

Billion PBX

Software Based VoIP PBX

Version 2.0

User Manual

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1. About Billion PBX

Billion PBX – is a software that converts usual office computer into powerful IP-PBX and builds the phone system on your ip-network using SIP protocol. This system will not only allow you to make regular voice calls but also let you implement the wide range of additional features such as call forwarding, voice mail, callback and many others.

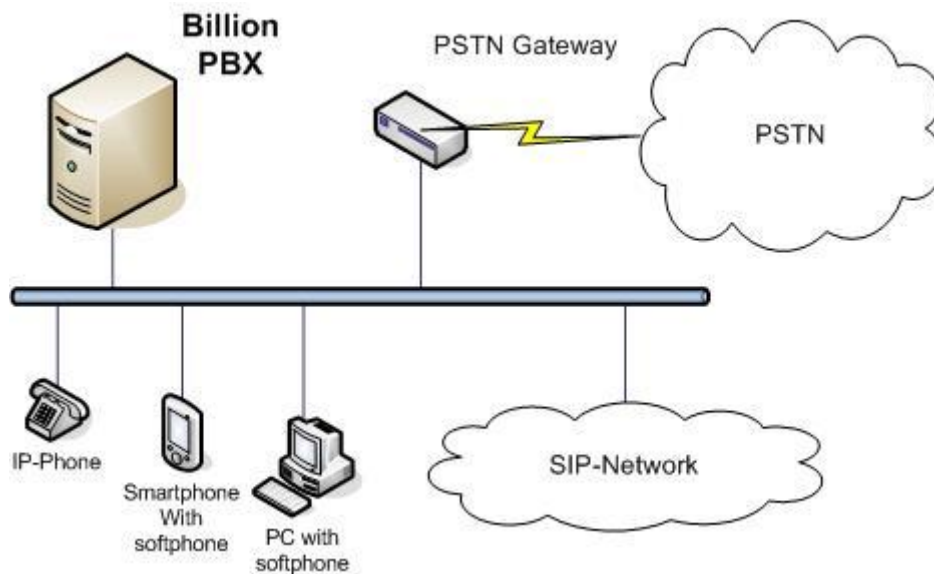


Рис. 1. How Billion PBX works with other VoIP network elements (in general).

Installation and configuration simplicity, low hardware requirements, cross-platform support, flexible licensing policy – this is all about Billion PBX.

Billion PBX has been managed through convenient web-interface both remotely and locally.

Billion PBX can work under the following operating systems:

- Microsoft Windows 2000/XP/2003/Vista/2008,
- Linux,
- FreeBSD.

Key features of Billion PBX:

- SIP subscriber registration,
- Call routing using SIP and H.323 protocols: by priority, by least cost (LCR), by endpoint load, by endpoint availability,
- Call authorization and authentication,

- Advanced call features: various call forwarding, voicemail, call hold, group call, ring back tone, music-on-hold,
- Call recording,
- Callback,
- Subscriber profile management (self-service),
- Call Data Records (CDR),
- Embedded call rating and billing system,
- Interface to external billing system,
- NAT-traversal,
- Interactive Voice Response system (IVR),
- Reporting.

1.1. Subscriber registration

Billion PBX performs registration of subscribers using SIP Registrar protocol. During registration subscriber sends authentication data and its current ip-address. Billion PBX checks for this subscriber in its database and in case of successful authentication adds this subscriber to a list of registered subscribers. Subscribers registered on Billion PBX can accept incoming calls. For outgoing calls registration is not necessary.

1.2. Call routing

Billion PBX routes calls using different rules. Call can be directed to subscriber or to endpoint (terminator).

Calls have been terminated using SIP or H.323 protocols. If several terminators can accept the call it is possible to use different routing rules: static or dynamic.

When using static routing Billion PBX sends calls to terminators in the order set by administrator. If connection was not established using first terminator call will be sent to the next and so on.

In case of dynamic routing Billion PBX chooses terminator during routing process depending on other factors when it accepts the call. Billion PBX supports the following types of dynamic routing:

- By least cost (LCR – Least Cost Routing). Billion PBX determines the cost of call according to rating tables for each terminator and builds a list in the order of ascending prices. Call will be sent to the terminator that has a lowest price for this destination. If connection was not established using first terminator call will be sent to the next and so on.
- By endpoint load. Billion PBX calculates the number of calls currently held by each terminator and chooses the one with minimal number.
- By endpoint availability. Billion PBX calculates the number of free lines on each terminator and chooses the one with maximal number.

- Simultaneously. Billion PBX will send call to all the Endpoints and Subscribers in the list. Connection will be established with the first responded device, rest will receive cancelation.
- Round Robin. Billion PBX will balance load of terminators by the number of served calls.
- By Minimal Duration. Billion PBX will balance load of terminators by the calls duration.

1.3. Call authorization and authentication

Billion PBX authorizes each call came from endpoints or subscribers. Subscriber authentication performs based on authentication data similar to registration process. Endpoints are authorized by ip-address stored in Billion PBX database.

1.4. Advanced call features

Billion PBX allows the following advanced call features:

- Call forwarding to the certain number, auto-responder or voicemail:
 - Unconditional,
 - When busy,
 - When no answer after certain period,
- Call hold,
- Group call,
- Voicemail,
- Ring back tone,
- Music-on-hold.

1.5. Call recording

When necessary Billion PBX can perform call recording saving calls into media-files on the hard disk.

1.6. Callback

In order to significantly reduce the expenses for long distance and mobile calls Billion PBX provides callback mechanism. The cost saving achieved due to the difference between the costs of long distance outgoing mobile call and 2 outgoing voip-calls – 1 to mobile number and 1 to foreign number.

Callback can be initiated through call to Billion PBX using IVR or through http-request. For more details check [Callback system](#) section.

1.7. Subscriber profile management (self-service)

Billion PBX provides subscribers with web-interface for profile management including, for example, call forwarding settings maintenance.

1.8. Call data records (CDR)

Detailed information about each call processed by Billion PBX has been written to text Call Data Record files (CDR-files). These files can be further processed by, for example, external billing system or used for some statistics reporting. Based on CDR-files Billion PBX generates reports. The CDR-files format can be found in [Appendix 1](#).

1.9. Embedded call rating and billing system

Billion PBX provides basic functions for call rating and customer balance control. Administrator can create different rating plans for traffic sale or purchase. Rating plans can also be used for least cost routing. For more details about rating plans check [“Embedded billing”](#) section.

1.10. Interface to external billing system

Billion PBX can be integrated with external billing system using RADIUS protocol. For more details on this topic see [“Integration with external billing system”](#) section.

1.11. NAT-traversal

Billion PBX can successfully work in segmented networks using NAT. To achieve this Billion PBX modifies ip-addresses and ports in media-packets, uses UDP hole punch method etc. For more detail see [“NAT traversal”](#) section.

1.12. Interactive Voice Responses (IVR)

Billion PBX includes powerful script processor for interactive voice menu management. IVR-scripts describes different functions such as: voicemail, callback and others. Billion PBX administrators can create their own IVR-scripts that implements various communication logic. Working with IVR-scripts has been described in the document “Billion PBX. IVR system”.

1.13. Reporting

Billion PBX provides report generation system based on information about processed calls. Administrator can create custom templates including required data. For more details check [“Reporting”](#) section.

2. Software and hardware requirements

Billion PBX works on following operating systems:

- Microsoft Windows XP/2003/Vista/2008/7,
- Linux,
- FreeBSD.

Hardware requirements depends on planning load measured by the number of concurrent calls an whether media-proxy will happen or not. Below is the table of minimal hardware requirements depending on the various load range.

Number of concurrent calls	Minimal hardware requirements
< 64	Pentium IV 1,5GHz/512Mb RAM/10 Gb HDD
64-128	Pentium IV 1,5GHz/1Gb RAM/10 Gb HDD
128-256	Pentium IV 2,6GHz/1,5Gb RAM/10 Gb HDD
256-512	Pentium IV 2,6GHz/2Gb RAM/10 Gb HDD/1Gbit LAN
512-1024	Dual Pentium IV 2,6GHz/4Gb RAM/20 Gb HDD/1Gbit LAN

3. Preparation

Before using Billion PBX you need to install, register and start it. After that Billion PBX must be configured according to your requirements.

It is necessary to know that Billion PBX will require the following ports at first start::

- 1800/tcp – for control panel. If this port is busy Billion PBX will not start.
- 1802/tcp – for subscriber self-service page. If this port is busy Billion PBX will not start.
- 5060/udp – default SIP port. If this port is busy (for example, in case that some other SIP software is installed on this computer) Billion PBX will show the message box when you enter the control panel and will not be able to establish calls using SIP.
- 1720/tcp – default H.323 port. If this port is busy (for example, in case that some other H.323 software is installed on this computer) Billion PBX will show the message box when you enter the control panel and will not be able to establish calls using H.323.

All above mentioned ports can be changed later by administrator.

3.1. Installing Billion PBX

Since Billion PBX can work on any of three operating systems – Windows, Linux, FreeBSD – there is a separate installation package for every operating system.

3.1.1. Microsoft Windows installation

To install Billion PBX on Microsoft Windows open

- **bpbx_windows_en-X.X-X.i386.msi** for 32-bit system or
- **bpbx_windows_en-X.X-X.x64.msi** for 64-bit system

Follow the instructions of installation wizard.

3.1.2. Linux, FreeBSD installation

To install Billion PBX on Linux or FreeBSD you can use RPM-packets **bpbx_linux-X.X-X.i386.rpm** or **bpbx_FreeBSD-X.X-X.i386.rpm**. You will need superuser (root) rights to complete the installation. If your operating system does not support rpm-packets you can use .tar-files instead. This file contains regular archive that you need to extract on your computer.

3.2. Starting and stopping

Billion PBX will start automatically right after installation.

After computer reboot Billion PBX will start automatically on Microsoft Windows. On Linux and FreeBSD you need to make additional configuration to enable auto-start. Put the script **bpbx-start** into the list of auto-starting tasks.

For manual start and stop on Microsoft Windows use Run -> Programs -> Billion PBX -> Start service/Stop service. On Linux/FreeBSD use **bpbx-start** and **bpbx-stop** scripts.

In Microsoft Windows it is recommended to enable automatic recovery of Billion PBX service. On Linux and FreeBSD check the **cron.txt** file for recovery enabling instruction.

4. Configuration and monitoring

Administrator performs configuration and monitoring of Billion PBX through web-based control panel that can be accessed both locally (on the computer where Billion PBX installed) and remotely from LAN or through internet.

To open Billion PBX control panel you need to enter the ip-address of computer where Billion PBX installed and the port number (by default: 1800) into web-browser address field. For example, if you are trying to access Billion PBX control panel locally you need to enter the following: <http://127.0.0.1:1800/>.

Billion PBX control panel consists of several sections that can be divided into following groups:

- Configuration,
- Embedded billing,
- Reporting,
- Monitoring,
- License management.

You can choose required section on the menu panel on the left side of the control panel web-page.

4.1. Control panel: Configuration

Administrator has an access to the most Billion PBX settings through the control panel. Configuration group contains the following pages:

- Subscribers
- Endpoints
- Groups
- Routes
- Routing servers (hidden by default)
- Billing servers (hidden by default)
- General settings
- External database (hidden by default)
- Routing settings
- Billing settings
- H.323 settings
- SIP settings
- CDR settings
- Email
- Advanced settings

Some menu items may be hidden depending on the following settings:

- If **Router type** is "RADIUS" (see **Routing settings** section), item "Routes" will be hidden, but item "Routing servers" will be shown.
- If **Billing type** is "RADIUS" (see **Billing settings** section), item "Billing servers" will be shown.
- If **Billing type** is "Internal" (see **Billing settings** section), items "Rate plans", "Customers" and "Calling cards" will be shown.
- If "Use external database" setting is turned on, items "Subscribers", "Endpoints" and "Routes" will be hidden.

4.1.1. Subscribers

Subscriber is a SIP-client that can register on Billion PBX as on the standard SIP-registrar (SIP-server).

Subscriber information is presented in the table including:

- On – if this box is checked subscriber is active. Otherwise Billion PBX will ignore this subscriber.
- Description – additional information about subscriber in free form.
- Account – SIP-account of subscriber. In fact, this is the phone number of subscriber. IF this field contains the string like 111@192.168.0.1, Billion PBX will authorize this subscriber by ip-address.
- Advanced properties:
 - Login – used for authentication as a user name,
 - Password,
 - Aliases – list of alternative accounts (phone numbers) separated by space, comma or semicolon. Call came to any of listed aliases will be sent to this subscriber.
 - Simultaneous calls limitation – if this number will be reached Billion PBX will send “BUSY” signal in response to new calls to this subscriber.
 - Use DTMF Transfer – if this parameter is checked this Subscriber will be able to perform the transfer of current call using DTMF signal in the following format: *<new number>#
 - Sip Authentication Dialog. Possible values:
 - None – dialog is not happened, Billion PBX gets login and password from unsecure headers,
 - Proxy Authentication Required and WWW Authenticates – Billion PBX sends 407 Proxy Authentication Required message with the WWW Authenticates field,
 - Proxy Authentication Required and Proxy Authenticates – Billion PBX sends 407 Proxy Authentication Required message with the Proxy Authenticates field,
 - Unauthorized and WWW Authenticates – Billion PBX sends 401 Unauthorized message with the WWW Authenticates field,
 - Unauthorized and Proxy Authenticates – Billion PBX sends 401 Unauthorized message with the Proxy Authenticates field.
 - Can close media – this setting shows that this subscriber can close and re-open media-session, for example, when using different codecs for call and for IVR-dialog before the call.
 - Allow INVITE without SDP – this setting allows sending INVITE message without nested SDP-message.
 - Permit early start – if checked Billion PBX will allow media-stream opening before sending OK-message.
 - Permit transcoding – in case of codecs mismatch and in case of existence required codec in Billion PBX it will perform conversion of media-streams.

- Record Call – if checked Billion PBX will record media-session of calls with this subscriber into media-file directory set in [Advanced settings](#).
- Use Account as CLI in Redirect – if checked Billion PBX will forward the call on behalf of this subscriber (not of the calling party).
- Registrars – list of external servers that Billion PBX will register on behalf of this subscriber. This list includes Endpoints that has “Register PBX on this endpoint” setting turned on. You need to choose required lines in the list.
- Using proxy endpoint – if checked then this Subscriber does not require registration. It will work through some Endpoint (as through gateway).
- Net interface – here you can set network interface that will be responsible for this subscriber. This list contains interfaces entered on “SIP settings” page. If this setting is not empty and the call has come from another interface, this call will be refused.
- Groups – here you can choose the groups that subscriber belongs to.
- If **Billing type** is “Internal” (see “Billing settings” section), group “Internal billing” is shown. This group contains field “Customer” that binds subscriber to a customer for billing purposes. For more information see [“Embedded billing”](#) section.
- If **Billing type** is “RADIUS” (see “Billing settings” section), group “RADIUS-billing” is shown. For more information see [“Integration with external billing”](#) section.
- IVR group
 - Voicemail Store IVR Script
 - Voicemail Play IVR Script
 - IVR alerting time, sec
 - IVR establish time, sec
- Profile properties:
 - Don’t disturb – if checked then calls will not be sent to this subscriber.
 - Play service messages – if checked Billion PBX will play messages to the caller if call to this subscriber may not be established by some reason. If not checked there will be no voice messages, Billion PBX will only send signaling SIP-messages that should be interpreted by SIP-device accordingly.
 - Play ring back message – if checked Billion PBX will play ring back tones to the caller during “ringing”. If not checked Billion PBX will only send RINGING SIP-message to the caller.
 - Send mailbox message to email – if checked Billion PBX will send voice messages in wav-files to email addresses set in the “Email addresses” field.

- Email addresses – list of email addresses separated by space or comma.
- Redirection table contains following columns:
 - On, enables call forwarding by this event.
 - Event – what triggers forwarding.
 - To voice mailbox – if checked call will be forwarded to voice mailbox.
 - To number – if this setting is filled and “To voice mailbox” not checked call will be forwarded to this phone number. This setting can also contain URL in the form of sip:111@192.168.0.1.
- Timeout, sec.
- Numbers replacement – for dialed number (or subscriber’s A-number in case of callback) Billion PBX will look for replacement number in this field. If found new number will be used instead of original. This functionality can also be called “Short numbers”. For example, if this field contains “100=777 101=999” than 100 will be replaced with 777 and 101 – with 999 while 102 will not be modified.
- Language – Billion PBX will use IVR-messages of the language set by this parameter.

Advanced and Profile settings have been entered in popup window that shows by clicking the appropriate link. “Accept” button in the popup window will close it. If any changes were made in the popup windows then link “Edit” becomes red. It means that changes were made but not saved yet.

When adding new subscriber or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under subscriber list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.1.2. Endpoints

Endpoint is any ip-host that interacts with Billion PBX and is not a subscriber. For example, a gateway to PSTN or SIP-network can be considered as an Endpoint. Endpoints may send and receive traffic to Billion PBX, thus play originator or terminator role. Besides, IVR scripts may also be a kind of specific Endpoints.

Endpoint can be registered on Billion PBX by SIP protocol or vice versa Billion PBX can be registered on an Endpoint by SIP protocol.

Endpoint information is presented in the table including:

- On – if this box is checked Endpoint is active. Otherwise Billion PBX will ignore this Endpoint.
- Description – additional information about Endpoint in free form.
- Protocol – possible values: SIP/H.323/IVR.

- IP-address or name – if chosen Protocol is SIP or H.323 this field must contain Endpoint ip-address. If chosen protocol is IVR, this field must contain IVR-script file name or sound file name without extension. If Endpoint works as originator and is located behind the NAT this field may contain pair of ip-addresses – internal and external separated by “|”. If this field is empty, user must fill Account/Login/Password in Common properties of the Endpoint to let it get authorized in Billion PBX.
- Common properties:
 - Register PBX on this Endpoint – if checked Billion PBX will register itself on this Endpoint with below mentioned parameters.
 - Account – SIP- or H.323-account that Billion PBX will use to register on this Endpoint.
 - Login – SIP- or H.323-login that Billion PBX will use to register on this Endpoint.
 - Password – SIP- or H.323-password that Billion PBX will use to register on this Endpoint.
 - Simultaneous calls limitation – if this number will be reached Billion PBX will send “BUSY” signal in response to new calls to this Endpoint.
 - Use DTMF Transfer – if this parameter is checked the user of this Endpoint will be able to perform the transfer of current call using DTMF signal in the following format: *<new number>#
 - Permit transcoding – in case of codecs mismatch and in case of existence required codec in Billion PBX it will perform conversion of media-streams.
 - Record Call – if checked Billion PBX will record media-session of calls with this Endpoint into media-file directory set in [Advanced settings](#).
 - Play service messages – if checked Billion PBX will play messages to the caller if call to this Endpoint may not be established by some reason. If not checked there will be no voice messages, Billion PBX will only send signaling SIP-messages that should be interpreted by SIP-device accordingly.
 - Play ring back message – if checked Billion PBX will play ring back tones to the caller during “ringing”. If not checked Billion PBX will only send RINGING SIP-message to the caller.
 - Net interface – here you can set network interface that will be responsible for this Endpoint. This list contains interfaces entered on “SIP settings” page. If this setting is not empty and the call has come from another interface, this call will be refused.
 - Groups – here you can choose the groups that Endpoint belongs to.
 - SIP group (enabled if chosen protocol is SIP):
 - Can close media – this setting shows that this Endpoint can close and re-open media-session, for example, when using different codecs for call and for IVR-dialog before the call.

- Allow INVITE without SDP – this setting allows sending INVITE message without nested SDP-message.
- Domain – this setting allows enabling domain name in the registration message instead of ip-address that some SIP-providers require.
- If **Billing type** is “Internal” (see “Billing settings” section), group “Internal billing” is shown. For more information see [“Embedded billing”](#) section.
 - For originating use calling number instead of customer – if checked customer binding will be ignored and customer will be determined during the call based on calling number (A-number).
 - Customer – this field binds Endpoint to a customer for billing purposes.
- If **Billing type** is “RADIUS” (see “Billing settings” section), group “RADIUS-billing” is shown. For more information see [“Integration with external billing”](#) section.
- Origination properties:
 - Allow originating – if checked Billion PBX will accept incoming calls from this Endpoint.
 - Additional IP-addresses – list of ip-addresses from which Billion PBX will allow incoming calls.
 - Use Display Name as Calling Number –if checked Billion PBX will use Display_Name (“Display_Name” <[sip:A-number@host](#)>) instead of calling number (A-number), no matter if A-number is presented or not. If not checked Display_name will be used only if A-number is not presented.
 - Permit early start – if checked Billion PBX will allow media-stream opening before sending SIP OK-message or H.323 Connect-message.
 - Alerting Mode – possible values: Alerting As Is, Generate Alerting before Progress, Use Alerting instead of Progress, Forbid Alerting after Progress, Generate Alerting before OK.
 - Max Progress – maximum number of Progress messages
 - Q.931 call end reason replacement – the value of this field will be sent instead of received Q.931 value in case of unsuccessful call.
 - Pin-code and password in caller number pattern – may be empty or consist of 2 or 3 characters. If empty Pin-code and password will not be extracted from A-number. If this field consists of 2 characters: first is Pin-code length and second is password length. If this field consists of 3 characters: third character is a separator of Pin-code and password (separator is not included nor in Pin-code nor in password). Second length can be set as “~” that means that the rest of the A-number will be the password. For example, “24” means that first 2 characters are pin-code and 3-6 characters are password. “~4#” means that before “#” is Pin-code and password and after “#” is the caller number, and 4 last characters before “#” are password.

- ANI translation rule – this field sets the translation rule of A-number in the call that comes from this Endpoint. The syntax of this field is described in [“Billing settings”](#) section.
- Caller number translation rule – this field sets the translation rule of B-number in the call that comes from this Endpoint. The syntax of this field is described in [“Billing settings”](#) section.
- Initial DTMF digits for caller – this is the string of DTMF-signals that will be sent to this Endpoint as soon as connection will be established.
- Language – Billion PBX will use IVR-messages of the language set by this parameter.
- IVR group:
 - Use call back – if checked Billion will activate callback mechanism when call from this Endpoint will come. In that case Billion PBX will refuse incoming call and will originate the call back to the A-number according to the routing plan. For more details see [“Callback system”](#) section.
 - Callback delay, sec – pause between initiating call acceptance and sending call to the user.
 - IVR called number and IVR script file name – if call will come from this Endpoint with this B-number Billion PBX will execute this IVR-script. This script will run before billing balance control and thus here is the place for subscriber IVR-authorization, for example, when calling cards are used.
 - IVR alerting time and IVR establish time, sec. – this interval is required for providing comfort communication between subscriber and Billion PBX. If it’s too short subscriber may be not ready to hear the message.
 - IVR maximum time, min – maximal duration of IVR script.
 - Use PROGRESS instead of OK – if checked Billion PBX will use “Progress” message instead SIP “OK” message of H.323 “Connect” message.
- SIP group (if chosen protocol is SIP):
 - Call end reason replacement – in case of unsuccessful call this value will be used instead of received call end reason value.
- H.323 group (if chosen protocol is H.323):
 - Progress Indicator for PROGRESS and ALERT.
 - Media Wait For Connect.
- Termination properties,
 - If chosen protocol is SIP or H.323:

- Stop on busy – if checked Billion PBX will stop routing process if it receives “Busy” signal after sending call to this Endpoint. If not checked Billion PBX will try this number on another Endpoint according to routing plan. It is recommended to switch this setting off if you are not sure that “Busy” signal from this Endpoint is correct.
 - ANI translation rule – this field sets the translation rule of A-number in the call that will be sent to this Endpoint. The syntax of this field is described in [“Billing settings”](#) section.
 - Called Number Translation Rule – this field sets the translation rule of B-number in the call that will be sent to this Endpoint. The syntax of this field is described in [“Billing settings”](#) section.
 - Initial DTMF digits for callee – this is the string of DTMF-signals that will be sent to this Endpoint as soon as connection will be established.
 - Permit redirection – if this setting is turned off Billion PBX will ignore TRANSFER commands received from this Endpoint.
- Codecs limitation. Possible values: None/Include only selected/Exclude all selected. If “None” is chosen this setting will be ignored. If “Include only selected” is chosen Billion PBX will accept only calls with one of selected codecs. If “Exclude all selected” is chosen Billion PBX will ignore selected codecs from the list of codecs suggested by Endpoints. It is important to understand that existence of codec in this list does not mean the possibility of transcoding using this codec. To perform transcoding codec library should be installed in Billion PBX.
 - Preferred codecs. Codecs will be sorted according to this table before sending the codec list to the terminating Endpoint.
 - Protocol parameters:
 - For IVR:
 - IVR alerting time and IVR establish time, sec. – this interval is required for providing comfort communication between subscriber and Billion PBX. If it’s too short subscriber may be not ready to hear the message.
 - IVR maximum time, min – maximal duration of IVR script.
 - Use PROGRESS instead of OK – if checked Billion PBX will use “Progress” message instead SIP “OK” message of H.323 “Connect” message.
 - For SIP:
 - Transport – possible values: UDP/TCP.
 - For H.323:

- H.323 limitations – you can choose one or more values from the following list: Forbid fast start/Forbid H245 tunneling/Forbid H245 in setup.
- Telephone number plan,
- Telephone number type,
- Telephone number presentation,
- Telephone number screening.

Advanced, Origination and Termination settings have been entered in popup window that shows by clicking the appropriate link. “Accept” button in the popup window will close it. If any changes were made in the popup windows then link “Edit” becomes red. It means that changes were made but not saved yet.

When adding new Endpoint or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under Endpoint list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.1.3. Groups

Groups allow binding Subscribers and Endpoints creating virtual areas. Using Groups you can separate Subscribers and Endpoints since routing has been done only between members of the same Group. If you don’t use Groups routing restrictions are not applied. Every Subscriber or Endpoint can be included in more than one Group.

Group information is presented in the table including:

- On – if checked Group is available.
- Name – Group name in free form hat will be shown in Subscriber and Endpoint properties.

When adding new Group or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under Group list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.1.4. Routes

Billion PBX uses routes to forward calls that are not directed to Subscribers. If dialed number (B-number) does not match any Subscriber account or alias Billion PBX will try to send this call to one of the routes.

Routes bind dialed number (B-number) to Endpoint that plays the terminator role in this case. Route information is presented in the table including:

- On – if this box is checked Route is active. Otherwise Billion PBX will ignore this Route.

- Description – additional information about Route in free form.
- Prefix– this field contains prefix of dialed number (B-number) determining call destination. For example, if this field contains 7812~ it means that all the calls with dialed number beginning from 7812 will be sent to this Route. Character “~” here means “any number” after entered prefix. If this field contains only “~” all the calls will be sent to this Route. If there are no “~” character in this field only calls with exact match of dialed number and prefix will be sent to this Route. At the right of this field there is a button that calls additional prefix properties dialog:
 - Sub Prefixes Limitation – possible values: None/Include only/Exclude all of.
 - Sub Prefixes – list of sub prefixes separated by space or line carrier without “~” character. Limitation mode in field above is applied to this list.
 - ANI Limitation – possible values: None/Include only/Exclude all of.
 - ANI – list of A-numbers, separated by space or line carrier. Limitation mode in field above is applied to this list.
- Number Translation Rule – this field sets the rule of dialed number (B-number) changing during call routing. Character “~” used in this field means “dialed number without prefix”. For example, Route Prefix is “12~” and Number Translation Rule is “45~78”. If Billion PBX receives call with dialed number “12345” then according to this rule transformed dialed number will be “4534578”: prefix “12” will be dropped, character “~” between 45(~)78 will be replaced with number without prefix – 345. The following table contains more examples of how this rule works:

Prefix	Number Translation Rule	Dialed number received from originator	Dialed number sent to terminator
~	~	12345	12345
12~	~	12345	345
~	00~	12345	0012345
12~	00~	12345	0012345
12~	~67	12345	34567

Besides, this field may contain macro **{CALLED_NUMBER}** that places A-number into dialed number (B-number). For example:

A-number	Number translation rule	Dialed number received from originator	Dialed number sent to terminator
12345	~={CALLED_NUMBER}	777	12345
12345	~={CALLED_NUMBER}	777	777(12345)

- Termination properties
 - Endpoints and Subscribers – this list binds the Route to Endpoints and Subscribers. Every Route may be directed to more than one Endpoint and Subscriber. Besides Called number may be set in this table – this number will be sent directly to terminator. Also there can be several Routes with the same prefix. Exact structure of routing table is up to Billion PBX administrator.
 - Call mode – possible values:
 - By order – Endpoints and Subscribers will be picked according to the order in the list.
 - Simultaneously – call will be sent to all the Endpoints and Subscribers in the list. Connection will be established with the first responded device, rest will receive cancelation.
 - Round Robin – terminators will be sorted as if “By order” method is chosen but Billion PBX will store the information about last terminator and the next call will be sent to the next terminator by order. This method provides balancing of terminators load by number of served calls.
 - By Load – call will be sent to Endpoint or Subscriber that currently process the lowest number of calls.
 - By Availability – call will be sent to Endpoint or Subscriber that currently have highest number of available lines.
 - By Minimal Duration – call will be sent to terminator that has minimal total duration since the start of Billion PBX. This method provides balancing of terminators load by the calls duration.
 - By Least Cost – call will be sent to Endpoint or Subscriber that has the lowest price for this destination (available only if **Billing Type** is “Internal”).
 - Loss Blocking – this setting is available only if Billing Type is set to “Internal”. If this setting is checked Billion PBX will control that sell price will be higher than buy price.
 - Ring Back Tone File
 - Number of cycles – number of full cycles that Billion PBX will try to send the call on this Route. Cycle includes one attempt through every Endpoint and Subscriber included in this Route.
 - Pause between cycles, sec. – waiting time between cycles.
 - Max ringback duration, sec. – this value will overwrite corresponding value in [Advanced Properties](#).

- Simultaneous calls limitation – if this number will be reached Billion PBX will send calls to the next Route with matching prefix.
- Stop hunting on this route – if checked Billion PBX will not proceed to the next Route if terminator will refuse connection. In that case Billion PBX will send appropriate error code to call originator.

Termination settings have been entered in popup window that shows by clicking the appropriate link. “Accept” button in the popup window will close it. If any changes were made in the popup windows then link “Edit” becomes red. It means that changes were made but not saved yet.

When adding new Route or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under Route list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.1.5. Routing Servers

Billion PBX can communicate with external routing servers using RADIUS protocol. To enable working with external routing server **Router type** should be set to “RADIUS” (see [“Routing Settings”](#) section). In that case internal routing is disabled and page “Routes” became unavailable.

Billion PBX can work with several external routing servers simultaneously. Connection will be established with the first available server from the list from top to bottom. The following settings are common for all the servers in the list:

- Response timeout, sec – waiting time till repeating request.
- Request retries – number of attempts.
- Use auxiliary servers – if checked Billion PBX will send requests to all the servers at once.
- User Name – Billion PBX will use this parameter for authentication on external routing servers.
- Password – Billion PBX will use this parameter for authentication on external routing servers.

Routing Server information is presented in the table including:

- On – if this box is checked Routing Server is active. Otherwise Billion PBX will ignore this Routing Server.
- Description – additional information about Routing Server in free form.
- IP-address.
- Password– «secret» in RADIUS terms.
- Access port – port for Access command.

- Accounting port – port for Accounting command.

When adding new Routing Server or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under Routing Server list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.1.6. Billing Servers

Billion PBX can communicate with external billing servers using RADIUS protocol. To enable working with external billing server **Billing type** should be set to “RADIUS” (see [“Billing Settings”](#) section).

Billion PBX can work with several external billing servers simultaneously. Connection will be established with the first available server from the list from top to bottom. The following settings are common for all the servers in the list:

- Response timeout, sec – waiting time till repeating request.
- Request retries – number of attempts.
- Use auxiliary servers – if checked Billion PBX will send requests to all the servers at once.
- User Name – Billion PBX will use this parameter for authentication on external routing servers.
- Password – Billion PBX will use this parameter for authentication on external routing servers.

Billing Server information is presented in the table including:

- On – if this box is checked Billing Server is active. Otherwise Billion PBX will ignore this Billing Server.
- Description – additional information about Billing Server in free form.
- IP-address.
- Password– «secret» in RADIUS terms.
- Access port – port for Access command.
- Accounting port – port for Accounting command.

When adding new Billing Server or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under Billing Server list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.1.7. General Settings

This page contains following parameters:

- Admin Username – if empty Billion PBX does not perform authorization at opening control panel.
- Admin Password.
- Viewer Username – with this username Billion PBX will allow viewing control panel in read-only mode.
- Viewer Password.
- Log Level – this setting determines how much information Billion PBX will write into log-file (“BPBX Log.txt” for Windows or “bpbx.log” for Linux/FreeBSD). When problem with call processing happens it is recommended to set this parameter to “Debug3” and send created log-file to Billion PBX technical support service.
- Log File Max Size, Kb – this is the maximal size of the log file. When this size is reached Billion PBX will create a new log file “BPBX Log XX.txt” or “bpbxXX.log”, where XX is a file number.
- Log File Count Limit – number of log files that Billion PBX creates. When this number is reached Billion PBX deletes oldest file.
- HTTP port – port for control panel access, default: 1800.
- HTTP interfaces – network interfaces from which control panel is available.
- User HTTP port – port for self-service web-page, default: 1802
- User HTTP interfaces – network interfaces from which self-service web-page is available.
- Status Page Refresh Interval – default value for refresh delay on status pages (calls, subscribers, etc). This value can be changed directly on the status page.
- Use External Database – if checked Billion PBX will use external database as a source of configuration information about Subscribers, Endpoints and Routes. All corresponding sections in menu will be unavailable. Also CDR information will be written in external database. For more details see [“Working with external database”](#) section.

Press “Accept” button to save changes. If HTTP port was changed Billion PBX should be restarted.

4.1.8. External Database

This section is available if “Use External Database” is checked on “General Settings” page. For more details see [“Working with external database”](#) section. This section contains parameters of connection to external database.

- JVM Library Path – for example, `c:\Program Files\Java\jdk1.6.0_03\jre\bin\client\jvm.dll`
- Class Path – path to `bpbx.jar` file and JDBC-driver libraries. For example, `c:\Program Files\ProfInfoTech\Billion PBX\bpbx.jar; ./msbase.jar; ./mssqlserver.jar; ./msutil.jar`

- JVM Options – this setting may contain one or more options necessary for driver operations.
- Driver – JDBC-driver class file, used for database access. For example, `com.microsoft.jdbc.sqlserver.SQLServerDriver`
- Url – address line that driver uses for database access. For example, `jdbc:microsoft:sqlserver://server:1433;DatabaseName=bpbx;SelectMethod=cursor`
- Login – for database access.
- Password – for database access.
- Initial number of connections. Default: 2.
- Maximum number of pending connections. Default: 10.
- Maximum number of connections. Default: 50.
- Partition length in called number. If this parameter is 0 Billion PBX will not extract partition from dialed number.

Press “Accept” button to save changes.

4.1.9. Routing Settings

This section contains the following settings:

- Router type:
 - Internal
 - RADIUS
- Called Number Translation Rule – this parameter sets the template of changing calling number in the call. The syntax of this setting described in [“Billing settings”](#) section.

After modifying any settings press “Accept” button to save changes.

4.1.10. Billing Settings

In this section the following Billing types can be chosen:

- None – “Route plans”, “Customers” and “Calling cards” pages are unavailable. Billion PBX will not perform call rating and balance control.
- RADIUS – Billion PBX will communicate with external billing system using RADIUS protocol. For more details see [“Integration with external billing system”](#) section. There you will also find the description of additional parameters from this page for this Billing type.

- Internal – Billion PBX will activate embedded billing system. For more details see [“Embedded billing system”](#) section. There you will also find the description of additional parameters from this page for this Billing type.

Press “Accept” button to save changes.

4.1.11. H323 Settings

This section contains the list of interfaces that Billion PBX will use for accept incoming calls on H.323 protocol. By default calls are accepted on all available interfaces on 1720 port.

Press “Accept” button to save changes.

4.1.12. SIP Settings

This section contains the list of interfaces that Billion PBX will use for accept incoming calls and registration requests on SIP protocol. By default calls are accepted on all available interfaces on 5060 port.

The following common parameters are available:

- Realm – this field will be sent in authentication requests in “realm” field. Default: BPBX.
- Registrar Expires Time, min – duration of registration. After this period Subscriber or Endpoint should send repeating registration request.

Press “Accept” button to save changes.

4.1.13. CDR Settings

This section contains the following parameters responsible for CDR collection:

- Save to – possible values: File/External database
- Consider useless calls – unsuccessful calls will be collected also
- CDR File Creation Interval – this is the frequency that Billion PBX will use to create new CDR-files. Billion PBX writes current calls into a file with **.current** extension. After the entered period this file will be copied into constant file and **.current**-file is becoming empty. Constant file has following format: <year>_<month >_<day >_<hour>_<minute >_<second >.bpbx-cdr, for example, 2010_10_02_10_45_21.bpbx-cdr.
- CDR Files Folder – absolute or relative (from Billion PBX installation directory) path.
- CDR Files Type – extension of CDR-files, by default: **.bpbx-cdr**. Files will be renamed with with extension after copying from **.current**-file. Any extension is allowed.
- CDR File Format – field separator. Possible value: CSV(comma delimited)/Table (tab delimited).
- Date Format.
- Time Interval Format – possible values: Hours:Min:Sec/Seconds only.
- Write Field Names – if checked Billion PBX will write field names in the first lines of every CDR-file.

- Fields – fields selected in this list will be written to CDR-file.

Press “Accept” button to save changes.

4.1.14. Email

Billion PBX allows email notifications. This page contains the following parameters:

- SMTP-сервер – SMTP-server ip-address for outgoing messages,
- Address From – Sender name,
- Server Requires Authentication,
- Account,
- Password.

Press “Accept” button to save changes.

4.1.15. Advanced Settings

This page contains following parameters:

- Max dialing duration, sec.
- Max ringback duration, sec.
- Max call duration, min.
- Playing exhausted money message time, sec.
- TCP base.
- TCP max.
- RTP base.
- RTP max.
- NAT Traversal Mode – possible values: None/ NAT External Address/STUN server. For more details see [“NAT Traversal”](#) section.
- NAT External Address – external ip-address of network gateway if NAT Traversal Mode set to “NAT External Address”.
- STUN Server Address – ip-address of STUN server if NAT Traversal Mode set to “STUN Server”.
- Always Require Authentication for Incoming – if checked Billion PBX will authenticate Subscriber on every incoming call even if it has already passed authentication during registration process.
- Use regular expressions for number translation rule – if checked then in order to use “+” character in number translation rule use should enter “\” character before. For example, translation rule for

number +12345 may look like \+1~. If this setting is not checked then “+” may be used without any additions.

- Monitor Call – if checked Billion PBX will check media-stream existence and cancel call in case of media-stream disappearing.
- Maximum % of CPU loading – if this number will be reached no more calls will be accepted. It is recommended to set this parameter not higher than 80% to avoid loss of responsiveness in case of large number of incoming calls.
- Amount Rejected for Bouncer – number of unauthorized requests received by Billion PBX from the same IP-address. Upon reaching this number such IP-address will be placed into “black list” (/logs/bouncer.txt file). This file may be used by administrator to create firewall rules.
- Period Rejected for Bouncer, sec – period of calculation of unauthorized requests to make a decision about “black list” inclusion.
- Folder for Recorded Calls – Billion PBX will write wav-files with calls into this directory. File format: <year>_<month>_<day>_<hour>_<minute>_<second>_<millisecond>><call id>_<A-number>_<B-number>.wav. For example, 2010_10_03_18_22_43_477d3a65_2_3.wav. Files are in PCM-format, stereo. Left channel – originator, right channel - terminator.
- Calling Cards Folder – directory for storing files related with calling cards management.
- Sub Folder for Recorded Calls – possible values: None/ANI/Called Number/ANI_Called Number. This field allows to organize recorded calls storage on hard disk.
- IVR Default Language – this setting determines the language for IVR-scripts and wav-files. Each language has its own sub-folder in “ivr” folder.
- Service Messages group – this group contains names of files for various service messages. Files can be of two types: .wav or .xml. Wav-files are used for simple message playback. If more complicated logic is required that xml-files should be used.
 - IVR Folder – this parameter shows where ivr files have been stored. This directory contains xml-files while wav-files have been placed in wav sub-directory.
 - No User Message File.
 - No Money Message File.
 - No Route Message File.
 - Internal Error Message File.
 - Exhausted Money Message File.
 - Ring Back Tone File.
 - Music On Hold File.

- Subscriber Offline Message File.

Press “Accept” button to save changes.

4.2. Embedded Billing System

Billing system embedded in Billion PBX provides basic functionality for call rating and customer balance control. This billing system is intended to work with limited number of customers not exceeding several hundreds. For larger projects it is recommended to use external billing system.

Embedded Billing System supports two popular business models:

- Billing of Subscribers,
- Calling Card Billing.

Below is the description of used terms:

- Rating Plan – named table of prices for various call destinations. Rating Plan may be used both for call rating and for least cost routing.
- Customer – company or an individual that has a money balance in Billion PBX Embedded Billion System. Customer can be a traffic seller or buyer for Billion PBX owner. Endpoints and Subscribers are bound to Customer. During call processing Billion PBX checks and modifies Customer’s balance according to Rating Plans set for the Customer. If Customer sells traffic to Billion PBX owner then Endpoints bound to this Customer are terminators and this Customer should have **Rating Plan for Selling**. If Customer purchases traffic from Billion PBX owner then Endpoints bound to this Customer are originators and this Customer should have **Rating Plan for Purchasing**.
- Calling Card – accounting unit with money balance. Calling Cards are managed by batches. Information about calling cards has been stored in external text files. For every Calling Card batch **Rating Plan for Purchasing** should be set.

If Embedded Billing System has been enabled and there are some errors in configuration Billion PBX will not be able to accept calls by the “Internal Error” reason.

Typical scenario for new Subscribers or Endpoints creation with Embedded Billing System is following:

1. Create a Rating Plan and fill the table of destination prices.
2. Create a Customer and assign a Rating Plan for Selling or Purchasing.
3. Create a Subscriber or Endpoint and choose appropriate Customer in Common Properties.

Typical scenario for new Calling Card batch creation with Embedded Billing System is following:

1. Create a Rating Plan and fill the table of destination prices.
2. Create a text file with Calling Card information (for details about file format see [“Calling Cards”](#) section).
3. Upload text file setting the Rating Plan on the “Calling Cards” page of Billion PBX control panel.

On the page “Billing Settings” the following additional parameters are available when you choose “Internal” Billing Type:

- Enable Balance Notification – if checked Billion PBX will send information about Customer balance in response to registration request in the field “Billion-balance”.
- Currency – if “Enable Balance Notification” is checked Billion PBX will send this value in response to registration request in the field “Billion-currency”.

In Billion PBX control panel there are following sections related with Embedded Billing System (by default these sections are hidden – they are shown if Billing Type is “Internal” on “Billing Settings” page):

- Rating Plans
- Customers
- Calling Cards
- Import
- Export

4.2.1. Rating Plans

This section contains the list of Rating Plans used by Customers and Calling Cards. Rating Plan information is presented in the table including:

- Description – description of Rating Plan in free form.
- Name – unique name of Rating Plan that will be shown for selection.
- Routes. Clicking this link will open popup-window with destination prices including following:
 - Description – name of destination in free form.
 - Prefix – destination prefix. Empty prefix means “all destinations”. Comparison of B-number and prefix starts from longest prefix. For example, if there are prefixes 7812 and 7, B-number 78125428518 will be rated for 7812 prefix.
 - Rate of Minute – cost of 1 minute for this destination. Rates per second.
 - Rate of Message – cost of message for this destination.
- Advanced Properties
 - Free Time, sec – free interval from the call beginning.
 - Billing Step, sec – minimal rating period. By default, the value is 1 that means “each second”. For example, if this field will have value “60” it will mean “every minute”.

- Call Back First Leg Count Mode – possible values: Count All/Count Only Conversation/Don't Count.

“Accept” button in the popup window will close it. If any changes were made in the popup windows then link “Edit” becomes red. It means that changes were made but not saved yet.

When adding new Rating Plan or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under Rating Plan list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.2.2. Customers

Customer information is presented in the table including:

- On – if checked Customer is active. If not checked Billion PBX will ignore this Customer and it will not be available for selection in Endpoint or Subscriber properties.
- Name – unique customer name.
- Advanced properties:
 - Aliases – different billing names can be bound to the single customer.
 - Groups – list of groups that customer belongs to.
- Rating Plan for Selling.
- Rating Plan for Purchasing.
- Balance – current Customer's balance. This value has been modifying automatically.
- Balance Control – if not checked Embedded Billing System will work only do call rating without checking money availability on this Customer's account.
- Web – password to self-service web-page.

When adding new Customer or changing existing one it is necessary to choose appropriate value in the column “Action” – “Add” or “Keep”. If you choose “Copy” the contents of a corresponding line will be copied in the bottom line of the table for the subsequent editing.

Pressing “Accept” button under Customer list will save all changes. You can modify several rows at once. “Accept” button will save all of them.

4.2.3. Generate Calling Cards

In this section user creates calling card packages for further use. The following data should be entered:

- Cards Amount

- Balance
- Activity Period from Activation, days
- Absolute Expiration Time
- PIN Code Length
- Tariff Plan

The result will be placed into “BPBX resource folder\callingcards\newcardsX.csv” file.

In this file every card is presented as a single line with the following fields separated by comma:

- Name – card number
- Balance – starting balance (with dot as a decimal separator)
- Absolute Expiration Time
- Activity Period from Activation – number of days since activation
- Password – PIN-code
- Tariff Plan

This file contains reference data intended, for example, for physical cards producing.

Besides, file endedcardsX.csv has been created. This file contains information for cards management presented by the following fields separated by comma:

- Name – card number
- Tariff Plan
- Balance – current balance (with dot as a decimal separator)
- Activation Time
- Activity Period from Activation
- Absolute Expiration Time
- Removal Time

4.2.4. Import

This section allows uploading calling card information from external text file into Billion PBX.

Rating Plans

Load should be done from text files. Data in these files is presented as blocks separated by empty line. Each block contains information about one Rating Plan. First line is the header and contains the following information about Rating Plan (separated by “;”):

- Description
- Name
- Free time, sec
- Billing Step, min.

Rest lines of block contain destination prices including following fields separated by comma:

- Description
- Prefix
- Rate of Minute
- Rate of Message

Calling Cards

To upload calling cards information to Billion PBX choose Rating Plan and file with data. In the file each line describes one calling card. This line contains following fields separated by comma, semi-colon, space or tab:

- Pin-code
- Balance with “.” as decimal separator,
- Absolute activity period,
- Activity period from activation,
- Password to self-service web-page.

Allowed time format – 2010/03/12 (12 March 2008), allowed interval format – 720:0:0.0 (720 hours).

4.2.5. Export

This section allows download the information about Rating Plans and Calling Cards from Billion PBX to external file.

If Rating Plan field is empty Billion PBX will download information about all Rating Plans.

File format is the same as described in previous section.

4.3. Reporting

Following sections provides reporting functionality:

- Reports

- CDR-files.

4.3.1. Reports

Billion PBX generates reports based on information stored in CDR-files or CDRs in external database.

Report is a table where each line represents one call. Shown field list and the range of records are customized by the user.

Reports page contains two sections:

- Patterns,
- Report Generation.

Section “Patterns” contains the list of report patterns. Each pattern contains the following fields:

- Name,
- From Time – starting date/time.
- To Time – ending date/time.
- Limitation – value for filtering. This value will be applied to the field selected in Advanced properties described below.
- Advanced properties – opens popup-window with the field list and selection of the field to apply limitation.

Report Generation section contains list of Patterns and button “Run Report”. Generated report will be shown in popup-window.

4.3.2. CDR Files

Billion PBX allows CDR files downloading through the control panel.

CDR Files page contains a table where each row represents one CDR-file. Name of CDR-file is a link. User can download the file by right-clicking on the name and choosing “Save object as...”. With then link on the right column selected CDR-file can be deleted from Billion PBX. Administrator can create file remove.bat in Billion PBX installation directory. This file will be executed with chosen file name as parameter. This way CDR-files can be moved to some archive location.

Link “Remove All” deletes all CDR files.

4.4. Control Panel: System Monitoring

Billion PBX control panel provides following pages for system monitoring:

- Subscribers Status
- Status on Registrars
- Calls Status

- Statistics
- Benchmarks
- Log Files

4.4.1. Subscribers Status

Information about current status of Subscribers and Endpoints is presented in the table including following columns:

- Type – possible values: S – Subscriber, EP – Endpoint,
- Description,
- Account,
- IP-address,
- Creation time,
- Time to live.

Refresh period can be changed manually (default: 10 sec).

4.4.2. Status on Registrars

Information about current status of registration of Billion PBX on external SIP-servers is presented in the table including following columns:

- Type – possible values: BPBX – Billion PBX и S – Subscriber (transparent registration),
- Description,
- Account,
- IP-address,
- Creation time,
- Time to live.

Refresh period can be changed manually (default: 10 sec).

4.4.3. Calls Status

Current page contains the list of calls currently passed through Billion PBX including the following columns:

- Elapsed time
- Caller number (A-number)
- Originator – signaling and media ip-addresses of originator and used protocol

- Originator's codec
- Callee number (B-number)
- Terminator – signaling and media ip-addresses of terminator and used protocol
- Terminator's codec
- State – possible values
 - Routing – gathering routes list,
 - Dialing – calling current terminator,
 - Waiting for response,
 - Connected – connection established but media-streams are not ready,
 - Call – call in process,
 - Disconnection – connection is closing.
- Action – call interruption button.

Refresh period can be changed manually (default: 10 sec).

4.4.4. Statistics

This section contains consolidated data about originators, subscribers, terminators and routes activities. To enable data showing check needed boxes:

- Subscribers origination
- Subscribers termination
- Endpoint origination
- Endpoint termination
- Routes
- Route termination

Statistic data is represented in 3 tables:

- By Subscribers
- By Endpoints
- By Routes

Tables by Subscribers and Endpoints contains following columns:

-
- #
 - Name
 - Period
 - Origination All calls
 - Origination Max calls
 - Origination ASR,% - share of successful calls in total number of calls initiated by this Subscriber or Endpoint
 - Origination ACD – average duration of calls initiated by this Subscriber or Endpoint
 - Origination PDD – Post Dial Delay
 - Origination short calls, % - share of short calls in total number of calls initiated by this Subscriber or Endpoint
 - Termination All calls
 - Termination Max calls
 - Termination ASR,% - share of successful calls in total number of calls terminated by this Subscriber or Endpoint
 - Termination ACD – average duration of calls terminated by this Subscriber or Endpoint
 - Termination PDD – Post Dial Delay
 - Termination short calls, % - share of short calls in total number of calls terminated by this Subscriber or Endpoint

Table by Routes contains following columns:

- #
- Name
- Period
- All calls
- Max calls
- ASR,% - share of successful calls in total number of calls terminated on this route
- ACD – average duration of calls terminated on this route
- PDD – Post Dial Delay

- Short calls, % - share of short calls in total number of calls terminated on this route

4.4.5. Benchmarks

This section contains information about resources used by the system.

At the top of the page user can set the page refresh frequency (by default – 10 second). Also here is the general information about CPU, memory and operating system.

Below is the table of resources that is regularly refreshed with following data:

- Active calls,
- Change calls – number of started and finished calls since last measurement.
- Rejected over CPU calls – number of calls rejected by Billion PBX because maximum allowed CPU load was reached. In this case originator will receive response depending on protocol used: 480 Temporality not available for SIP or Q.931 41dec Temporary Failure for H.323.
- CPU usage, %,
- CPU idle, %,
- Memory usage, %,
- Threads,
- Sockets.

Below is the statistics since the start of Billion PBX:

- Total working time, Total CPU time, Network traffic, Total calls duration,
- Calls:
 - All,
 - Successful,
 - Rejected over CPU,
 - Rejected over authentication,
 - Rejected over limitation,
 - Rejected over license,
 - Failed,
 - More than 5 minutes duration.

4.4.6. Лог-файл

Log-file contains all the information about Billion PBX working and problems that happened. Administrator can set the log depth and the number of log-files created. When more than 1 log-file is used Billion PBX prompts for

4.5. License Page

This section is intended for activation of license for Billion PBX.

4.6. Store-Retrieve Configuration

Using this page administrator may perform configuration backup and restore operations.

At the top of the page there is a button “New Configuration Store”. Pressing this button creates new ini-file containing current configuration information. This file appears in the table.

The following operations may be applied to every file in the table:

- Retrieve – pressing this link restores configuration from this file. If Internal billing is activated, at the top of the page there is a checkbox – “Retrieve Calling Cards and Customers Balance”. If it is checked customers and calling cards balances will be also restored from the file, otherwise this data will not be overwritten.
- Store – pressing this link will overwrite this file with current configuration information.
- Remove- pressing this link deletes file.

5. Self-service web-page

Billion PBX provides the following functionality for customers and subscribers through self-service web-page:

- Profile management page – subscriber can modify profile parameters described in [“Subscribers”](#) section.
- Balance page – this page is available for customers when internal billing is enabled. On this page customers can view balance information and the list of calls made by bound subscribers and endpoints.
- Calling card page – this page is for calling card owner and available if embedded billing is enabled.

Self-service web-page can be accessed through the special port (by default, 1802). This port can be changed on the [“General settings”](#) page. For example, <http://127.0.0.1:1802>. Before opening self-service web-page Billion PBX performs user authentication. According to entered login and password Billion PBX decides which self-service page should be shown. User name and password for different page types are set:

- For profile management page – user name and password are SIP login and password of appropriate Subscriber set in Subscriber’s properties.
- For balance page – user name and password set in [“Customers”](#) section where user name is “Description” and password is “Web-password”.
- For calling card page – user name is the card number and the password is PIN-code.

6. Integration with external billing system

Billion PBX can be integrated with external billing system using RADIUS protocol. This can be enabled in [“Billing settings”](#) section. **Billing type** should be set to “RADIUS”. For this billing type the following additional parameters can be set:

- Billing Leg – possible values:
 - Answer – interaction performed only for Billion PBX – Terminator leg.
 - Originate – interaction performed only for Originator – Billion PBX.
 - Answer and Originate – interaction performed for both legs.
- AAA Mode – billing usage mode:
 - Authentication, Authorization, Accounting – Billion PBX will request external billing for customer authentication, call permission and send the report about consumed resources (call duration).
 - Authentication, Authorization – Billion PBX will request external billing for customer authentication and call permission.
 - Accounting – Billion PBX will send the report about consumed resources (call duration).
- Use as subscriber username – this setting sets the field that will be sent to external billing as a subscriber username. Possible values:
 - Default – value of the field “Default user name” (see below) will be used.
 - Login – subscriber’s login will be used.
 - Description – subscriber’s description will be used.
 - Account – subscriber’s account will be used.
- Use as subscriber password – this setting sets the field that will be sent to external billing as a subscriber password. Possible values:
 - Default – value of the field “Default password” (see below) will be used.
 - Password – subscriber’s password will be used.
 - Description – subscriber’s description will be used.
 - Account – subscriber’s account will be used.
- Use as Endpoint username – this setting sets the field that will be sent to external billing as a Endpoint username. Possible values:
 - Default – value of the field “Default user name” (see below) will be used.

- Login – Endpoint’s login will be used.
- Description – Endpoint’s description will be used.
- Calling number – ANI field will be used if call will come from Endpoint. This value should be used if Endpoint work as gateways for subscribers that are not internal Billion PBX subscribers (for example, PSTN-subscribers).
- Calling IP– Endpoint ip-address will be used.
- Use as Endpoint password – this setting sets the field that will be sent to external billing as an Endpoint password. Possible values:
 - Default – value of the field “Default password” (see below) will be used.
 - Password – Endpoint’s password will be used.
 - Description – Endpoint’s description will be used.
 - Calling number – ANI field will be used if call will come from Endpoint. This value should be used if Endpoint work as gateways for subscribers that are not internal Billion PBX subscribers (for example, PSTN-subscribers).
 - Calling IP– Endpoint ip-address will be used.
- Default login.
- Default password.
- Called number translation rule – this parameter contains two sections separated by “=”. First part is a number template, second – translation rule. Number will be changed if it matches the template. Template may include digits and special characters: “.” – means any digit and “~” means any number of any digits but not empty string. Rule may contain the same characters as a template but the special characters group should be exactly the same as in template. In that case the part of called number matching the special characters will be put on the place of these characters in the number. More than one rule can be entered separated by comma or semicolon. Here are some examples:

Rule	Called number	Result
.....=7812.....	5428518	78125428518
8~=7~	88125428518	78125428518
~=5428518	123456	5428518
~=	123456	
=5428518		5428518

- Interim update interval, min – if this parameter is not set **AAA-method for Interim Update** setting is ignored.
- Interrupt calls on failed Accounting.

The configuration of access of Billion PBX to external billing servers can be done in [“Billing servers”](#) section.

7. Callback system

Billion PBX provides callback mechanism allowing users to reduce long distance and mobile calls cost. Cost reducing happens, for example, due to difference between cost of 1 outgoing long distance call from mobile number and 2 outgoing internet calls.

Billion PBX supports 3 ways of callback activation:

- http-request,
- Interactive Voice Response (IVR),
- SMS-request.

7.1. Callback through http-request

This method is especially convenient in case of integration of Billion PBX and 3rd party software – for example, web-site or SMS-server.

Billion PBX accepts GET-request of the following form:

http://127.0.0.1:1800/StartCallBack?from=ivr:NAME&to=tel:NUMBER&billing-user=BILLING_USER&billing-password=BILLING_PASSWORD&id=CALL_ID&groups=GROUP1,GROUP2&wait=disconnect|connect|route&maxCallDuration=IN_SECONDS

Upon receiving such request the following script works:

1. Billion PBX authenticates user by “billing-user” and “billing-password” settings and in case of success goes to the next step.
2. Billion PBX dials **NUMBER** presented in “to” parameter.
3. When call is answered Billion PBX plays IVR-script **NAME** presented in “from” parameter. IVR-script may accept input parameters, for example:

```
ivr:CallBack.xml,tel:called-number
```

In that case called-number parameter stores destination phone number and Billion PBX will not establish dialog. Instead it will immediately dial this number.

4. During IVR-script run Billion PBX may perform user authorization, for example, checking if funds on the balance are enough to make this call. In case of success Billion PBX proceeds to the next step.

5. Billion PBX establishes connection with dialed number and may also reduce funds on the balance for this call.

Parameter “wait” maybe presented with the following possible values: *disconnect*, *connect* or *route*. In that case Billion PBX will wait for appropriate event before returning web-page.

If access to control page is protected with password Billion PBX will perform authentication in response of GET-request:

```
HTTP/1.1 401 Unauthorized
Date: Wed, 13 Sep 2006 08:57:45 GMT
Server: PWLib-HTTP-Server/1.0 PWLib/1.0
MIME-Version: 1.0
Connection: Keep-Alive
Content-Type: text/html
Content-Length: ??
WWW-Authenticate: Basic realm="BPBX"
```

In that case it is necessary to include “Authorization” field in the message header:

```
Authorization: Basic AUTHENTICATION_PARAMETER
where AUTHENTICATION_PARAMETER – is a string “login:password” encoded by Base64 method.
HTTP/1.1 200 OK
Date: Wed, 27 Sep 2006 11:53:26 GMT
Server: PWLib-HTTP-Server/1.0 PWLib/1.0
MIME-Version: 1.0
Connection: Keep-Alive
Content-Type: text/html
Content-Length: 2
OK
```

During run of this script Billion PBX performs different checks that may fail. In that case in response of http-request Billion PBX will send error message with the following possible values:

- LicenseLimitation_or_CPUOverload – call attempt with maximum number of licensed concurrent calls reached or maximum CPU load reached,
- Caller – error in IVR-script,
- NoUser – user not found or password is incorrect,
- NoMoney – not enough funds to make this call,
- NoRoutes – no routes to establish “first leg” (from Billion PBX to initiator),
- NoBilling – no connection with billing system.

7.2. Callback through IVR

This method allows callback functionality without any 3rd party software. There are two basic scripts:

- Callback based on A-number

- Callback with PIN-code

7.2.1. Callback based on A-number

This script works when you know all the phone numbers from which your customers will do the callback. For example, these are mobile phones of your colleagues or clients making long distance calls. Internal billing may be optionally enabled.

This is the approximate script:

1. Subscriber calls from mobile phone 1112223 to the access number 345678.
2. Call is accepted by the PSTN-gateway, forwarded to VoIP and sent to Billion PBX.
3. Billion PBX reads A-number in incoming call and cancel it without answering.
4. If internal billing is enabled Billion PBX search for customer with 1112223 number. In case of success Billion PBX dials this subscriber (1112223) according to routing table.
5. Subscriber accepts the call from Billion PBX and answers. Billion PBX runs IVR-script and requests destination number.
6. Subscriber enters destination number by DTMF-signals.
7. Billion PBX opens "second leg" establishing connection with destination number according to routing table.
8. Billion PBX connects both legs and the conversation of subscriber and its destination number starts. In fact there are 2 calls in that moment: from Billion PBX to subscriber and from Billion PBX to destination number.

7.2.2. Callback with PIN-code

This script is applied, for example, in case of building callback system based on pre-paid cards, when you don't know the A-numbers of your clients.

This is the approximate script:

1. Subscriber calls from mobile phone 1112223 to the access number 345678.
2. Call is accepted by the PSTN-gateway, forwarded to VoIP and sent to Billion PBX.
3. Billion PBX makes outgoing call to received A-number according to routing table.
4. Subscriber accepts the call from Billion PBX and answers. Billion PBX runs IVR-script and requests PIN-code.
5. Subscriber enters PIN-code by DTMF-signals.
6. Billion PBX searches for active calling card with entered PIN-code and in case of success requests destination number from subscriber.

7. Subscriber enters destination number by DTMF-signals.
8. Billion PBX opens “second leg” establishing connection with destination number according to routing table.
9. Billion PBX connects both legs and the conversation of subscriber and its destination number starts. In fact there are 2 calls in that moment: from Billion PBX to subscriber and from Billion PBX to destination number.

7.3. Callback through SMS-request

Billion PBX can initiate incoming call with the series of short messages sent to service number. This scenario is similar to [Callback based on A-number](#) but in that case incoming message (SIP message) plays the role of the first call. Destination number is presented in the message body. If no destination number is presented in the message Billion PBX will establish IVR-session to request destination number.

8. Working with external database

All Billion PBX configuration data is stored:

- Under Microsoft Windows: in registry or “bpbx.ini” file.
- Under Linux/FreeBSD: in “bpbx.ini” file.

In large-scale projects including thousands of storing information units it is recommended to use external database server. Database server can be placed both on the same computer with Billion PBX and on dedicated server. Billion PBX interconnects with external database server by JDBC protocol.

If external database is used following objects are stored in it:

- Subscribers
- Endpoints,
- Registration statuses,
- Embedded billing objects,
- CDRs.

The specific of using external database is that Billion PBX currently does not provide user interface to manage its content. Thus administrator should use 3rd party software to maintain database. For example, RDBMS PostgreSQL and pgpAdmin tool may be used for that purpose.

The database structure in the form of SQL-script is presented as a separate document “Billion PBX. External database structure”. There can be also found comments about database fields usage and their possible and recommended values. The examples of connection parameters can be found in [“External database”](#) section.

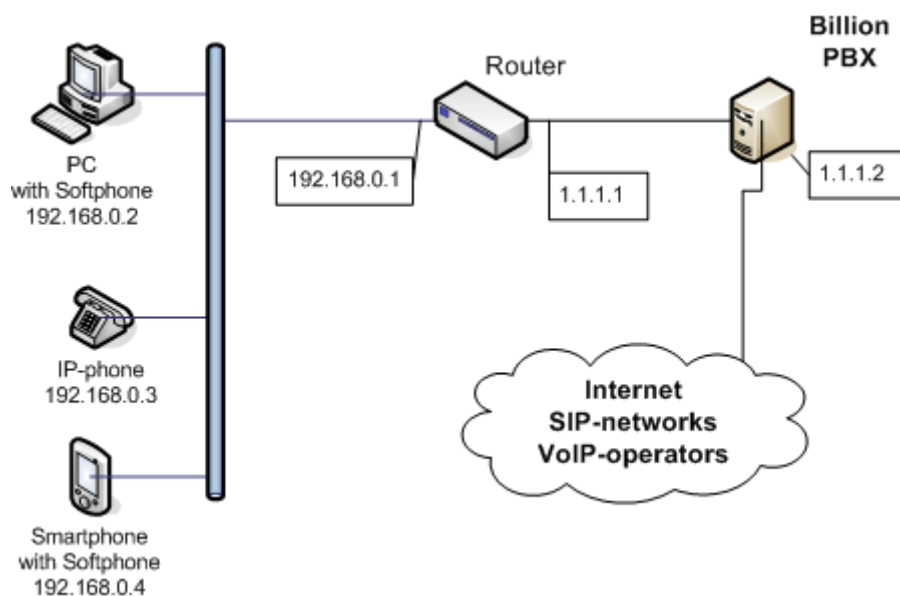
9. NAT traversal

Billion PBX can work in segmented networks with NAT implementation. Following scenarios are possible:

- Billion PBX is in external network while some subscribers and originators/terminators are behind the NAT.
- Billion PBX is behind the NAT (in internal network) while some subscribers and originators/terminators are in external network.
- Billion PBX is installed on the server that performs NAT functionality, some devices on other side some on another.

9.1. Billion PBX in external network

The following picture illustrates this scenario:



In this example Billion PBX has a public ip-address 1.1.1.2. The network that Billion PBX works with is behind the NAT that has a public ip-address 1.1.1.1 and internal ip-address 192.168.0.1. Subscribers served by Billion PBX have internal ip-addresses 192.168.0.x.

9.1.1. From subscriber to external network

Subscribers from internal network may call to external network with use of STUN-server. In that case Billion PBX works with subscriber as with public host and does not take any extra actions. If subscriber does not use STUN-server Billion PBX determines NAT presence and does following:

- If UDP is used as a transport (in most cases) Billion PBX responds to signaling messages to the public NAT ip-address instead of "contact" ip-address.
- Upon receiving first media-packet from subscriber Billion PBX starts sending back media-stream to public NAT ip-address instead of the ip-address from signaling message.

9.1.2. From external network to subscriber

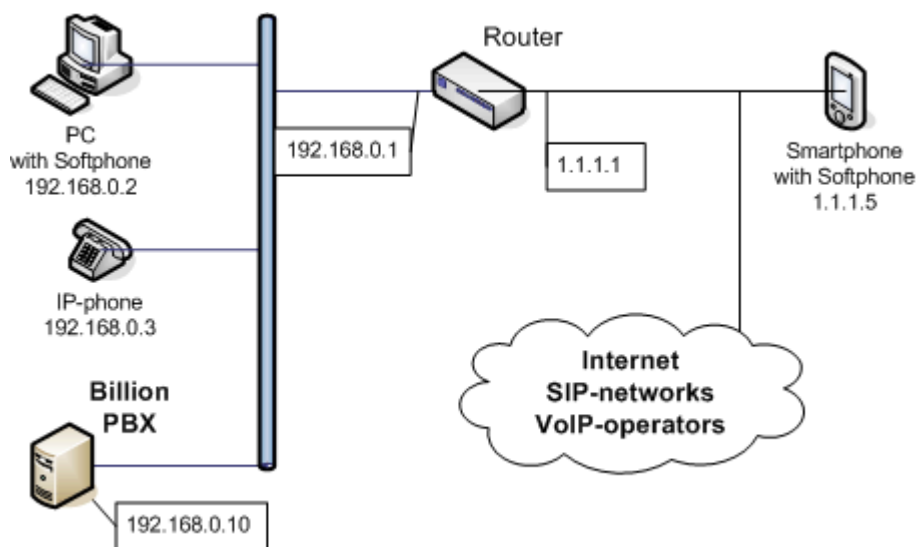
If subscriber uses STUN-server then as in previous case Billion PBX works with subscriber as with public host.

If subscriber does not use STUN-server Billion PBX determines NAT presence and does following:

- At subscriber's registration Billion PBX reminds ip-address of the sender (NAT public ip-address). All the calls intended to this subscriber are sent to this ip-address. If NAT closed the port since last registration call will not be established.
- Upon receiving first media-packet from subscriber Billion PBX starts sending back media-stream to public NAT ip-address instead of the ip-address from signaling message.

9.2. Billion PBX in internal network

The following picture illustrates this scenario:



In this example Billion PBX has an internal public ip-address 192.168.0.10. The network where Billion PBX installed is connected to internet through the NAT with public ip-address 1.1.1.1 and internal ip-address 192.168.0.1. Subscribers served by Billion PBX may be both inside the network with ip-addresses 192.168.0.x and outside the network, for example, with ip-address 1.1.1.5.

9.2.1. From subscriber to external network

If terminator in the public network supports NAT traversal (by analogue with [9.1](#)) then everything should work.

Otherwise there are following options of NAT traversal:

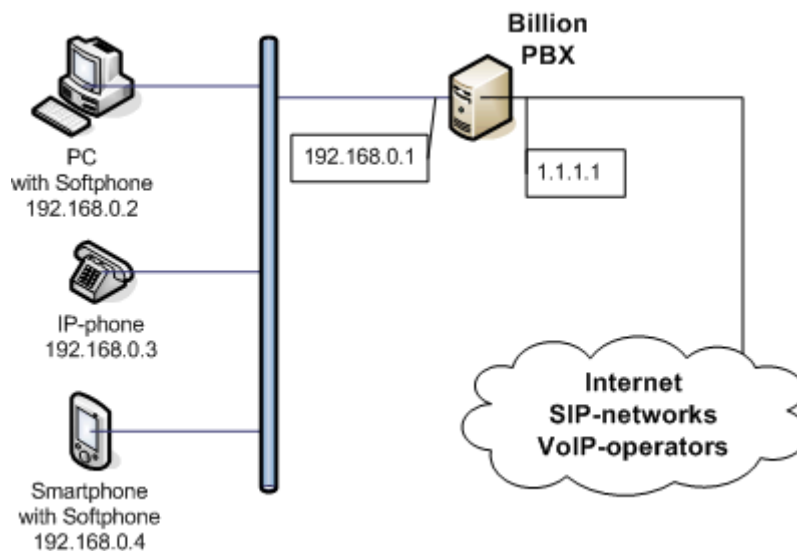
- In Advanced settings choose "NAT External address" for **NAT traversal mode** and enter respected value in **NAT external address**. Also it is necessary to configure network router to forward all the signaling and media packets coming to external NAT address to internal address of computer with Billion PBX. This option may be used only if Billion PBX administrator have an access to network router configuration.
- In Advanced settings choose "STUN server" for **NAT traversal mode** and enter respected value in **STUN server**. To use this option NAT should provide two neighbor ports for every call. It is possible that NAT will be unavailable to do it or searching of ports will be too long. In that case call will not be established.

9.2.2. From external network to subscribers

To receive incoming calls from external network to subscribers Billion PBX should be registered on external registrar. To make registration successful it is recommended to use the same options as shown in [9.2.1](#).

9.3. Billion PBX on networks border

The following picture illustrates this scenario:



In this example Billion PBX is installed on the computer with two network interfaces. This computer performs network router functions.

This scheme is the most convenient for NAT traversal because both call legs works independently and call establishing does not depend on other factors.

10. Working with media

10.1. Media proxy and transcoding

Billion PBX establishes voice or video connections with media stream proxying.

Sometimes media-codecs supported by both parties of the call do not match. In that case it is necessary to perform codecs conversion (or transcoding). Billion PBX is able to perform transcoding if it has appropriate codecs installed. If one of necessary codecs is not presented the call may not be established.

However if both parties are trying to establish connection using codec that is not in Billion PBX then no transcoding required and such call can be successfully completed.

The list of codecs supplied with Billion PBX is presented in [Appendix 2](#).

10.2. Media-files

To make IVR system work Billion PBX uses media-files – files with .wav extension. They are stored in ivr/eng/wav directory. If necessary administrator can replace any file from this directory with his/her own. The following format should be implemented:

- Bit Rate: 128 kbps
- Audio sample size: 16 bit
- Channels: 1 (mono)
- Audio sample rate: 8 kHz
- Audio format: PCM

Media-file is so-called “raw sound”. During playback this file should be converted into one of the codecs available for call party. If Billion PBX does not have such codec then file playback will not be completed.

However it is possible to prepare media-files in appropriate format. In that case Billion PBX can playback files of unsupported codecs. Such file can be directly streamed to the user.

Since transcoding is resource consuming process it is recommended to prepare media-streams even for codecs supported by Billion PBX.

Conversion can be done by converter tool (converter.exe for Windows). This tool accepts as command-line parameters the list of codecs for which conversion will be performed or * to perform conversion for all codecs. In case of running without command-line parameters this tool will show the prompt. Generated stream files will be placed in subdirectories in ivr/eng directory. Directory names are the names of codecs.

11. Possible problems and troubleshooting

- After start Billion PBX cannot open SIP (5060) or H323 (1720) port for incoming calls.

Troubleshooting: check if this port is open and not in use by other software. If something was changed, for example, other software was shutdown, it is necessary to re-read configuration by pressing Accept button on the page of SIP or H323 settings.

- After system crash and restart all ports are busy.

Troubleshooting: it is possible that operating system did not make resources free yet. In that case it should be done manually. In problem persists Billion PBX will automatically run command-file BSS.bad.start.bat. This file may contain any program calls needed by administrator, for example, email sending.

- In configuration window hypertext links do not work.

Troubleshooting: turn on javascript option for web-browser.

12. Authentication policy

The following rules are implemented when Billion PBX communicates with subscribers, originators and terminators:

- Registration

- The subscriber registration based on values of following parameters: “Account” + “IP-address” + “port”.
- Host behind the NAT have the same ip-address but different ports.
- Call receiving
 - Search sequence during call authentication process:
 - Registered subscribers – by “IP-address” + “Port”,
 - Unregistered subscribers – by Account,
 - Unregistered Originators – by ip-address.

Appendix 1. CDR-files format

CDR-file is a text file each line of which is a single call. Fields in the line are separated by TAB or comma depending on the CDR settings. The list of fields in CDR-file includes:

- Session ID
- User name (according to authentication scheme)
- User password (according to authentication scheme)
- Caller phone number
- Caller gateway ip-address
- Caller gateway name
- Dialed number (as it received from caller)
- Callee gateway ip-address
- Callee gateway name
- Call start time
- Alerting time (when callee phone starts ringing)
- Session beginning time (start of conversation)
- Session end time
- Session duration
- Bytes sent from caller
- Bytes sent from callee
- QoS value
- Media channels info
- End reason (Billion PBX internal reasons)
 - Caller – session ended by caller
 - Callee – session ended by callee
 - DurationLimit – maximum call duration reached
 - NoBilling – unable to connect external billing system

- NoUser – customer was not found in billing system
 - NoMoney – customer does not have enough money on the account
 - NoRoutes –there is no routes for this dialed number
 - BadRoute – route does not work
 - CapabilityExchange – codecs of caller and callee do not match
 - TransportFailed – connection was canceled
 - Administrator – administrator canceled the call using Call status page
 - NoRate – internal billing does not have appropriate rate for the destination number
- Billion PBX ip-address
 - Number of channel – number of concurrent calls for the moment of the call start
 - Q.931 end reason
 - Cost of service sold
 - Cost of service purchased
 - Customer name for terminator
 - Caller phone number sent to terminator after transformation
 - Dialed number sent to terminator after transformation
 - RTP IP address of originator
 - RTP IP address of terminator
 - List of originator's codecs
 - List of terminator's codecs
 - Name of Billion PBX route

Time is shown in the following format: year (4 digits), "/", month(2 digits), "/", day (2 digits), space, hour, ":", minutes, ":", seconds, space, UTC shift.

Appendix 2. Codecs included in Billion PBX

- G.711-ALaw-64k,
- G.711-uLaw-64k,
- G.726-16k,
- G.726-24k,
- G.726-32k,
- G.726-40k,
- GSM-06.10,
- iLBC-13k3,
- iLBC-15k2,
- LPC-10,
- MS-GSM,
- MS-IMA-ADPCM,
- SpeexNarrow-11k,
- SpeexNarrow-15k,
- SpeexNarrow-18.2k,
- SpeexNarrow-5.95k,
- SpeexNarrow-8k,
- SpeexWide-20.6k.

Additional codecs may be installed as add-ons.