace information) |
| TCP | Any | SAM-O Client | 21 | Auxiliary Server(s) | FTP responses |
| TCP | > 1023 | SAM-O Client | Any | Auxiliary Server(s) | Passive FTP ports for data transfer (See Section 10.6) |
| Only for 5620 SAM Auxiliary Call Trace Collectors | | | | | |
| TCP | Any | SAM-O 3GPP-compliant Client | 9735 | Auxiliary Server(s) | Corba interface to access Call Trace information |

When there is a firewall at the interface that communicates with the 5620 SAM Servers, the following rules apply for inter process communication. If multiple interfaces are used for 5620 SAM Server communication to the clients (GUI and OSS) and auxiliary servers, the network traffic from the 5620 SAM Auxiliaries could pass through the SAM client interface (NIC 3 on Figure 11 ) or the SAM network interface (NIC 1 on Figure 11 ) of the 5620 SAM Auxiliary.

**Table 45** Firewall rules for inter process communication on the 5620 SAM Auxiliary Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Server(s) | 1094-1095 | Auxiliary Server(s) |
| TCP | Any | Auxiliary Server(s) | 4448-4449 | Auxiliary Server(s) |

When there is a firewall at the interface that communicates with the 5620 SAM Servers, the following rules apply. If multiple interfaces are used for 5620 SAM Server communication to the clients (GUI and OSS) and auxiliary servers, the network traffic from the 5620 SAM Auxiliaries could pass through the SAM client interface (NIC 3 on Figure 11 ) or the SAM network interface (NIC 1 on Figure 11 ) of the 5620 SAM Auxiliary.

**Table 46** Firewall rules for traffic coming into the 5620 SAM Auxiliary Server(s) from the 5620 SAM Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | 1096-1097 | Server(s) | Any | Auxiliary Server(s) |
| TCP | 1098 | Server(s) | Any | Auxiliary Server(s) |
| TCP | 1099 | Server(s) | Any | Auxiliary Server(s) |
| TCP | 4444 | Server(s) | Any | Auxiliary Server(s) |
| TCP | 4446-4447 | Server(s) | Any | Auxiliary Server(s) |
| TCP | 4450 | Server(s) | Any | Auxiliary Server(s) |
| TCP | 8093 | Server(s) | Any | Auxiliary Server(s) |
| TCP | 8094 | Server(s) | Any | Auxiliary Server(s) |
| TCP | > 32768 | Server(s) | > 32768 | Auxiliary Server(s) |

When there is a firewall at the interface that communicates with the 5620 SAM Server and 5620 SAM Server redundancy is configured, the following rules apply. If multiple interfaces are used for 5620 SAM Server communication to the clients (GUI and OSS) and auxiliary servers, the network traffic from the 5620 SAM Auxiliaries could pass through the SAM client interface (NIC 3 on Figure 11 ) or the SAM network interface (NIC 1 on Figure 11 ) of the 5620 SAM Auxiliary.

**Table 47** Firewall rules for setups with redundant 5620 SAM Servers

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | 1100 | Server(s) | Any | Auxiliary Server(s) |

When there is a firewall at the interface that reaches the 5620 SAM Client(s) (NIC 3 on Figure 11 ) and NAT is used on the 5620 SAM Auxiliary Server(s), the following rules apply to allow the OSS clients to collect the logToFile accounting statistics files. Services require the use of public addresses. An xml tag (ftpServerIpAddress) in nms-auxiliary.xml is used to indicate where the OSS client can pickup the logToFile files in the event that the clients cannot reach the published public address of the 5620 SAM Auxiliary.

**Table 48** Additional Firewall rules required to allow services on the 5620 SAM client(s) to communicate with the 5620 SAM Auxiliary(s) if NAT is used on the Auxiliary Server(s).

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Server Public Address | 21 | Auxiliary Server Private Address |
| TCP | 21 | Auxiliary Server Public Address | Any | Auxiliary Server Private Address |
| TCP | > 1023 | Auxiliary Server Public Address | > 1023 | Auxiliary Server Private Address |

When there is a firewall and NAT at the interface that communicates with the 5620 SAM Server and 5620 SAM Server redundancy is configured, the following rules apply. If multiple interfaces are used for 5620 SAM Server communication to the clients (GUI and OSS) and auxiliary servers, the network traffic from the 5620 SAM Auxiliaries could pass through the SAM client interface (NIC 3 on Figure 11 ) or the SAM network interface (NIC 1 on Figure 11 ) of the 5620 SAM Auxiliary.

**Table 49** Additional rules required to allow services on the Auxiliary Server(s) to communicate with other services on the Auxiliary server(s) if NAT is used on the Auxiliary Server(s).

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Server Public Address | 1094-1095 | Auxiliary Server Private Address |
| TCP | Any | Auxiliary Server Public Address | 4448-4449 | Auxiliary Server Private Address |

When there is a firewall at the interface that reaches the SAM management network (NIC 1 on Figure 11 ), the following rules apply.

**Table 50** Firewall rules for traffic coming into the 5620 SAM Auxiliary Server(s) from the 5620 SAM Database Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | 1523 | Database Server(s) | Any | Auxiliary Server(s) |
| TCP | 9002 | Database Server(s) | Any | Auxiliary Server(s) |
| TCP | > 32768 | Database Server(s) | > 32768 | Auxiliary Server(s) |

When there is a firewall at the interface that reaches the SAM management network (NIC 1 on Figure 11 ), the following rules apply.

**Table 51** Firewall rules for traffic coming into the 5620 SAM Auxiliary Server(s) from the 5620 SAM Server(s)

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Server(s) | 12800 | Auxiliary Server(s) |
| TCP | 12800 | Server(s) | Any | Auxiliary Server(s) |

**Table 52** Firewall rules for traffic between redundant 5620 SAM Auxiliary Statistics Collector Servers.

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Statistics Collector | 22 | Auxiliary Statistics Collector |

**Table 53** Firewall rules for traffic between redundant 5620 SAM Auxiliary Call Trace Collector Servers.

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Call Trace Collector | 9010 | Auxiliary Call Trace Collector |

When there is a firewall at the interface that reaches the SAM management network (NIC 1 on Figure 11 ) and NAT is configured, the following rules apply and services require the use of public addresses.

**Table 54** Additional firewall rules required to allow services on the 5620 SAM Auxiliary Server(s) to communicate with other services on the 5620 SAM Auxiliary server(s) if NAT is used on the 5620 SAM Auxiliary Server(s).

| Protocol | From port | On | To port | On |
|---|---|---|---|---|
| TCP | Any | Auxiliary Server Public Address | 12800 | Auxiliary Server Private Address |
| TCP | 12800 | Auxiliary Server Public Address | Any | Auxiliary Server Private Address |
| TCP | Any | Auxiliary Server Public Address | > 32768 | Auxiliary Server Private Address |

### 5620 SAM Server to delegate workstation

Ensure that ICMP protocol traffic from the 5620 SAM Server workstation(s) can reach the 5620 SAM delegate workstation.

### 5620 SAM Client to managed network communications

Apply the following changes to the connection between the 5620 SAM Client and the managed network. Note that all connections are bi-directional.

**Table 55** Port requirements for firewall rules for setups

| Protocol | From port | On | To port | On | Notes |
|---|---|---|---|---|---|
| For 5870 DSC: | | | | | |
| TCP | Any | 5620 SAM Client(s) | 443 | Managed Network | HTTPS |
| For 9471 MME: | | | | | |
| TCP | Any | 5620 SAM Client (s) | 1099 | Managed Network | RMI |
| TCP | Any | 5620 SAM Client (s) | 1234 | Managed Network | Search-agent |
| TCP | Any | 5620 SAM Client (s) | 1235 | Managed Network | Search-agent |
| TCP | Any | 5620 SAM Client (s) | 4567 | Managed Network | tram |
| TCP | Any | 5620 SAM Client (s) | 8443 | Managed Network | HTTPS |
| TCP | Any | 5620 SAM Client (s) | 9683 | Managed Network | HTTPS |
| For eNodeB NEM: | | | | | |
| TCP | Any | 5620 SAM Client(s) | 161 | Managed Network | SNMP |
| TCP | Any | 5620 SAM Client(s) | 830 | Managed Network | NetConf over SSH |
| For GNE management: | | | | | |
| TCP | Any | 5620 SAM Client (s) | 80/8080 | Managed Network | HTTP (See GNE vendor for specifics) |
| TCP | Any | 5620 SAM Client (s) | 443/8443 | Managed Network | HTTPS (See GNE vendor for specifics) |

| For the Omni-switch family of switches: | | | | | |
|---|---|---|---|---|---|
| TCP | Any | 5620 SAM Client(s) | 80 | Managed Network | HTTP |
| TCP | Any | 5620 SAM Client(s) | 443 | Managed Network | HTTPS |

# 11 Deploying 5620 SAM with multiple network interfaces/IP addresses

The 5620 SAM Server and 5620 SAM Auxiliary components of the application communicate with very different entities: a managed network, a collection of Clients (GUIs and OSS), and between each other. Since these entities usually exist in very different spaces, Alcatel-Lucent recognizes the importance of separating these different types of traffic. Alcatel-Lucent therefore supports configuring the 5620 SAM Server and 5620 SAM Auxiliary such that it uses different network interfaces (IP addresses) to manage the network and to service the requirements of the 5620 SAM Clients.

5620 SAM Server uses an internal communications system (JGoups/JMS) to handle bi-directional access to the 5620 SAM Server for the 5620 SAM Clients and the 5620 SAM Auxiliary servers. In 5620 SAM Release 9.0, this communication system can be configured to allow the 5620 SAM Clients and 5620 SAM Auxiliaries to communicate using different network interfaces on the 5620 SAM Server. This adds significant flexibility when isolating the different types of traffic to the 5620 SAM Server. If using this mode, special attention must be paid to the firewall rules on the network interfaces on the 5620 SAM Server and 5620 SAM Auxiliary (NICs 1 and NICs 3 on Figure 11 ).

Deploying a 5620 SAM Server and 5620 SAM Auxiliary with multiple IP addresses is only supported when the 5620 SAM Server is installed on Solaris.

When installing 5620 SAM components on workstations with multiple interfaces, each interface must reside on a separate subnet, with the exception of interfaces that are to be used in an IPMP group.

## 11.1 5620 SAM Server multiple IP addresses deployment scenarios

The 5620 SAM Server supports the configuration of different IP addresses for the following purposes:

- One network interface can be used to manage the network. (NIC 2 on Figure 11 ) This network interface contains the IP address that the managed devices will use to communicate with the 5620 SAM Server and 5620 SAM Auxiliary. All managed devices must be configured to use the same IP address to communicate to the 5620 SAM Server.
- One network interface can be used to service the requirements of the 5620 SAM clients (GUIs and OSS) (NIC 3 on Figure 11 ). This network interface contains the IP address that all clients (GUIs and OSS) will use to communicate with the 5620 SAM Server. All clients (GUIs and OSS) must be configured to use the same IP address to communicate to the 5620 SAM Server. This IP address can be different from the one used by the managed devices to communicate with the 5620 SAM Server.
- One network interface can be used to communicate with the 5620 SAM Database as well as any redundant 5620 SAM components should they be present (NIC 1 on Figure 11 ). This network interface contains the IP address that the 5620 SAM Database and redundant 5620 SAM components will use to communicate with the 5620 SAM Server. This IP address can be different from the addresses used by the 5620 SAM clients and the managed devices to communicate with the 5620 SAM Server.

- In a redundant 5620 SAM installation, the 5620 SAM Servers and 5620 SAM Auxiliary must have IP connectivity to the 5620 SAM Server peer. If multiple interfaces are used for communication to the clients and auxiliary servers, the connectivity required could be to the client interface (NIC 3 on Figure 11 ) or the database/server interface (NIC 1 on Figure 11 ).
- Additional network interfaces may be configured on the 5620 SAM Server workstation, at the customer's discretion, to perform maintenance operations such as workstation backups.
- IPv4 and IPv6 network elements can be managed from the same interface or from separate interfaces. (NIC3 and/or NIC4 on Figure 11 ).

## 11.2 5620 SAM Auxiliary Statistics Collector multiple IP addresses deployment scenarios

The 5620 SAM Auxiliary Statistics Collector supports the configuration of different IP addresses for the following purposes:

- One network interface can be used to retrieve information from the managed network. (NIC 2 on Figure 11 ) This network interface contains the IP address that the managed devices will use to retrieve the accounting statistics files from the network elements.
- One network interface can be used to service the requirements of the 5620 SAM clients (GUIs and OSS) (NIC 3 on Figure 11 ). This network interface contains the IP address that all OSS clients will use to communicate with the 5620 SAM Auxiliary Statistics Collector. OSS Clients will use this IP address to retrieve the logToFile statistics collection data from the 5620 SAM Auxiliary Statistics Collector.
- One network interface can be used to communicate with the 5620 SAM Database as well as any redundant 5620 SAM components should they be present (NIC 1 on Figure 11 ). This network interface contains the IP address that the 5620 SAM Database and redundant 5620 SAM components will use to communicate with the 5620 SAM Server. This IP address can be different from the addresses used by the 5620 SAM OSS clients and the managed devices to communicate with the 5620 SAM Server.
- In a redundant 5620 SAM installation, the 5620 SAM Auxiliary Statistics Collector must have IP connectivity to the 5620 SAM Server peer. If multiple interfaces are used for the 5620 SAM Server to communicate to the clients and auxiliary servers, the connectivity required could be to the client interface (NIC 3 on Figure 11 or the database/server interface (NIC 1 on Figure 11 ).
- Additional network interfaces may be configured on the 5620 SAM Auxiliary Statistics Collector workstation, at the customer's discretion, to perform maintenance operations such as workstation backups.
- IPv4 and IPv6 network elements can be managed from the same interface or from separate interfaces. (NIC3 and/or NIC4 on Figure 11 ).

## 11.3 5620 SAM Auxiliary Call Trace Collector multiple IP addresses deployment scenarios

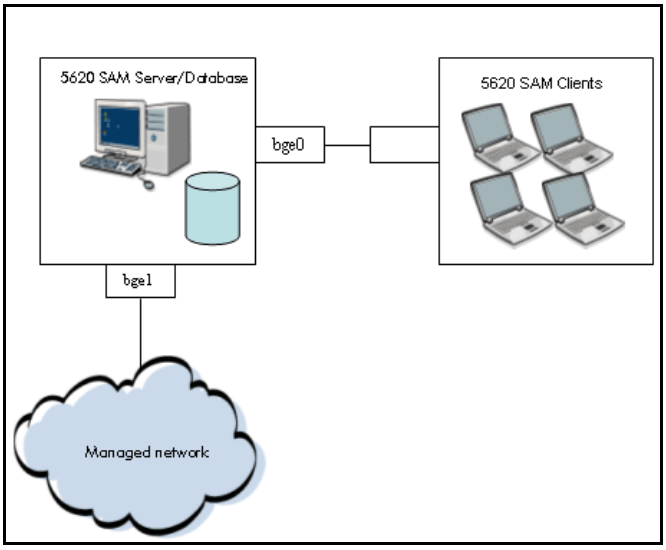
The 5620 SAM Auxiliary Call Trace Collector supports the configuration of different IP addresses for the following purposes:

- One network interface can be used to retrieve information from the managed network. (NIC 2 on Figure 11 ) This network interface contains the IP address that the managed devices will use to send the call trace messages from the network elements.
- One network interface can be used to service the requirements of the 9958 WTA client (NIC 3 on Figure 11 ). This network interface contains the IP address that all clients will use to communicate with the 5620 SAM Auxiliary Call Trace Collector. 9958 WTA will use this IP address to retrieve the Call Trace data from the 5620 SAM Auxiliary Call Trace Collector.
- One network interface can be used to communicate with the 5620 SAM management complex as well as any redundant 5620 SAM components should they be present (NIC 1 on Figure 11 ). This network interface contains the IP address that the 5620 SAM management complex components will use to communicate with the 5620 SAM Auxiliary Call Trace Collector. If a redundant 5620 SAM Auxiliary Call Trace Collector is present, this network interface will also be used to sync Call Trace and Debug Trace data collected from the network, with the peer 5620 SAM Auxiliary Call Trace Collector. This IP address can be different from the addresses used by the 9958 WTA clients and the managed devices to communicate with the 5620 SAM Server.
- In a redundant 5620 SAM installation, the 5620 SAM Auxiliary Call Trace Collector must have IP connectivity to the 5620 SAM Server peer. If multiple interfaces are used for the 5620 SAM Server to communicate to the clients and auxiliary servers, the connectivity required could be to the client interface (NIC 3 on Figure 11 or the database/server interface (NIC 1 on Figure 11 ).
- Additional network interfaces may be configured on the 5620 SAM Auxiliary Call Trace Collector workstation, at the customer's discretion, to perform maintenance operations such as workstation backups.
- IPv4 and IPv6 network elements can be managed from the same interface or from separate interfaces. (NIC3 and/or NIC4 on Figure 11 ).

It is not necessary to use the first network interface on the 5620 SAM Server workstation (i.e. ce0, bge0) to communicate with the 5620 SAM GUI Clients.

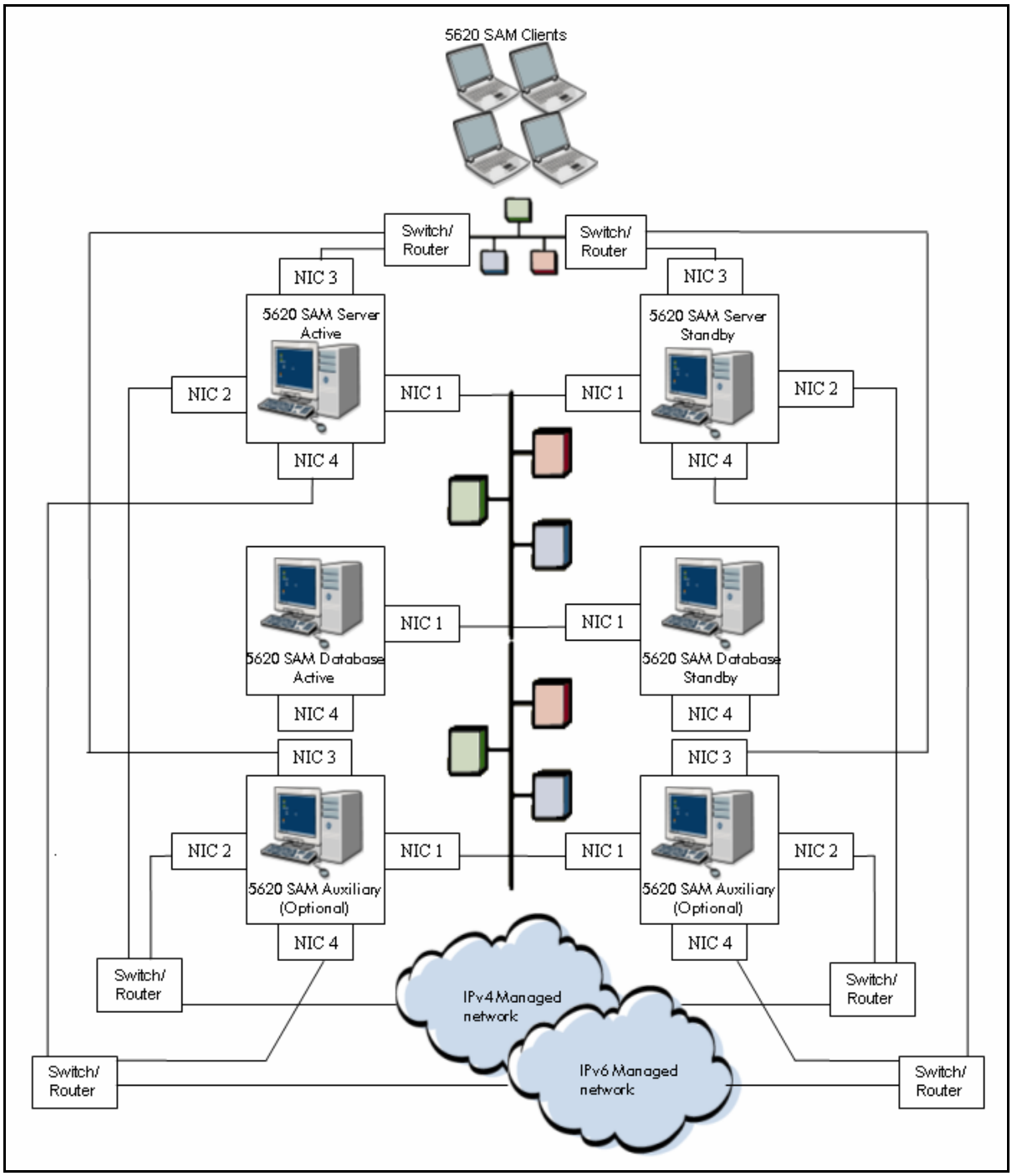
The following figure illustrates a collocated 5620 SAM Server/Database deployment where the 5620 SAM Server is configured to actively use more than one network interface.

**Figure 10** Collocated 5620 SAM Server/Database deployment with multiple network interfaces




The following figure illustrates a distributed, redundant 5620 SAM deployment where the 5620 SAM Servers are configured to actively use more than one network interface.

**Figure 11** Distributed 5620 SAM Server/Database deployment with multiple network interfaces




Due to limitations with the inter-process and inter-workstation communication mechanisms, a specific network topology and the use of hostnames may be required (See Section 11.6). Contact an Alcatel-Lucent representative to obtain further details.

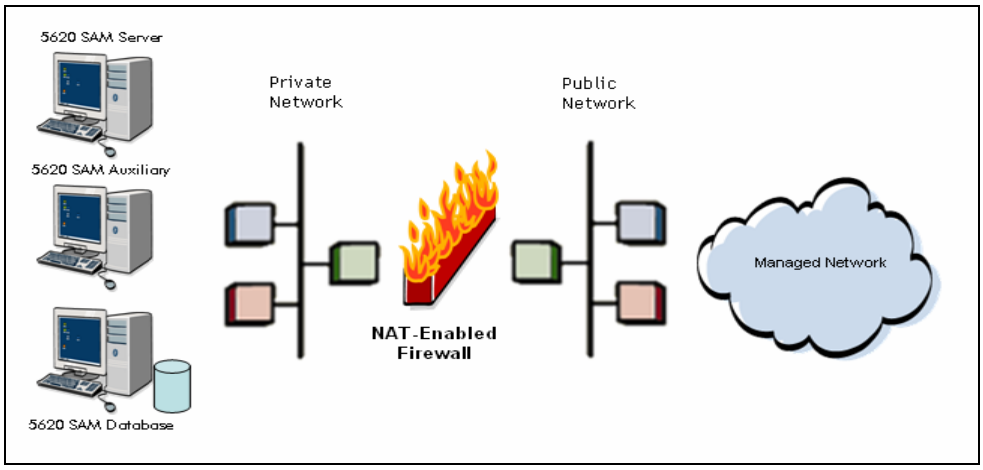
## 11.4 Using Network Address Translation

5620 SAM supports the use of Network Address Translation (NAT) between the following components:

- The 5620 SAM Server and 5620 SAM Clients (GUIs or OSS)
- The 5620 SAM Server and the managed network
- The 5620 SAM Auxiliary and the managed network
- The 5620 SAM Server and the 5620 SAM Auxiliary
- All redundant components of a 5620 SAM deployment (5620 SAM Server and 5620 SAM Database)

The following figure illustrates a deployment of 5620 SAM where NAT is used between the 5620 SAM Server and the managed network.

**Figure 12** 5620 SAM Server deployments with NAT between the Server and the managed network




The following two figures illustrates a deployment of 5620 SAM where NAT is used between the 5620 SAM Server and the 5620 SAM Clients (GUIs, OSS or Client Delegates). In figure 13, SAM Clients on the private side and public side of the NAT-Enabled Firewall must connect to the public IP address of the SAM Server. A routing loopback from the SAM Server private IP address to the SAM Server public IP address must be configured in this scenario as all SAM Clients must communicate to the SAM Server through the SAM Server public IP address.

The 5620 SAM Auxiliary will need to be able to connect to the public IP address of the 5620 SAM server.

**Figure 13** NAT'd 5620 SAM Server deployment with IP Address communication

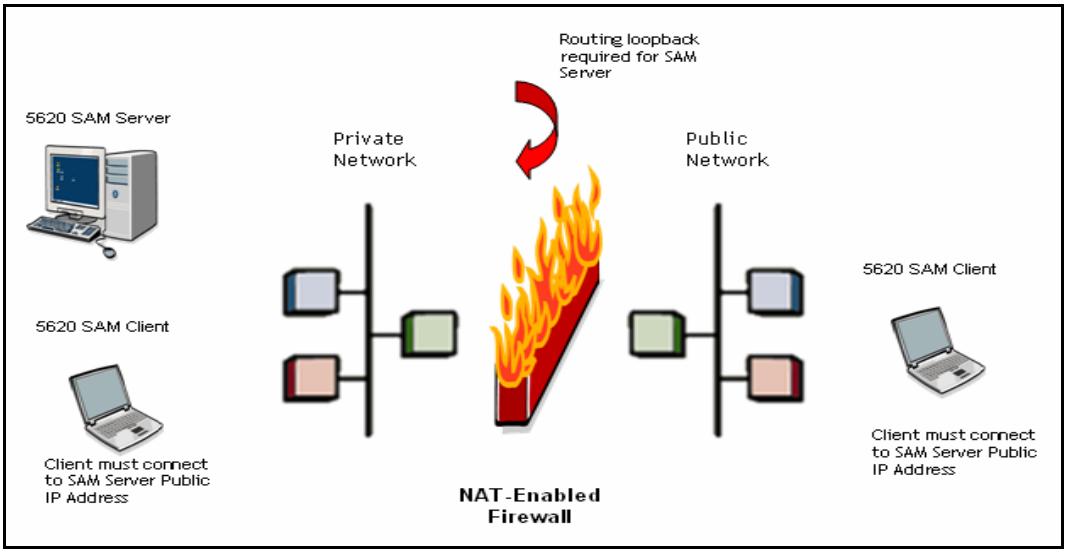
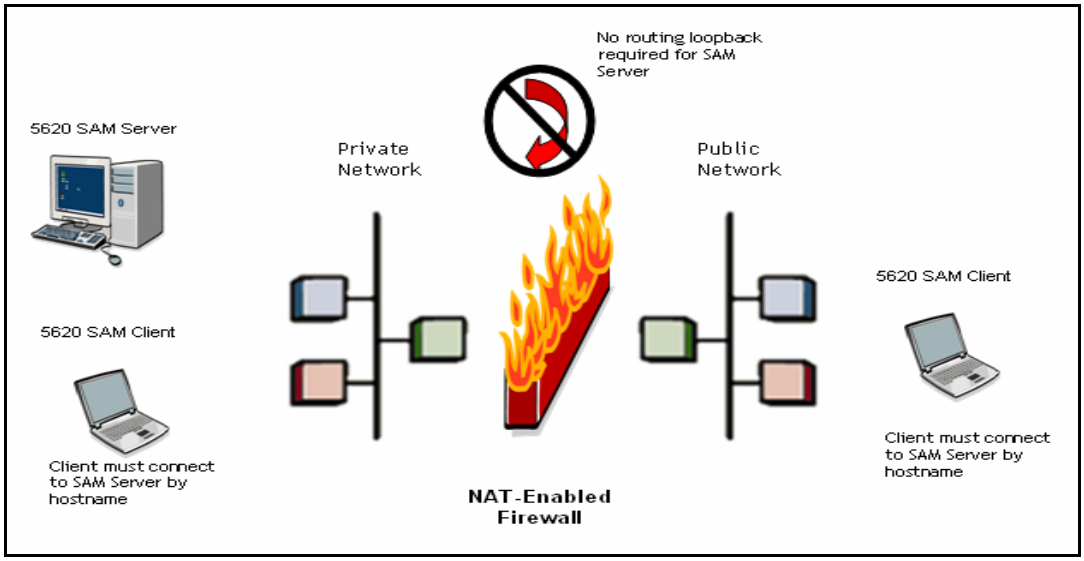


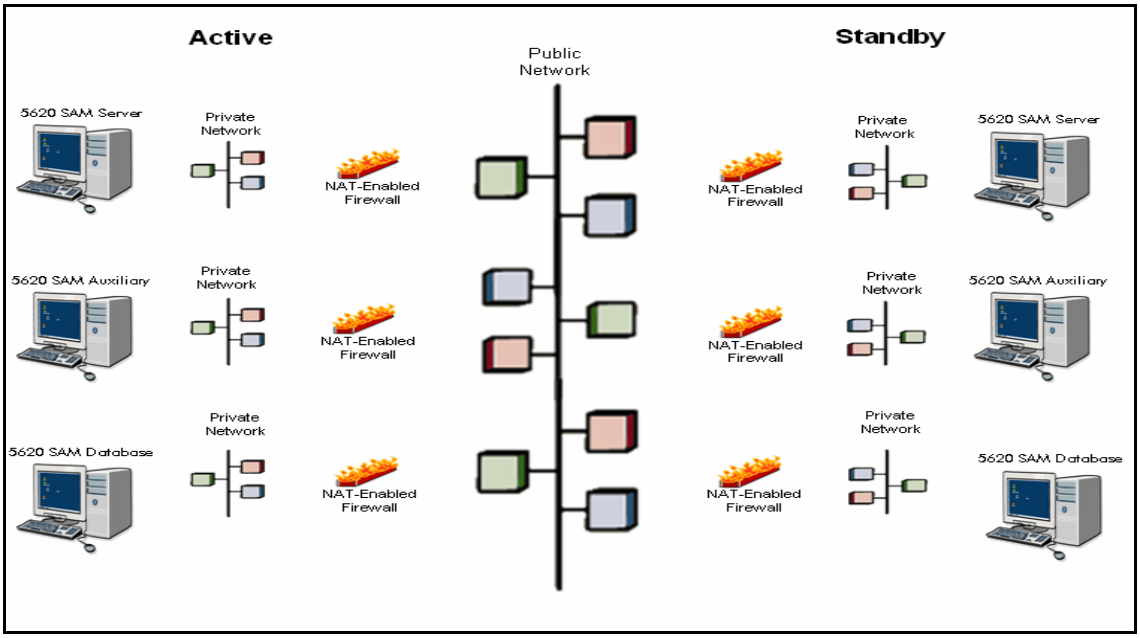

**Figure 14** NAT'd 5620 SAM Server deployment with Name Resolution based communication




In Figure 14 , a name resolution service on the public side of the NAT-Enabled Firewall is configured to resolve the SAM Server hostname to the public IP address of the SAM server. Name resolution service on the private side of the NAT-Enabled Firewall is configured to resolve the SAM Server hostname to the private IP address of the SAM server. Clients on both sides of the NAT-Enabled Firewall are configured to communicate with the SAM Server via hostname where the SAM Server hostname must be the same on both sides of the NAT-Enabled Firewall.

The following figure illustrates a deployment of 5620 SAM where NAT is used between the 5620 SAM Server and Database components of a redundant 5620 SAM deployment.

**Figure 15** 5620 SAM deployments with NAT between the 5620 SAM Servers and Databases




NAT rules must be in place before 5620 SAM installation can occur, since the installation scripts will access other systems for configuration purposes.

## 11.5 Configuring 5620 SAM Server to utilize multiple network interfaces

The configuration of the 5620 SAM Server application to use multiple interfaces is done at installation time. At that time, the installation utility prompts the user to enter the IP addresses of the various network interfaces that are to be used within the 5620 SAM network management complex.

## 11.6 Use of hostnames for the 5620 SAM Client

There are a number of situations where it is necessary for the 5620 SAM Client to be configured to use a hostname rather than a fixed IP address to reach the 5620 SAM Server.

For situations where the 5620 SAM Server's public address is exposed to multiple networks with different IP addresses, a hostname can be used instead of a fixed IP address. This is most useful when NAT is used between 5620 SAM clients and the 5620 SAM Server that can be accessed via multiple networks.

For situations where the 5620 SAM Client and the 5620 SAM Auxiliary are using different network interfaces to the 5620 SAM Server, the 5620 SAM Client must use a hostname to reach the 5620 SAM Server.

In both cases, a hostname can be used by configuring DNS, or by configuring the local host file to ensure that the hostname can be translated to an IP address.

This feature is available as of 5620 SAM Release 6.0 R4

# 12 Obtaining technical support

Technical Support Engineers are available to assist you 24 hours a day, 7 days a week.

For the list of regional contact telephone and fax numbers, visit: http://support.alcatel-lucent.com and click on the Alcatel-Lucent Support link.

# 13 Glossary

| Term | Description |
|---|---|
| 5620 SAM | 5620 Service Aware Manager<br><br>The 5620 SAM is the network management system. |
| 5620 SAM client | The 5620 SAM client provides a GUI to configure IP network elements. |
| 5620 SAM-O client | A 5620 SAM-O client is an application that uses the 5620 SAM-O interface to perform functions such as inventory management or alarm monitoring. |
| 5620 SAM-O 3GPP client | A 5620 SAM-O 3GPP client is a Corba client that is used to access the information from the 5620 SAM auxiliary call trace collector. |
| 5620 SAM auxiliary | The 5620 SAM auxiliary is a generic term that covers both the 5620 SAM auxiliary statistics collector and the 5620 SAM auxiliary call trace collector |
| 5620 SAM auxiliary call trace collector | The 5620 SAM auxiliary call trace collector handles the call trace information from the eNodeB network elements and places the information into files that are accessible via the 5620 SAM-O 3GPP client. |
| 5620 SAM auxiliary statistics collector | The 5620 SAM auxiliary statistics collector handles statistics collection from the network elements and passes the results to the 5620 SAM database. |
| 5620 SAM database | The 5620 SAM database stores network objects, configurations, and statistics. |
| 5620 SAM server | The 5620 SAM server mediates between the 5620 SAM database, 5620 SAM client, and the network. In some installations it also handles statistics collection. |
| 5780 DSC | The 5780 Dynamic Services Controller is the policy entity that forms the linkage between the service and transport layers. |
| OmniSwitch 6400, 6850, 6885, and 9000 series | Alcatel-Lucent OmniSwitches<br><br>An advanced, stackable, fixed configuration, triple-speed family of Ethernet switches. |
| 7210 SAS-E | Alcatel-Lucent 7210<br><br>Designed as a service-provider owned and managed CLE device, the 7210 SAS-E is a small footprint, Carrier Ethernet, customer-edge device. The 7210 SAS-E can also be deployed as a cost-effective aggregation device for smaller sites. The 7210 SAS-E is MEF 9 and 14 certified and built to provide cost-effective, highly scalable Carrier Ethernet services delivery. |
| 7250 SAS | Alcatel-Lucent 7250 Service Access Switch<br><br>A feature-rich customer premises device purpose-built to deliver a complete portfolio of voice, video and data services to enterprise customers. |

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| 7450 ESS | Alcatel-Lucent 7450 Ethernet Service Switch<br><br>An Ethernet switch that enables the delivery of metro Ethernet services and high-density service-aware Ethernet aggregation over IP/MPLS-based networks. |
| 7705 SAR | Alcatel-Lucent 7705 Service Aggregator Router<br><br>A router that provides IP/MPLS and pseudowire capabilities in an aggregation platform. |
| 7710 SR | Alcatel-Lucent 7710 Service Router<br><br>The 7710 SR is a 10-Gbyte version of the 7750 SR that provides granular lower-speed private data services with SLAs |
| 7750 SR | Alcatel-Lucent 7750 Service Router<br><br>A superior multi-service edge router - purpose built for service providers who are looking to deliver a new wave of residential and business services on a single IP/MPLS network. |
| 9471 MME | The 9471 Mobility Management Entity is based on an ATCA-based Linux platform. |
| 9500 MPR | Alcatel-Lucent 9500 Microwave Packet Radio<br><br>An efficient switch that transports multimedia traffic, while supporting legacy TDM with the QoS. |
| 9958 WTA | Alcatel-Lucent 9958 Wireless Trace Analyzer<br><br>Used to collect and analyze eNodeB call Trace data from 5620 SAM Auxiliary Call Trace Servers |
| Telco T5C | Telco Systems T5 Compact Service Extension Node<br><br>Enables the delivery of high-performance and media-rich metro Ethernet services. The unique flexibility, efficiency, service, and high-availability characteristics of the Telco Systems T5C provide seamless service extension capabilities to the Alcatel-Lucent 7450 Ethernet Service Switch (ESS) and the Alcatel-Lucent 7750 Service Router (SR) product portfolios in the Metro Core, Metro Edge, Metro Access, and at the customer premises' boundary |
| failover | Failover is the process of changing the roles of a redundant system, for example, when the standby database takes over the role of a failed active database. A failover required manual intervention to be reversible. |
| BPD | Bandwidth delay product<br><br>The maximum amount of data that can be in transit on the network at any given time. |
| eNodeB NEM | eNodeB Network Element Manager<br><br>Application launched from the 5620 SAM UI that provides OA&M functionality for eNodeBs. |
| GNE | Generic Network Element |

A network element for which 5620 SAM provides a light level of network management. 5620 SAM provides SNMP status to monitor interface statuses as well as the ability to log in to the network element and the ability to launch scripts to the network element.

JMS — Java Message Service

JMS is an API that combines Java technology with enterprise messaging. The JMS API defines a common set of interfaces for creating applications for reliable asynchronous communication among components in a distributed computing environment, so that the applications are portable across different enterprise systems.

LAN — local area network

A LAN is a group of computers or associated devices that share a common communications line and typically share the resources of a single processor or server within a small geographic area, for example, within an office building.

MDA — media dependent adaptor

MDA is a pluggable interface module on a 7750 SR or a 7450 ESS that distributes traffic between the network and the system I/O module. An MDA is also referred to as a daughter card.

NIC — network interface card

A NIC connects a workstation to network hubs or switches.

OSS — operational support system

An OSS is a network management system supporting a specific management function, such as alarm surveillance and provisioning, in a service provider network.

SAP — service access point

An SAP is a point of communication exchange between an application and the LLC or between layers of software.

SDP — service distribution path

A service distribution path acts as a logical way of directing traffic from one 7750 SR to another 7750 SR through a unidirectional service tunnel. The SDP terminates at the far-end 7750 SR, which directs packets to the correct service egress SAPs on that device. A distributed service consists of a configuration with at least one SAP on a local node, one SAP on a remote node, and an SDP binding the service to the service tunnel.

SNMP — Simple Network Management Protocol

A protocol used for the transport of network management information between a network manager and a network element. SNMP is the most commonly used standard for most interworking devices.

SNMP trap — An SNMP trap is an unsolicited notification that indicates that the SNMP agent on the node has detected a node event, and that the network management domain should be

aware of the event. SNMP trap information typically includes alarm and status information, and standard SNMP messages.

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| Solaris | The name for the UNIX operating system variant developed by SUN Microsystems. |
| STM | Service Test Manager<br><br>The 5620 SAM service test manager (STM) system provides the ability to group various OAM tests into test suites for network troubleshooting and for verifying compliance with SLAs. |
| switchover | Switchover is the process of switching the roles of a redundant system, for example, switching the roles of an active and standby database. A switchover is reversible. |
| TCP | Transmission Control Protocol<br><br>TCP is a protocol used, along with the Internet Protocol (IP), to send data in the form of message units between computers over the Internet. While IP takes care of handling the actual delivery of the data, TCP takes care of keeping track of the individual units of data (called packets) that a message is divided into for efficient routing through the Internet. |
| Telnet | Telnet is the Internet-standard TCP/IP protocol for remote terminal connection service. It allows a user at one site to interact with a remote timesharing system at another site as if the user's terminal connected directly to the remote machine. The Telnet command and program are used to log in from one Internet site to another. It gets the user to the login prompt of another host. |
| UDP | User Datagram Protocol |
| UNIX | UNIX is a multi-user, multitasking operating system, which is used on mainframes, workstations, and PCs. UNIX is the basis of Solaris and SunOS, which are operating systems used by Oracle and HP workstations. |
| XML | eXtensible Markup Language<br><br>XML defines the syntax to customize markup languages. The markup languages are used to create, manage, and transmit documents across the Web. |

## ISSUE HISTORY OF THIS RELEASE OF THE *5620 SAM PLANNING GUIDE*

| Edition number | Date of issue | Reason for issue |
|---|---|---|
| 3HE 06557 AAAA TQZZA Ed.01 | March 09th,2011 | Creation for Beta |
| 3HE 06557 AAAB TQZZA Ed.01 | April 20th,2011 | Updates for R1 |
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