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IPDR BASED BILLING SYSTEM FOR VoIP

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Abstract**:** ***The IPDR is the corresponding record for the IP-based networks. The IPDR organization will produce a specification for the detail record to track network and service usage and facilitate usage-based billing for IP-based network. The specification will also provide a major part of architecture for the measurement of IP-based transactions, and identifying the network resource usage, which will be an important step towards a scaleable billing mechanism element.***

Keywords: **Include at least 4 keywords or phrases and should be in Alphabetical Order.**

I. INTRODUCTION

1.1 PROBLEM DEFINITION

The standards (e.g. CIBER, TAP, EMI) for capturing and transferring accounting and billing information (e.g. CDR for voip) are not sufficient for next generation services; they are either insufficiently flexible to reliably represent emerging services or are proprietary to specific vendors. Hence it is required to make common usage record format and exchange protocol to facilitate the flow of usage information from IP network elements managers to support systems. The proposed system is required to use IPDR packet format for communication and in order facilitate cost effective call detail exchange between mediation system and BSS.

1.1.1. THE RATIONALE BEHIND IPDR INITIATIVE

The key challenge here is to develop interfaces with which various support systems can exchange usage, provisioning and control information with each other. The networks and service industry has now recognized the need for a common method of defining usage data transactions, without which usage-based billing and settling bills between IP operators will be impractical.

The idea central to IPDR initiative is akin to that of CDR (Call Detail Record), which is a record of system events and widely used in telephony world. A CDR is produced every time a user makes a call. Among other information, a CDR contains begin and end times of calls, and identifications of caller and called parties. This information is then used by the billing system to create accounting records and prepare bill.

As shown in Fig.1, there are three 'Description' elements in line 04, 07, 11. The 'Description' element has a completely different meaning related to its location: line 04 is a description for certificate information; line 07 is a description for measurement; line 11is the description for measured results. Information for an XML element is an important aspect and needs to be protected.

VoIP Specifications for New System (IPDR Approach):

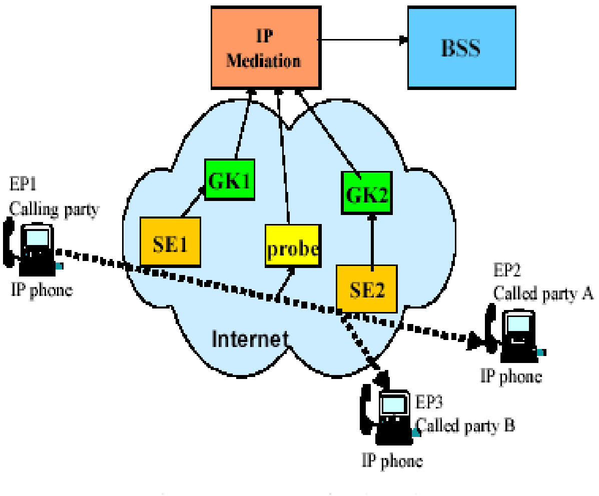


Figure 1. VoIP Service (IP-IP)

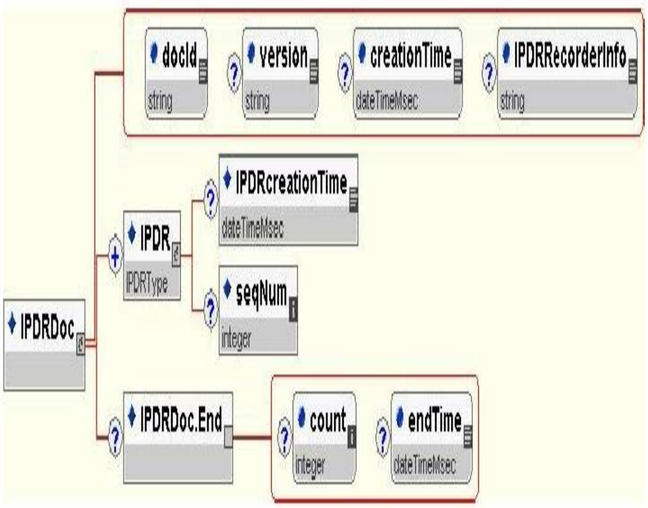
The independent non-proprietary record format. The IPDR packets are XML based record format. The XML record structure and service definitions provide usage information in a consistent, self-describing, human readable format. These structures allow for the creation of documents by one system in a format that can be understood and easily used by another.

The main reason for using XML is that it is widely used for representing business data in technology-neutral and platform independent manner.

As the system is being specified to remain format and protocol neutral, thereby avoiding a single or narrow subset of existing (and/or future) data formats and protocols.

The Standard interface for billing Systems.

The proposed system is using Java Value Type Access Interface which is specified in OSS common IP billing API. The interface is will provide a standardized way to transport Usage Records of any type. This is the easiest way for two IP Billing API applications to exchange the data.



The system is capable of exchange of large sets of Usage Records quickly, thus maintaining adequate throughput.

The system handles the near real-time collection and batch transfer of Usage Records.

IPDR provides one master IPDR Schema that declares common elements in an IP-based service. It starts with a general part defining the properties of the IPDR document (can be seen as a header block). Then a collection of IPDR's can be defined. This is the body of the document. It ends with some end information.

Proposed System

The figure below provides an overview of the system to be designed and implemented. On the left, there is a mediation system which stores IPDR doc. The OSS Common IP Billing API will provide the interface to transfer these Docs from mediation to billing side. The task of locating Mediation system through JNDI Name server , retrieval of IPDR Docs and parsing of usage records are performed by this interface.

The IPDR Doc is XML document in the drawing above and contains one record for each time some user uses service provided by the system (VoIP). These records are the input for the second Java program: OSS Common IP Billing API Program. It read the data records out of the XML document and transfer it to Billing system.

From these XML Based IPDR Document, the system categorize incoming and outgoing calls and total usage duration for each subscriber.Also This document can be used to create separate bills for the users.

The IPDR Doc(IPDR Packet) instance for the above case:

```
<?xml version="1.0"?>
<!-- Assumptions:
Call is being made from IP to IP
Call is terminated (normally) by the called side -->
<IPDRDoc xmlns="http://www.ipdr.org/namespaces/ipdr"            //constant XML name space identifier
xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance           //constant XML schema identifier
IPDRRecorderInfo ="apex.virtualsummit.com"
// Identity of IPDR  recorder
xsi:schemaLocation=http://www.ipdr.org/public/ VoIP3.5-A.0.xsd      //Name Of the SIS specific .xsd file
version="3.5-A.0" docId="f81d4fae-7dec-11d0-a765-00a0c91e6bf6">
<IPDR>
<seqNum>1</seqNum>
//unique number per ipdr within IPDR Doc
<IPDRCreationTime>2000-02-01T07:00:00Z</IPDRCreationTime>
// UTC time   stamp at the time the billing file is created (in ISO format)
<subscriberId>Vendor Phone-1</subscriberId>
 // Tied to a SC or  a SE requesting a service
<ipAddress>172.171.7.10</ipAddress>                          //ipaddress of subscriber
<serviceConsumerType>EU</serviceConsumerType>                // end user
<pin>6294621</pin>
// personal identification  number
<startAccessTime>2000-11-24T09:59:45Z</startAccessTime>
//SC initiate call request
<startTime>2000-11-24T10:00:00Z</startTime>                    //  Time when SC Starts consuming SE
  <endTime>2000-11-24T10:20:00Z</endTime>                    //Time when SC stops using  SE
<timeZoneOffset>-300</timeZoneOffset>
```

```
// Time offset, in minutes, of  local  time zone referenced to GMT
//Number of minutes ahead (+) or behind (-) GMT of the local time zone in which the service is consumed.
<callDuration>1200</callDuration>
//   endTime- startTime.
<type>V</type>                                    //voice
<incomingCodec>G711Alaw</incomingCodec>    //codec signal to convert analog signal to digital and vice
versa
<disconnectReason>normalCallClearing</disconnectReason>
<originalDestinationId>192.168.2.83 </originalDestinationId>  // called party number
<portNumber>17779</portNumber>     //port number utilized for call
</IPDR>
</IPDRDoc>

specific .xsd file

version="3.5-A.0"

docId="f81d4fae-7dec-11d0-a765-00a0c91e6bf6">

<IPDR>

<seqNum>1</seqNum>  //unique number per ipdr within IPDR Doc

<IPDRCreationTime>2000-02-01T07:00:00Z</IPDRCreationTime>

 // UTC time stamp           at the time the billing        file is created  (in ISO format)

<subscriberId>Vendor Phone-1</subscriberId>  // Tied to a SC or a SE requesting a service

<ipAddress>172.171.7.10</ipAddress> //ipaddress of subscriber

<serviceConsumerType>EU</serviceConsumerType>             // end user

<pin>6294621</pin>                                                    // personal identification  number

<startAccessTime>2000-11-24T09:59:45Z</startAccessTime>  //SC initiate call  request

<startTime>2000-11-24T10:00:00Z</startTime>                  //  Time when SC  Starts consuming  SE

<endTime>2000-11-24T10:20:00Z</endTime>                //Time when SC stops using    SE

<timeZoneOffset>-300</timeZoneOffset> // Time offset, in minutes, of  local  time zone referenced to GMT

//Number of minutes ahead (+) or behind (-) GMT of the local time zone in which the service is consumed.

<callDuration>1200</callDuration>                     //   endTime- startTime.

<type>V</type>                                       //voice

<incomingCodec>G711Alaw</incomingCodec>

//codec signal to convert analog  signal to digital and vice versa

<disconnectReason>normalCallClearing</disconnectReason>
```

his

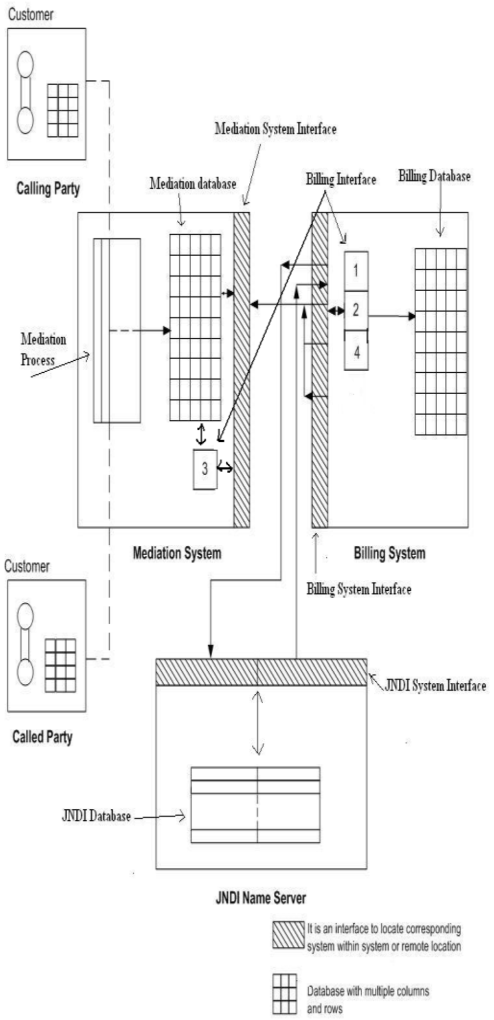


Figure 4.

The figure above provides an overview of the system which is designed and implemented.

Terms used in Diagram:

1. Mediation Process: Call of calling party and called party goes through the Instance of mediation process. Whenever connection goes down either normally or abnormally instance of mediation process stores data into mediation database.
2. JNDI System/Billing System/Mediation System- Interface: These interfaces are used to locate corresponding system within system or outside of system (It means it is located in other computer).
3. Billing Interface: Billing Interface consists of following 4 sub processes. It is numbered as 1, 2, 3 and 4.

1) Entity Discovery: It contacts the JNDI server to locate Mediation system.
2) Capability Negotiation: The system provides the billing system with the interface to determine the usage data and reporting capabilities of the mediation. The parameters are storage capacity, transfer protocols supported by this mediation, usage data format supported by mediation system.
3) Usage Data Availability Event Notification: The mediation creates an instance of usage data available event notification, populating it with the required

parameters, in order fir the billing system to locate and retrieve this usage data.

4) Usage data querying: The system provides the billing system with the interface to locate the mediation, a source of usage information and create the initial linkage to it. The mediation then creates a UsageRecValueIterator instance to represent the result of the query. A reference to this Iterator is sent to the billing system.

4. JNDI/Billing/Mediation Database: It stores particulars related to corresponding processes.
5. Calling party and Called party: There two parties communicate using any physical layer technology
viane of the instances of mediation Process. This instance will update the mediation database after completion of call.
4.2 System Activity
4.2.1 Entity Discovery

For the first time, the system has to locate entity like mediation system. The following shows steps to locate mediation system.

TABLE I

Process Name	Entity Discovery
Actors	Billing system, mediation system, Name Server
Pre-conditions	Address of the Name Server must be obtained before starting transaction.
Begins when	The Billing system sends a query to get a name of the mediation entity that meets the conditions.
Description	The system provides the Billing system with the interface to locate the mediation and a source of usage information. Then create the initial linkage to it.
Ends when	The Name Server returns the address of the mediation Entity.
Exceptions	(1) Designated Name Server is not found. (2) Name Server does not respond.

4.2.3. UsageDataAvailabilityEvent Notification

After call has made, when the usage data are available into the mediation system, it performs the following steps to notify availability of records to billing system

TABLE 2

Process Name	UsageDataAvailabilityEvent Notification
Actors	Billing system, mediation system, Name Server
Pre-conditions	The Billing system is having the reference for mediation system.
Begins when	The mediation detects availability of a new set of Usage Data
Description	The mediation creates an instance of UsageDataAvailableEvent

	notification, populating it with the required parameters, in order for the Billing system to locate and retrieve this Usage Data.
Ends when	The Billing system receives the UsageDataAvailableEvent notification

4.2.4. Usage Data Querying

TABLE 3

Process Name	Retrieval of Usage Records by Querying of mediation
Actors	Billing system, mediation system, Name Server
Pre-conditions	Billing system already has located the mediation Entity.
Begins when	The Billing system issues queryUsageRecords operation on the mediation.
Description	The system provides the Billing system with the interface to locate the mediation, a source of usage information and create the initial linkage to it. The mediation then creates a UsageRecValueIterator instance to represent the results of the query. A reference to this Iterator is sent to the Billing system.
Ends when	The Name Server returns the address of the mediation Entity.
Exceptions	(1) Designated Name Server is not found. (2) Name Server does not respond.

4.3 Algorithm (Imp_Interface):

Perform CDR (call detail record) transmission using IPDR packet through OSS IP Billing API interface. first register mediation and billing system into JNDI name server, locate mediation system, lookup mediation by billing system, making capability negotiation between them and perform querying of IPDR Packets by billing system.

Input.
Call detail records containing voIP usage attributes, subscriberID and IPDR DocID.

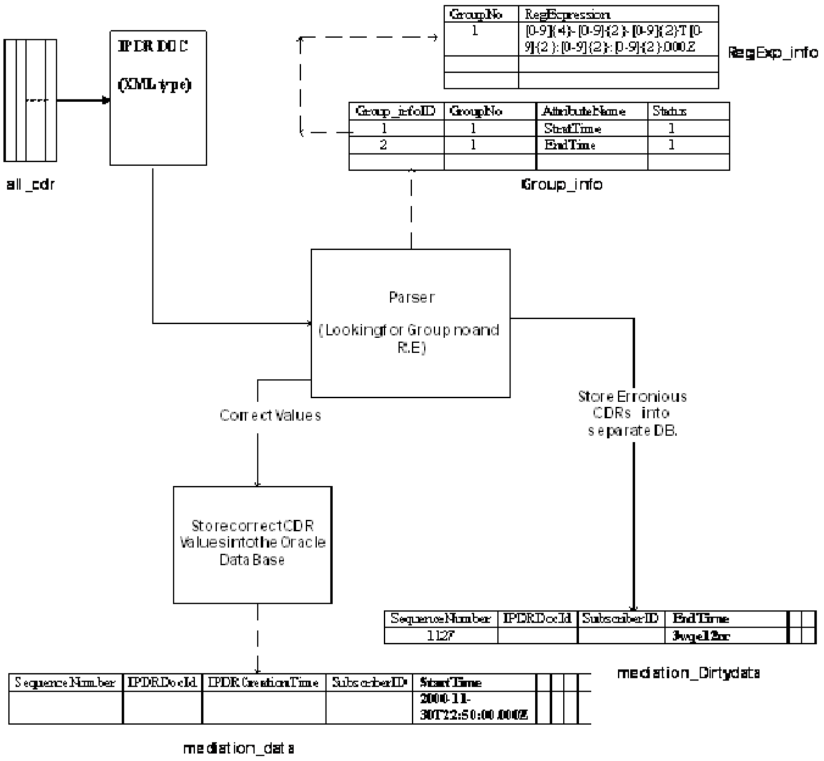
Output.
A IPDR formatted packet per subscriber containing usage records for specified time duration are transferred to billing system's database, separating their incoming and outgoing calls.

Method

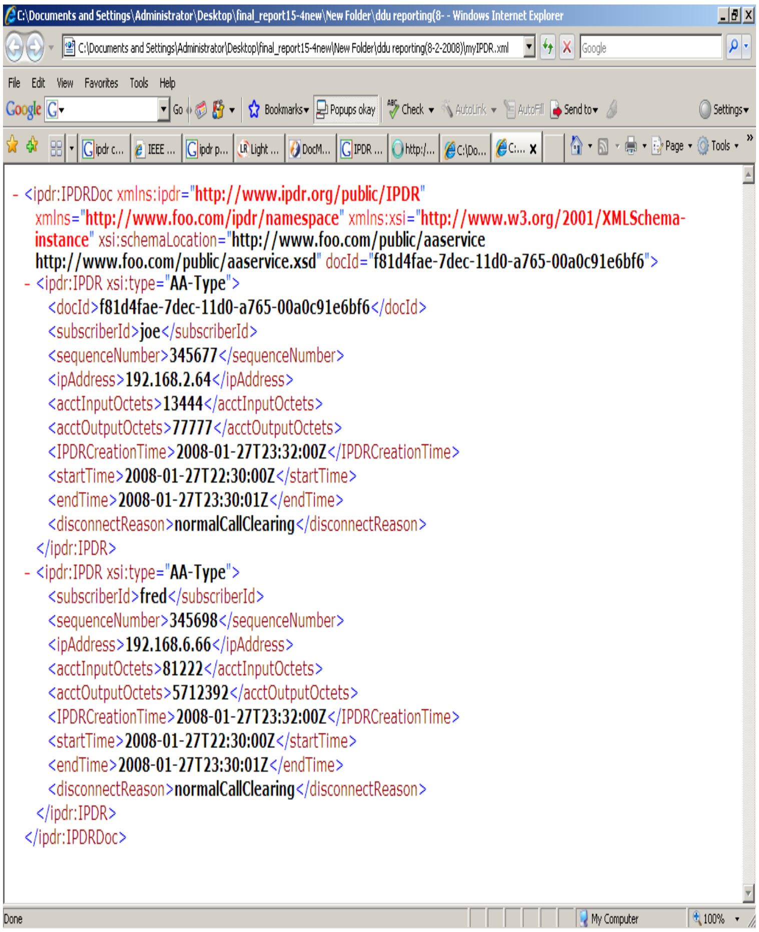
1. Entity Discovery: The Mediation entity is located by requesting Mediation reference to JNDI Name Sever.
2. UsageDataAvailabilityEvent Notification: The mediation creates an instance of Usage Data Available Event notification, populating it with the required parameters, in order for the Billing system to locate and retrieve this Usage Data
3. Usage Data Querying: The Billing system is provided with the interface to locate the mediation, a source of usage information and create the initial Linkage to it.
4. Parsing: The usage information are checked for their format. The values should be consistent and absolute.

5. Retrieval of Usage records: Collect the IPDR formatted usage data at Billing System.

5.1 Implemented model


GroupNo | RegExpression
1 | [0-9]{4}-[0-9]{2}-[0-9]{2}T[0-9]{2}:[0-9]{2}:[0-9]{2}.000Z
RegExp_info
IPDR DOC
(XML type)
all_cdr
Group_infoID | GroupNo | AttributeName | Status
1 | 1 | StratTime | 1
2 | 1 | EndTime | 1
Group_info
Parser
(Looking for Group no and R.E)
Correct Values
Store Erronious CDRs into separate DB.
StorecorrectCDR Valuesintothe Oracle Data Base
SequenceNumber | IPDRDocId | SubscriberID | EndTime
1127 | | | 3wge12sr
mediation_Dirtydata
SequenceNumber | IPDRDocId | IPDR CreationTime | SubscriberID | StartTime
| | | | 2000-11-30T22:50:00.000Z
mediation_data

IPDR Sample record tested on Billing System:


C:\Documents and Settings\Administrator\Desktop\final_report15-4new\New Folder\ddu reporting(8- - Windows Internet Explorer
C:\Documents and Settings\Administrator\Desktop\final_report15-4new\New Folder\ddu reporting(8-2-2008)\myIPDR.xml
Google
File Edit View Favorites Tools Help
Go Bookmarks Popups okay Check AutoLink AutoFill Send to Settings
ipdr c... IEEE ... ipdr p... Light ... DocM... IPDR ... http:/... C:\Do... C:...
Page Tools
Done
My Computer
100%

```
- <ipdr:IPDRDoc xmlns:ipdr="http://www.ipdr.org/public/IPDR"
    xmlns="http://www.foo.com/ipdr/namespace" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
    instance" xsi:schemaLocation="http://www.foo.com/public/aaservice
    http://www.foo.com/public/aaservice.xsd" docId="f81d4fae-7dec-11d0-a765-00a0c91e6bf6">
  - <ipdr:IPDR xsi:type="AA-Type">
      <docId>f81d4fae-7dec-11d0-a765-00a0c91e6bf6</docId>
      <subscriberId>joe</subscriberId>
      <sequenceNumber>345677</sequenceNumber>
      <ipAddress>192.168.2.64</ipAddress>
      <acctInputOctets>13444</acctInputOctets>
      <acctOutputOctets>77777</acctOutputOctets>
      <IPDRCreationTime>2008-01-27T23:32:00Z</IPDRCreationTime>
      <startTime>2008-01-27T22:30:00Z</startTime>
      <endTime>2008-01-27T23:30:01Z</endTime>
      <disconnectReason>normalCallClearing</disconnectReason>
    </ipdr:IPDR>
  - <ipdr:IPDR xsi:type="AA-Type">
      <subscriberId>fred</subscriberId>
      <sequenceNumber>345698</sequenceNumber>
      <ipAddress>192.168.6.66</ipAddress>
      <acctInputOctets>81222</acctInputOctets>
      <acctOutputOctets>5712392</acctOutputOctets>
      <IPDRCreationTime>2008-01-27T23:32:00Z</IPDRCreationTime>
      <startTime>2008-01-27T22:30:00Z</startTime>
      <endTime>2008-01-27T23:30:01Z</endTime>
      <disconnectReason>normalCallClearing</disconnectReason>
    </ipdr:IPDR>
  </ipdr:IPDRDoc>
```

No. Of CDRs	Page load Time(Seconds)	IPDR Doc Generation time(Seconds)	Actual Processed time(Seconds)	Page Termination time(Seconds)
500	3	2	17	2
1000	3	2	18	2
1500	3	2	42	2

The implemented system is tested with large set of Data records. I have considered various scenarios like Records from same subscriber, Records from different subscriber etc. and tested the system. The system processed efficiently on transferred efficiently to billing system.

Actual Processing timings:

CASE 1: various CDRs belong to same subscriber

TABLE I

CASE 2: various CDRs belong to Different subscriber

TABLE I

CASE 3: various CDRs belong to same subscriber with erroneous format

TABLE I

CASE 4: various CDRs belong to different subscriber with erroneous format

TABLE I

No. Of CDRs	Page load Time(Seconds)	IPDR Doc Generation time(Seconds)	Actual Processed time(Seconds)	Page Termination time(Seconds)
500	3	2	19	2
1000	3	2	30	2
1500	3	2	44	2

Conclusion and Future Work

We have proposed a simple but promising method for transmitting call detail records using a global record format from mediation system to BSS. which addresses efficiency and scalability issues . The Algorithm first locates mediation entity from JNDI name server. The Billing system perform lookup for mediation system through JNDI name server. The connection has established for transmission. Once it is done, the Mediation system and Billing system will perform capability negotiation to agree upon CDR format (which is IPDR), packet size, and transfer protocol supported. The mediation system sends DataAvailableEvent notification to Billing System as the IPDR packets for voIP service becomes ready to send. The Billing System then query the records using mediation reference that it already get from JNDI name server.

No. Of CDRs	Page load Time(Seconds)	IPDR Doc Generation time(Seconds)	Actual Processed time(Seconds)	Page Termination time(Seconds)
500	3	2	19	2
1000	3	2	31	2
1500	3	2	45	2

The proposed design is implemented. On Looking statistics coming out from various test cases, it is concluded that the system efficiently works on large bulk of CDRs.The IPDR Doc is created just in 2 seconds even for 1500 CDRs.The system also successfully parse all CDRs comparing with Regular grammars and transfers them to billing system Data resource.

The integration of Authentication and Authorization with Proposed system will be implemented. This will provide security benefits to the system. A part from voIP call detail records, the records of another service (Like Internet usage) used by the same subscriber will be integrated in the same IPDR packet, which gives billing system a huge scalability and efficiency. Still this is the big challenge to implement.

No. Of CDRs	Page load Time(Seconds)	IPDR Doc Generation time(Seconds)	Actual Processed time(Seconds)	Page Termination time(Seconds)
500	3	2	21	2
1000	3	2	31	2
1500	3	2	45	2

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