
# SR-S4500 1.5.5

## Functional Specification

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# SR-S4500

## Tandem Softswitch with Limited SBC Functions

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# 1 Introduction

## 1.1 Document Profile

The document describes the architecture of the SR-S4500 software application, provides a list of its main technical and functional specifications, as well as enumerates hardware and software requirements for correct operation of SR-S4500.

## 1.2 List of Abbreviations

| Term | Explanation |
|---|---|
| AAA | Authentication, Authorization, and Accounting. |
| ACD | Average Call Duration. ACD is one of the operational parameters registered in SR-S4500. ACD allows the evaluation of dial peer performance. |
| ASR | Answer Seizure Ratio. In SR-S4500, ASR is calculated:<br>• According to ITU-T Recommendation E.411, paragraph 3.6.3. This method is used by H.323 balancer and SIP proxy nodes to distribute workload among signaling nodes. ASR calculation is based on data received within the last 5 seconds.<br>• According to the SR-S4500 intrinsic formula. For details, see *SR-S4500 1.5.5 Operator's Manual, section 6.5 "How TMngr calculates ASR/ABR"*. |
| CC | Concurrent calls. |
| CDR | Call detail record. Set of data fields (call ID, call start and termination time, disconnect reason, etc) used for accounting and billing. |
| CPS | Calls per second. |
| CSV | Comma Separated Values – text format used to represent data in tabular form. Each string in the file is a row of the table. The values of each column is separated by a delimiter, for example, a comma (,), semicolon (;) or a tab symbol. Text values are embraced in double quotes ("); if the text value itself contains double quotes – they are represented by two double quotes following each other. |
| DB | Database. |
| DBMS | Database management system. |
| DNS | Domain Name system. |
| DTMF | Dual Tone Multi-Frequency. |
| EMA | Exponential moving average. |
| ENUM | Telephone Number Mapping (from TElephone NUmber Mapping.) A suite of protocols to unify the telephone numbering system E.164 with the Internet addressing system DNS. |
| FAS | False Answer Supervision. |
| H.323 | An ITU-T recommendation that defines the protocols to provide audio-visual communication sessions on any packet network. |
| LAR | Look Ahead Routing. |
| LATA | Local access and transport area. |
| LCR | Least cost routing. |

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| Term | Explanation |
|---|---|
| LDC | Local disconnect code. |
| LERG | Local Exchange Routing Guide. |
| LNP | Local Number Portability. |
| NANP | North American Numbering Plan. |
| NAT | Network Address Translation |
| NPA | Numbering Plan Area. A 3-digit code that designates one of the numbering plan areas in the NANP (North American Numbering Plan) for direct distance dialing. |
| OCN | Operating company number. |
| OoDRPS | Out-of-dialog requests per second (SIP). Out-of-dialog requests are:<br>• all new requests except INVITEs and REGISTERs;<br>• requests with no tag in the To header field.<br>For example, OPTIONS is generally considered to be an out-of-dialog request. However, received within an already established dialog it does not take part in the OoDRPS limitation. |
| PDD | Post Dial Delay. It is an interval between dialing the last digit of the called number and hearing the ringback tone.<br>SR-S4500 registers PDD as an interval between the receipt of the CONNECT packet from the call originator and the receipt of the ALERT, CONNECT or ProgressIndicator with value 8 (ProgressInbandInformationAvailable) packets from the terminator. The calculation of PDD is EMA-based, measured in milliseconds. |
| QoS | Quality of Service. SR-S4500 calculates QoS as a ratio of packets lost to total packets transferred, i.e. the smaller is the calculated QoS value, the better is QoS. |
| RADIUS | Remote Authentication Dial-In User Service. |
| RAS | Registration, Admission and Status. It is a fairly simple protocol for carrying messages used in the H.323 Gatekeeper discovery and endpoint registration processes. |
| RFC | Request For Comments. |
| RPS | Registrations per second. |
| RTP/RTCP | Real-Time Protocol / Real-Time Control Protocol. |
| SBC | Session Border Controller. |
| SIP | Session Initiation Protocol. |
| SLA | Service Level Agreement. |
| SNMP | Simple Network Management Protocol. |
| TMngr | Traffic Manager, the SR-S4500 core element designed for call routing, analysis of data streams passage along the routing paths with allowance made for QoS and profitability and ensuing optimization of traffic distribution among the route alternatives |
| TS | Traffic Switch, an application functioning as a session border controller that handles calls under the control of TMngr. |
| UDP | User Datagram Protocol. One of the core members of the Internet protocol suite (the set of network protocols used for the Internet). |
| VoIP | Voice over Internet Protocol. |

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| Term | Explanation |
| --- | --- |
| WUI | Web-based user interface. |

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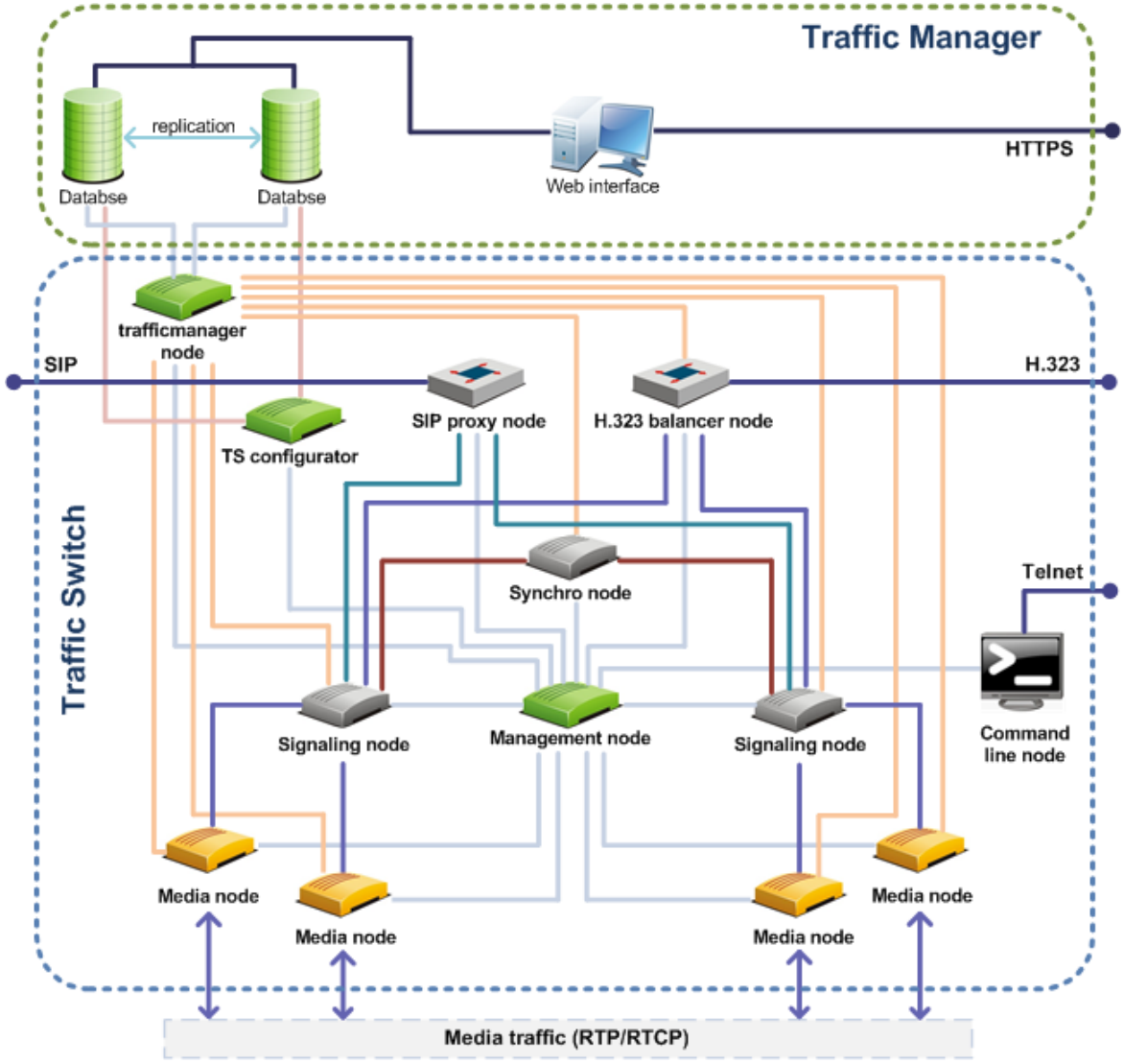
# 2 System Overview

SR-S4500 is a system for comprehensive management of IP telephony traffic flowing across the ITSP's network. SR-S4500 is designed to efficiently handle big amounts of simultaneous call sessions through application of adaptive call authorization and routing policies.

SR-S4500 includes two functional layers: a switching layer (Traffic Switch) and a traffic management layer (Traffic Manager). The job of TMngr is to keep and furnish data about available routing paths as well as provide traffic balancing rules for termination equipment. Traffic Switch perform all information processing and call handling. The distribution of operational functions among the SR-S4500 key components is as follows:

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## 2.1 Traffic Switch

Traffic Switch is the switching layer of the SR-S4500 system. Traffic Switch handles SIP and H.323 protocols, and performs two-way conversion of signaling protocols and voice codecs when necessary. Additionally, Traffic Switch is the primary source of call statistics that is analyzed and visualized by means of Traffic Manager, provides monitoring of the system and is responsible for notifications.

Traffic Switch comprises the following functional nodes, each one being an individual process:

- **Management node** ensures distribution of configuration data between other TS nodes, provides centralized control over them and serves as a collection point for SR-S4500 statistics.
- **H.323 Balancer node** serves as the entry point for H.323 traffic. The node handles H.323 registration (RAS) requests and provides load balancing among signaling nodes. When a user (calling device) tries to register with SR-S4500, the H.323 balancer node forwards relevant data to Traffic Manager. Depending on the response received, the registration request is either accepted or rejected. Load balancing is based on the current ASR value of each signaling node.
- **SIP proxy node** balances arriving SIP calls among signaling nodes, and serves as the single exit point for SIP traffic.
- **Signaling node** provides two-way conversion of SIP/H.323 signaling protocols and traffic distribution (load balancing) among media nodes (based on the current CPU load of each media node). Also, the signaling node handles SIP registrations.
- **Media node** handles media flows, functions as an RTP media proxy and performs conversion of voice codecs. The number of media nodes needed in SR-S4500 depends on the anticipated number of concurrent call sessions that involve RTP media proxy operation.
- **Command line node** is a telnet server that allows logging to a switching host using any telnet client.
- **trafficmanager node** ensures interaction between TS and TMngr by means of DBMS clients. It is also responsible for interaction with external billing systems and ENUM registers, codec sorting and distributing calls between termination devices within equipment groups.
- **TS configurator** transfers configuration data from the DB to internal TS tables, as well as monitoring data from internal TS tables to the web interface. Monitoring data is viewed and configuration is edited in the **Traffic Switch** category of objects in theweb interface. The TS configurator interacts only with two DBs (primary and failover).
- **Synchro node** ensures control over the used resources.

## 2.2 Traffic Manager

Traffic Manager carries out authentication and authorization of VoIP endpoints, performs call routing, call analysis, validation and transformation of call numbers, traffic load balancing and interoperates with external routing servers. In addition, Traffic Manager performs QoS control functions and generates information required for external billing systems.

Traffic Manger is:

- **Database** stores the primary system settings and all information necessary for call routing, online billing and statistical analysis.
- **Web-based user interface (WUI)** – provides a convenient graphical interface for administration tasks.

Functions performed by and features of the SR-S4500 TMngr:

- Flexible user authentication and authorization policies.
- Drawing up based on the calling number a list of routes for subsequent call routing with regard to rates and the route QoS. Such route hunting relies on isolating the rate zone prefix from the called number.

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- Sorting of the selected routes by minimum price (LCR) or according to custom statistics-based routing policies.
- Restriction imposing based on user authorization results, destination, termination providers and time.
- Called and calling number translation in accordance with pre-determined patterns.
- Connection data processing resulting in information conducive to detection of poor quality routing paths with the end of automatic exclusion of the latter from the routing process.
- Congestion threat assessment and route-oriented traffic balancing.
- Route health monitoring. Blocking of routes with poor statistics.
- Generation and adjustment of rate plans and discounts for customers.
- Support of rate plans and discounts extended by termination providers.
- Graphical and tabular representation of statistics including peak and current traffic, processed call totals, average and general call duration, ASR, QoS, etc.
- The majority of dynamic and statistical parameters are computed as an exponential moving average. The interval of averaging is a configurable parameter.
- Support of local number portability (LNP) including the TNS Carrier ENUM registry standard.
- Custom mapping of disconnect codes.
- Scheduled generation and delivery of reports by email as XLS or CSV files.
- Data warehouse mechanism that allows users to run resource-intensive procedures on a dedicated DB.
- Support of the SIP P-Charge-Info header in compliance with the FCC 11-161 regulations.

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# 3 Technical Data and Specification

**Carrier-to-Carrier/Carrier-to-Enterprise Connectivity**

- Conversion of media codecs:
  - G.729;
  - G.729A;
  - G.729B;
  - G.729AB;
  - G.723.1;
  - G711A-Law;
  - G.711μ-Law;
  - GSM FR;
  - Speex;
  - iLBC;
  - AMR NB;
  - G.726;
  - G.722;
  - G.722.1;
  - G.722.2.
- Support for and conversion of H.323 and SIP dialects;
- T.38 fax pass-through;
- SIP-T/SIP-I pass-through;
- SIP and H.323 video pass-through using H.261, H.263, H.264 codecs;
- Support of the majority of methods for DTMF transfer, including RFC 2833, SIP INFO, Inband DTMF in G.711 codec (for receiving only), signaling DTMF in H.245, Q.931.

**Supported protocols**

The following ITU-T standards are supported:

- H.323 v.2-v.4 “Packet-based multimedia communications systems”;
- H.245 v.7 “Control protocol for multimedia communication”;
- H.225 v.4 “Call signalling protocols and media stream packetization for packet-based multimedia communication systems”.

SIP (the current version of SR-S4500 uses UDP as a transport protocol for SIP):

*Basic signaling protocols:*

- RFC 3261 “SIP: Session Initiation Protocol”;
- RFC 3326 “The Reason Header Field for the Session Initiation Protocol (SIP)”;
- RFC 2976 “The SIP INFO Method”.

*Privacy:*

- RFC 3323 “A Privacy Mechanism for the Session Initiation Protocol (SIP)”;
- RFC 3324 “Short Term Requirements for Network Asserted Identity”;
- RFC 3325 “Private Extensions to the Session Initiation Protocol (SIP) for Asserted Identity within Trusted Networks”;
- SIP Extensions for Caller Identity and Privacy (Cisco proprietary way to handle privacy (Remote-Party-ID).

*SIP extensions:*

- RFC 3262 “Reliability of Provisional Responses in Session Initiation Protocol (SIP)”;

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- RFC 3265 “Session Initiation Protocol (SIP) – Specific Event Notification”;
- RFC 3311 “The Session Initiation Protocol (SIP) UPDATE Method”;
- RFC 3581 “An Extension to the Session Initiation Protocol (SIP) for Symmetric Response Routing”;
- RFC 4694 “Number Portability Parameters for the "tel" URI”;
- RFC 5168 “XML Schema for Media Control” (picture_fast_update is supported);
- RFC 5806 “Diversion Indication in SIP”;
- The Calling Party's Category tel URI Parameter.

SDP:

- RFC 3264 “An Offer/Answer Model with Session Description Protocol (SDP)”;
- RFC 3551 “RTP Profile for Audio and Video Conferences with Minimal Control”;
- RFC 3555 “MIME Type Registration of RTP Payload Formats”;
- RFC 4566 “SDP: Session Description Protocol”..

DTMF:

- RFC 2833 “RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals” (only in SIP);
- SIP INFO Method for DTMF Tone Generation (Cisco specification);
- Inband DTMF in G.711 codec (detection and/or transparent pass-through);
- H.323 signaling messages:
  – by an alphanumeric H.245 User Input message (as digits);
  – by an alphanumeric H.245 User Input message (as string);
  – by H.245 signal;
  – by a Q.931 Facility message with field Keypad.

RTP/RTCP:

- RFC 3550 “RTP: A Transport Protocol for Real-Time Applications”;
- RFC 3551 “RTP Profile for Audio and Video Conferences with Minimal Control”.

Monitoring over SNMP:

- SNMP v1 (RFC 1157);
- SNMP v2c, (RFC 1901);
- GET, GETNEXT, GETBULK requests to get counters and dispatch of SNMP traps using Net-SNMP application in Linux OS. For detailed description refer to http://www.net-snmp.org;

RADIUS Accounting (RFC 2866);

ENUM, RFC 3761 “The E.164 to Uniform Resource Identifiers (URI) Dynamic Delegation Discovery system (DDDS) Application (ENUM)”.

**Network security and SBC functions**

- NAT traversal:

  The system automatically detects hosts behind NAT devices. For this, it checks a host address written in the last network packet coming from a device. If it differs from the actual address where the packet comes from, the device is considered to be behind a NAT. In this case the system sends all further packets to the address from which this last packet originates.
  Media flow processing is the same. If media source address differs from the one specified in the signaling messages, the system transmits the media stream to the address from which the opposite stream comes.
  Please note that calls to H.323 terminal can't be placed if NAT router ports are defined dynamically.

- Concealment of the owner's network topology.
- Limitation of incoming traffic: the SIP proxy node can be configured to receive traffic only from trusted realms.
- Caller authentication by IP or username based on data stored in the DB.

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**Anti-fraud functions**

- FAS (False Answer Supervision) prevention.

  If SR-S4500 receives an Alerting/Progress or Connect message earlier than it is defined in the equipment configuration, the call is considered fraudulent and rejected with a specific predefined LDC. The feature is optional. If you want to enable it, please contact our support team.

**Call routing**

- Rerouting on route unavailability;
- Routing of calls to telephone numbers that were ported within landlines (Local Number Portability, LNP) or wireless networks (Mobile Number Portability, MNP).

*Native routing capabilities*

- Routing based on the calling/called number;
- Day-of-week and time-of-day based routing;
- Least busy (gateway/route) alternative routing;
- Routing policies based on route health parameters (ASR, ACD, etc);
- Least Cost Routing;
- Smart LCR (profitability-based routing);
- CPS %-based Routing;
- Jurisdictional routing (NPA/LATA/OCN), LERG support.

*External routing*

- ENUM-aided routing

**Statistics and network analysis**

- Display of CDRs meeting user-defined parameters;
- Export of CDRs into a text file (including scheduled export);
- Real-time monitoring of ASR, QoS, ACD, etc.;
- Monitoring of selected gateway/route performance statistics;
- Automated log file management (archiving, file size and file rotation control);
- Dashboard with up to 9 charts presenting real-time changes in business statistics and performance of the system.

**Billing**

- Single CDR collection point;
- Great number of fields in CDRs for detailed analysis and debugging;
- Generation of interim CDRs to store accounting data on active calls;
- Integration with external billing systems using RADIUS protocol;
- Cisco VSA;
- Customizable billing schemes for real-time charging of customers and vendors;
- Rate management;
- Invoicing of customers;
- Price mark-up control.

**Number translation**

- Flexible number translation options based on regular expressions;

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- Separate number translations for routing, billing, etc.

**Configuration management**

- Managing configuration via web interface supporting a flexible system of roles;
- Secure authentication and authorization of the system users', including configurable web password policies;
- Console interface via telnet;
- Provisioning the DB via web API over SOAP;
- Exporting data from the DB into CSV files;
- Importing data in the DB from CSV, XLS and XLSX files, as well as from such files in gzip, gz, bzip2, bz2 and zip archives.

**Logging and debugging**

- System trace logs with selectable information detail level;
- Call log viewing through the web interface;
- Call simulation;
- Logs of users' actions performed through the web interface and over API.

**Fault tolerance and availability**

The fault tolerance of TS is achieved due to its modular architecture. It is possible to run a whole set of nodes of the same type that increase the overall system performance and backup each other.

The fault tolerance of the DBMS is ensured by installing an additional DBMS and configuring replication between DBMSs.

**Geographically distributed configuration**

- Modular design of Traffic Switch;
- Locations intended to unite geographically close nodes that should interoperate with each other only;
- Dynamic distribution of licenses among locations.

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# 4 Software Requirements

**Traffic Switch (TS)**

Traffic Switch runs on the 32-bit OS Debian GNU/Linux 7 (Wheezy). It is recommended to use a 64-bit kernel to utilize larger amount of RAM.

**Traffic Manager (TMngr)**

The TMngr DBMS Oracle 10.2.0.5 can run on Red Hat Enterprise ES 5.5, 5.6, 5.7 and 5.8. Both Oracle and Red Hat ES should be 64-bit versions.

Recommended web browsers include:

- Microsoft Internet Explorer v.9 and higher;
- Mozilla Firefox v.3 and higher;
- Opera 11 and higher.

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# 5 Hardware Requirements

The section provides hardware requirements based on the typical configuration scenarios.

## 5.1 Minimum Configuration

The configuration is intended for start-up VoIP companies. It is a plug & play all-in-one solution that runs on commodity software and presents low deployment cost.

**Objective**: fast and cheap launch of a VoIP platform.

**Capacity**: up to 2 000 CC, up to 100 CPS.

**Configuration**: 1 TS, 1 TMngr.

| | Traffic Switch | Traffic Manager |
|---|---|---|
| CPU | Intel Xeon E5620 | Intel Xeon E5620 |
| RAM | 8 Gb | 24 Gb |
| HDD | SATA | SAS 10k 300 Gb |
| NIC | Intel-based | Standard |

## 5.2 Minimum Configuration with Full Redundancy

This configuration offers full redundancy functionality for small VoIP carriers. Increased reliability is obtained by means of installing two TMngr and two TS servers. Thus, the system will remain online in case of a failure of one of its elements. Moreover, the minimum configuration with full redundancy can be conveniently scaled to work with larger amounts of traffic.

**Objective**: fast and cheap launch of a VoIP platform, backup included.

**Capacity**: up to 2 000 CC, up to 100 CPS.

**Configuration**: 2 TS, 2 TMngr.

| | Traffic Switch | Traffic Manager |
|---|---|---|
| CPU | Intel Xeon E5620 | Intel Xeon E5620 |
| RAM | 8 Gb | 24 Gb |
| HDD | SATA | SAS 10k 300 Gb |
| NIC | Intel-based | Standard |

## 5.3 Medium Configuration with Full Redundancy

This configuration is a powerful VoIP traffic management tool for medium-scale carriers designed to process large volumes of transit traffic. It is a solution capable of utilizing existing infrastructure to deliver reliable and profitable VoIP traffic management.

The SR-S4500 medium configuration features 99.999% fail-safety, assures route quality control and protects the carrier's revenue.

**Objectives**:

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- Solving both technical and business tasks
- Real-time revenue level control
- Maintaining high ASR automatically

**Capacity**: 2 001 – 10 000 CC, up to 500 CPS.

**Configuration**: 5 TS, 2 TMngr with system full back up, updates without interruption in service.

| | Traffic Switch | Traffic Manager |
|---|---|---|
| CPU | Intel Xeon E5690 | Intel Xeon E5690 |
| RAM | 16 Gb | 64 Gb |
| HDD | SATA | SAS 15k 600 Gb |
| NIC | Intel-based | Standard |

## 5.4 Maximum Configuration with Full Redundancy

This configuration was developed with large-scale carriers' needs in mind. It delivers best performance options available. Comprised of several TS and TM modules, this configuration guarantees strict SLA assurance and 99.999% fail-safety. The maximum configuration is further scalable to meet the needs of the carrier in case of growth of transit traffic amounts.

There is a Data Warehouse in this configuration. Data Warehouse is a separate server which is not involved in call routing, running resource-consuming operations (invoice and statistical report generation, CDR processing, analytical procedures on price generation, route analysis, etc.). Thus routing servers have higher call processing speeds.

**Objectives**:

- Fast and flexible performance increase
- Strict SLA compliance
- 99.999% fail-safety and zero downtime during upgrades

**Capacity**: from 10 000 CC, from 500 CPS.

**Configuration**: several TS, 2 TMngr with system full back up.

| | Traffic Switch | Traffic Manager | Data warehouse |
|---|---|---|---|
| CPU | Intel Xeon X5690 | Intel Xeon E7-4870 | Intel Xeon X5690 |
| RAM | 16 Gb | 128 Gb | 128 Gb |
| HDD | SATA | SAS 15k + SSD | SAS 15k 600 Gb |
| NIC | Intel-based | Standard | Standard |

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