RELIANCE Communications

Bachelor Thesis

on

Over the Air Function (OTAF)

Submitted By

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OBJECTIVE

This document details the description of the Over The Air (OTA) activation process. The document lists the OTAF message flows, descriptions and the relationship with various network entities to realize the OTA activation process along with the CDMA2000 network.

OTAF (Over The Air Function) in CDMA

Introduction

As part of its "Basic Service Operations", Reliance has planned for extending Wireless coverage in 591 SDCAs (Short Distance Charging Areas), building up a total subscriber base of more than 10 Million. The scope of coverage of the CDMA based Wireless services shall be expanded rapidly to include most of the country's 2500+ SDCAs within next few years.

The MSCs shall be located in the Media Convergence Nodes (MCNs), where the "Back-Bone Transport" and the "Switching/Data" facilities converge. The technology for the wireless network is cdma2000 1x RTT. This technology is one of the standards approved by IMT 2000 as 3rd Generation wireless standard.

The network is based on 18 PLMN (Public Land Mobile Network). The States/Metros that comprise these are listed below.

S/No	Circle Name
1	Andhra Pradesh
2	Bihar
3	Delhi
4	Gujrat
5	Haryana
6	Himachal Pradesh
7	Karnataka
8	Kerala
9	Madhya Pradesh
10	Maharastra *
11	Mumbai*
12	Orissa
13	Punjab
14	Rajasthan
15	Tamil Nadu
16	Uttar Pradesh (East)
17	Uttar Pradesh (West)
18	West Bengal

(*) Although Mumbai is covered under the Maharashtra Circle License, it is considered as a separate PLMN for Project Planning and execution purposes. However, for all other purposes (like traffic dispersal, intra-circle traffic transport etc), Mumbai is considered a part of Maharashtra Circle.

A generic Cdma2000 Network

The cdma2000 system primarily consists of following basic network -

1. Radio Access Network
2. Core Switching Network
3. Packet Core Network

1. Radio Access Network (RAN)

The Radio Access Network comprises of three network elements -

- **BSC (Base Station Controller):**

  The BSC manages the radio network, handling connections to Mobile Stations including hand-off. It is connected with MSC for providing services to MS (Mobile Station) through BTS. It is also connected to the PDSN (Packet Data serving Node) by the PCF (Packet Control Function) to provide packet data services to the MS. All radio resources are primarily managed by the BSC.

- **BTS (Base Transceiver Station):**

  The BTS is an entity that provides transmission and reception of radio communication for interfacing with the MS on one hand; it is connected with Base Station Controller by wireline or wireless basis (backhaul) on the other hand for providing services to the MS.

- **MS(Mobile Station):**

  MS is the wireless terminal used by subscribers to access the CDMA network over a radio interface. The MS includes portable units, packet data access units, and units installed in vehicles, and fixed Terminals. It is also termed as the Mobile Node (MN) in the context of IP (Internet Protocol) mobility support. In this context the MN is basically any device which features a TCP/IP stack and

supports added functionality that allows it to register its location as it moves from network to network.

2. Core Switching Network (CSN)

The Core network consists of the following elements –

- **MSC/VLR (Mobile Switching Center/ Visitor Location Register) :**

  The MSC provides all of switching and signaling functions for establishing a call from and to MS within a service area as well as different service areas. MSC also establishes connections between the CDMA network and other operators' network. Although the MSC does not directly contribute for packet data calls, but is responsible for the mobility management of the mobile packet data subscriber.

  The MSC also has the VLR function. The VLR contains the information (Users profile, Users location information etc) of subscribers who are attached to the system. It tracks all the active subscribers and keeps a log about their locations to make correct routing of (terminating) calls.

- **HLR/AUC (Home Location register / Authentication Center)**

  HLR is a database that stores and manages subscribers' profiles. It contains all the details of the subscriber information (e.g., Electronic Serial Number (ESN), Mobile Identification Number (MIN), etc. and the restrictions for call making eligibility etc.). All supplementary services that the subscriber subscribes to, too need to be registered in the HLR.

  The HLR, has the AUC function incorporated. The AUC is an entity that manages the authentication information related to the MS. The AUC prevents mobile fraud by "authenticating" subscriber MSs upon registrations, call origination, call termination, and flash request.

3. Packet Core Network (PCN)

The Data Core Network provides packet data switching function in the wireless network. It consists of the following network elements-

- **PDSN (Packet Data Service node)**

  Data from the mobile is encapsulated in generic routing encapsulation and tunneled from the PCF within the BSC to the PDSN, where it is de-capsulated and further processed. The PDSN is the mobility anchor point between the mobile terminal and the PCN.

- **AAA (Authentication, Authorization and Accounting):**

  The AAA is based on RADIUS (Remote Authorization Dial-In-Service), and is analogous to the HLR of the CSN. It contains subscriber packet –data – provisioning information and is used to authenticate and determine the parameters of a subscriber's packet data session.
  AAA also generates "Billing Records (UDRs - - - Usage Data Records)" for packet data usage.

- **HA - FA (Home Agent - Foreign Agent):**

  The FA is the critical entity in the PCN, which makes mobility services available in the network. It is one end point of a HA -FA tunnel that is created when a MN successfully registers with its HA for mobile IP services. The HA which is the other point of the HA – FA tunnel is responsible for attracting traffic destined for the MN and tunneling it to the COA (Care of Address) associated for the MN.

- **Adjuncts:**

  Adjunct systems provide value-added services to the subscribers of the network. These are important network elements since their

services are key service differentiators that the network can provide.

The 'Adjuncts' are:

- **SMS – C (Short Message Service – Center):**

  The SMSC is an entity that provides for relaying, on store-and-forward basis, of short messages between "MS and MS" and between "MS and any other device" capable of handling SMSs.

- **VMS (Voice Mail Service):**

  The VMS is an entity associated with the MSC. The VMS provides facilities to callers for recording voice messages for retrieval later by the CDMA subscribers (who could not attend to the call). The VMS could also support additional services such as fax-mail etc.

- **IWU (Inter Working Unit):**

  The IWU provides protocols and data adaptation between the CDMA System and other networks, such as Internet or PSTN - for circuit switched data and analogue fax services.

- **WIN (Wireless Intelligent Network):**

  The WIN includes Service Switching Point (SSP), Service Control Point (SCP), Intelligent Peripheral (IP), Service Creation Environment (SCE) etc. It supports various features/services like prepaid, VPN, Free phone etc.

OTAF

Over-The-Air Activation or OTA is a procedure by which new or already programmed mobiles can be provisioned in a CDMA network. During the OTA procedure, some or all of the parameters that are stored in the semi-permanent area of the mobile are changed to suit the network to which it is subscribed.

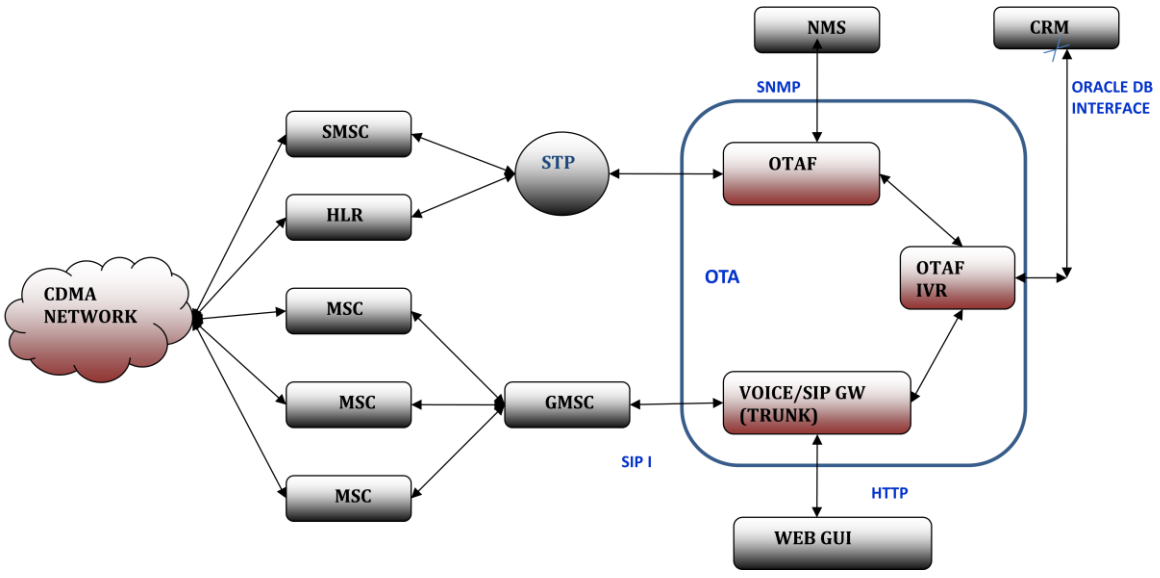
OTAF – Over The Air Functionality Platform has all the features and standards support and as a clear roadmap defined. Built on Trillium (CCPU) Platform, widely used in major telecom products, the OTAF platform enables operator for easy integration with core network elements as well as provides scalability and stability for Telco grade environment.

The OTAF is an entity that interfaces to the NIMS (Number Inventory Management System) backend server to support service-provisioning activities. The OTAF interfaces with the MSC to send to MS orders, which are necessary to complete the provisioning on the handset / Mobile Terminal. The OTAF supports two functions which are: OTASP – Over The Air Subscriber Provisioning and OTAPA – Over The Air Parameter Administration.

Each Network Element has its "local" OMC (Operation and Maintenance Center). The CSC (Customer Support Center) and Business Support System (BSS) are also a part of the network that takes care of Customer Relationship Management, provisioning and billing aspects. "Application Servers" are deployed for offering various services / applications to the CDMA users, and could be considered a part of the ''Network''.

1 System Architecture

Figure shows the network deployment architecture and connectivity for Indus OTAF solution .



The OTASP feature allows a potential wireless service subscriber to activate (i.e., become authorized for) new wireless services, and allows an existing wireless subscriber to make changes in existing services without the intervention of a third party. OTASP enables "Over-The-Air" programming of Number Assignment Modules (NAMs), and optionally, service provider or manufacturer specific parameters (e.g., lock code, call timer).

The OTASP feature has the following objectives:

- To support OTASP on digital systems
- To simplify the service provisioning process for both the user and the wireless service provider.
- To increase efficiency of mobile station NAM programming and reduce the possibility of errors during initial service provisioning
- To enable a potential wireless user to easily choose a desired wireless service provider
- To minimize fraudulent use of the wireless service
- To keep the distribution of the Authentication Key (A-key) secure
- To safeguard user information

The OTAPA is a network-initiated activity, which allows wireless service providers to remotely update operational parameters in Mobile Stations (MS) without user interaction. Typically, OTAPA involves downloading of parameters for a large number of MS. The OTAPA facilitates updating of Mobile Identification Number (MIN) related information and Preferred Roaming List (PRL) in MSs remotely, without the intervention of a third party. OTAPA includes updation of the following:

- A user's Number Assignment Module (NAM)
- Data option parameters
- Roaming lists OTAPA can be performed anytime after the MS has acquired the CDMA service from the service provider and is powered on. This particular activity does not interfere with normal end user operation and it can be terminated at any time due to user call activity. OTAPA does not require a voice dialogue with the service provider's customer service center and thus there is no need of

involvement or interaction with the mobile subscriber during parameter administration.

OTAPA relies on Subscriber Parameter Administration and Security Mechanism (SPASM) to prevent unauthorized programming of the mobile station's operational parameters.

Platform Functionality and Features

OTAF platform provides following major features:

1.1.1 All New Activations and Phone/Device Change

- Automatically configures the Security / encryption credentials, Mobile Phone Number, and Roaming data in the handset WITHOUT the need for Customer Care.
- This can be done directly by the subscriber, or by retail vendor.

1.1.2 Roaming Configuration

- Configures the handsets automatically to allow it to properly roam into other CDMA operators networks.

1.1.3 Open Market Handsets (OMH)

- Allows subscribers to change (buy new handsets) and insert their USIM (CDMA) by automatically configuring the new OMH handset with all appropriate configurations

1.1.4 OTASP (Over the Air Service Provisioning)

- Provides Carriers with a Flexible and Secured mechanism to support activation of the service for new subscribers
- Updating MS Provisioning Information for existing subscribers
- PRL update, A-Key provisioning
- NAM update, MDN update
- Involves subscriber to dial a IVR number (i.e *228#)

1.1.5 OTAPA (Over the Air Parameter Administration)

- Similar to OTASP. Updates the NAM and other parameters on air interface.
- Initiated by Network without involving subscriber)

1.1.6 *228 Calls

- Activation
- Activation using GSK (Get started Kit)
- MIN download/Change
- A key download and SSD update & SPC/SPL generation
- PRL download
- 3GPD parameters
- Handset Change Card

1.1.7 Preferred Roaming List (PRL) Support

- Multiple PRL
- GUI to manage the PRL files
- Upload tool/GUI

1.1.8 Multi-language support on IVR

1.1.9 Device Query

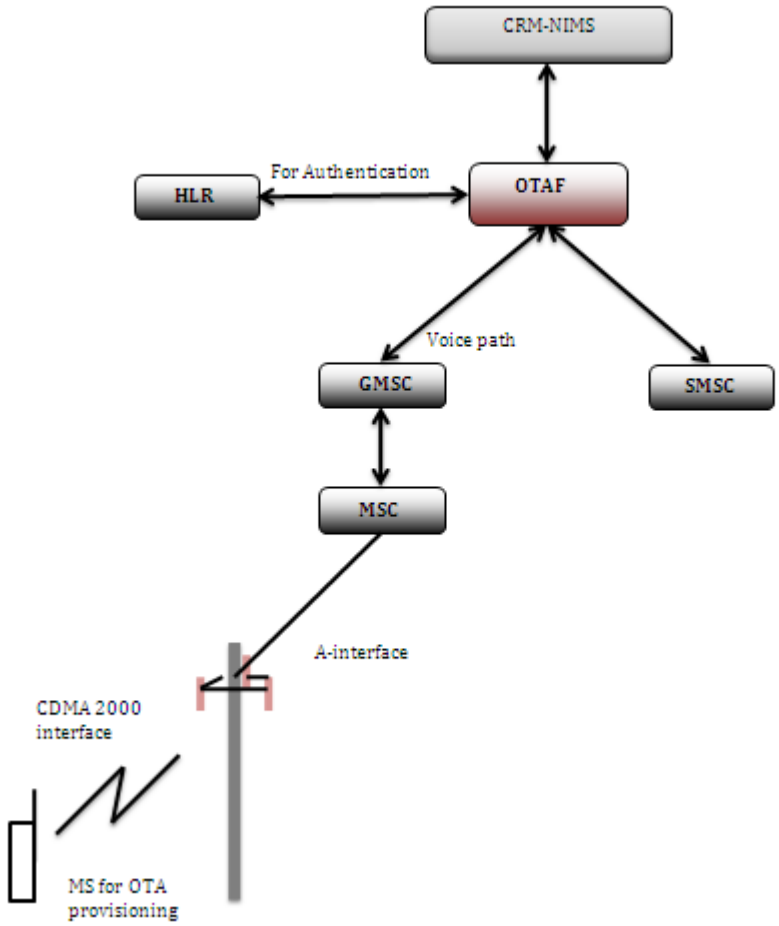
- PRL on handset
- ESN/MEID

2. Network Architecture2.1Overall Network Diagram

In the Reliance Network, there are two OTAFs located at Mumbai and Hyderabad.

The Mumbai OTAF is connected to the STPs at Mumbai and Faridabad and the Hyderabad OTAF is connected to the STPs at Hyderabad and Kolkata. There are 2 OTAF-IVRs in the Reliance network located 1 at Mumbai and other at Hyderabad.Mumbai OTAF-IVR is connected to the Mumbai OTAFand Hyderabad OTAF-IVR is connected to the Hyderabad

OTAF.



Based on the mapping in the OTAF, OTA call is routed to the MSC via STP.

The STP (Signaling Transfer Point)

The SS7 is held together by a digital sister of the switch known as a Signaling Transfer Point. The requirements of voice switching and digital transfer are different, but they resemble each other in some ways. The PSTN requires circuit connections of voice lines.

There is no need for connection in the SS7 network. What is referred to as “circuits” in the PSTN cannot carry messages until the switch makes a physical connection. Instead of circuits, the SS7makes use of transmission lines called links. In concept, at least, these links always exist and are always available to carry messages. Instead of “connecting,” the STP needs only to direct messages to the links which it selects as most appropriate to deliver the message. For example, if an STP has links heading off toward the four compass points, it might be more “appropriate” to direct a message addressed to California to a west-leading link than to an east-leading link. Of course, geography is not always the basis on which the STP will decide where to transfer

incoming messages. Other factors (such as least cost) have an impact on STP routing decisions just as they do in the PSTN. Nevertheless, the STP does not connect to these routes (since it already is connected); instead, it transfers messages to the selected route. You may see STPs illustrated in either of the two ways shown here.

3 Features and Functionalities supported by OTAF platform.

1 Supports for IS-725 and IS-725A.
IS 725 and IS 725 A deals with standard for IVR integration between two nodes.OTAF platform must support IS725 and IS725A protocol support as per CDMA/WCDMA standards. OTAF platform should have definite roadmap to support future versions and respective technologies.
2 Support for IS 683 (Version A to E).
IS 683 series of standards deals with OTASP and OTAPA requirements from OTAF platform therefore it is needed to follow all these versions of IS 683 for launching all OTASP and OTAPA services for CDMA subscriber.
3 *228 call for Activation.
To activate the connection, subscriber dials *228. This call lands on OTAF platform through GMSC interface over TDM/SIP. OTAF will then interact with phone gen database to download the NAM credentials on the handset. This method will be used when the subscriber is pre provisioned in the phone gen database. OTAF platform should support this functionality to activate the subscriber's connection.
4 *228 call for activation using GSK (Get started Kit)
when *228 call lands on OTAF, OTAF platform will forward ESN/MEID to Phone- gen database and based on which Phone-gen will revert with some response code indicating to input 9 digit Pin of Get Started Kit.
5 * 228 Call for MIN download/Change.
In case subscriber needs to download new MIN/NAM parameter, subscriber will initiate *228 call. OTAF platform has to negotiate with Phone gen to capture the NAM/MIN parameter and download them over the air.
6 *228 call for A key download and SSD update & SPC/SPL generation.
In case an existing subscriber cannot get authenticated in the network because of A-key mismatch, A-key needs to be regenerated.
7 *228 call for PRL download.
PRL download is mainly done by the subscriber when subscriber wants to roam in foreign network. To roam in foreign network, subscriber needs to download the foreign network credentials (PRL) into his

handset. For downloading these parameters, subscriber dials *228 which lands on OTAF platform.

8 *228 call for 3GPD parameters.

'3G Parameter Download' parameters are responsible for enhanced data experience in CDMA network.

9 *228 call for Handset Change Card.

Whenever the subscriber does the handset change procedure, OTAF downloads the NAM credentials on the new device after negotiations with Phonegen database.

10 True ESN and TRUE MEID support.

OTAF platform supports the identification of ESN and MEID based devices and passes on these values to Phone gen as it is received from MSC/GMSC. OTAF platform should be able to transact between such devices and phone gen without any problem.

11 Duplicate ESN & Pseudo ESN Identification –

As per the standards of ESN and MEID, When a MEID based RUIM is inserted in ESN based device, CDMA device will generate Pseudo ESN (pESN) and will use the same in all further transaction. In such case, MEID of the device will not come in picture any more. In those cases, there are chances that one or more MEIDs will generate the same pESN. Hence the Phone gen database will contain one pESN against multiple MEID. OTAF plays the different announcement to the subscriber on the response code received for duplicate pESN from Phone gen.

12 Multiple PRL support on the platform.

OTAF platform holds the multiple PRL files in its local database and downloads in the device based on the inputs from phone gen database.

13 GUI to manage the PRL files.

OTAF platform should have a GUI to manage PRL files through which details of PRL –PRL ID, PRL file name, PRL file size, date of creation, date of upload, date of modification etc.

14 Multi-language support on IVR.

OTAF platform can support multiple languages on IVR minimum upto 10 different languages. Ideally there should not be any limit on the file size of the IVR prompt.

15 SSD Update procedure

OTAF platform supports to initiate the SSD update procedure after A key
Regeneration/generation.

16 Query PRL on handset.

OTAF platform have a tool/GUI, to query the already activated devices for extracting the PRL from device.

17 Query for ESN/MEID.

OTAF platform have a tool/GUI, to query the device for extracting ESN or MEID of the device whichever is applicable. In case the device is no

RUIM based, device will return ESN/MEID, if device is RUIM based; device will return UIMID/EUIMID.

18 Query the device with protocol capability/upload protocol capability:

OTAF platform can query the device with protocol capability/upload protocol capability message to extract the make- model of the device and device firmware. Once retrieved from the device, OTAF passes these parameters to the Phone gen database. OTAF can play the different announcement on the error code received from Phone gen on passing the make-model and firmware information.

19 Manual PRL update tool/GUI

OTAF platform supports a GUI/tool to manually push the PRL to device. There is GUI to push the PRL manually to the device using input parameters as MIN/MDN and PRL ID.

20 PRL campaigning tool/GUI

OTAF supports a tool/GUI for campaigning the PRL push to several devices. This GUI have a table in which the MDN and the corresponding PRL ID to be entered and activity of PRL can be started. Such campaigning tool can then be able to publish the success/event report indicating no of successful transactions, no of unsuccessful transactions, total time taken, cause for failure etc.

4 Hardware Details

4.1 Chassis

Single Chassis of HP C7000 for OTAF Platform will be deployed at each site with 11 Blade servers loaded which gives 5 empty blade servers space for future use. The enclosure will have two L3 switches inside for Network connectivity.

4.2 Radware Load Balancer

1+1 will be deployed at each location.

4.3 Space and Power

- 1 42U Rack at each site will be deployed.
- All equipments will run on DC -48V Dual power Supply.
- Attached file gives Power requirement and Rack specs.

BLADE SERVER

- Half height (HH) server
- Intel Xeon 5000 series dual-core, quad-core processors
- 2 ~6 multi CPUs
- Up to 192 GB memory

Layer3 Catalyst switch

10/100/1000BASE-T ports and 4 Small Form-Factor Pluggable (SFP) Gigabit Ethernet port

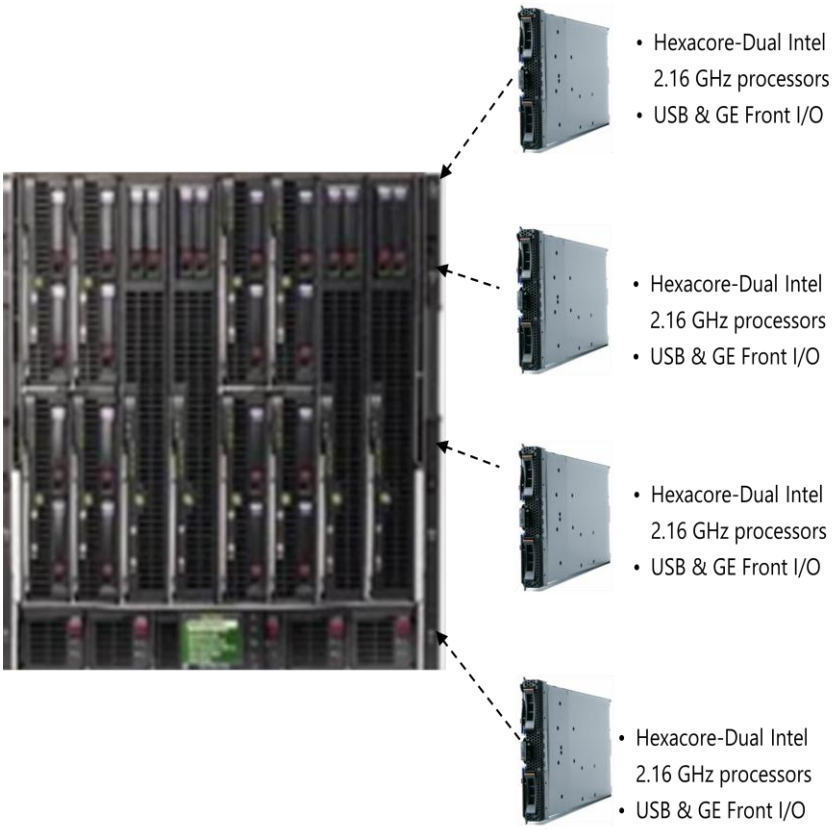
- 8 Gigabit Ethernet uplink ports: 4

VBS (virtual Blade Switch)

- Half-height enclosure
- direct attached and shared storage within a c-Class Blade System
- SAS or SATA disks

Storage Blade

- 10 U chassis , Servers with Intel based CPU
- NEBS Level-3 and ETSI Compliant
- Up to 16 half-height and/or up to 8 full-height server blades and/or storage blades per enclosure
- Redundant hot-plug cooling, redundant hot-plug power supplies, redundant connections.
- Four (4) or Ten (10) Active Cool 200 fans as standard. For redundancy and improved power
- Blade System Onboard Administrator ,Management modules



Application Card (AC)

- Multi-purpose Application Blade
- OTAF Core application Node
- Supports PRL, CPRL , NAM and A-key update procedures
- OTAF Call application logic.
- IT-DB Interface support.

System Manager (SM)

- System Configuration Management
- Centralized OAM (FM, CM, PM)
- Integrated EMS server
- Billing

Signaling Card (AC)

- Multi-protocol Signaling Blade
- SS7, Sigtran, TCAP, MAP, SCCP
- Supports IS-41 with MSC and HLR
- DFT-HA – Distributed Fault-Tolerant, High-Availability

Voice Gateway

- SIP signalling based voice Gateway
- Supports SIP-I/SIP
- Inband/out of band DTMF processing
- Supports IVR functionality
- Supports DTMF digit collection and announcement

5 Reporting

5.1 Web-based GUI Reporting

- Summary of the OTAF statistics
- Daily based, weekly based and monthly based reporting.
- View detailed statistics as per requirements.
- Sample reporting document.