

Rockchip Linux Application Development

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Preface

Overview

This document presents basic introduction for Linux application development.

Product Version

Chipset	Kernel Version
RV1109	Linux 4.19
RK1806	Linux 4.19

Intended Audience

This document (this guide) is mainly intended for:

Technical support engineers

Software development engineers

Revision History

Version	Author	Date	Change Description
V1.0.0	Fenrir Lin	2020-04-28	Initial version
V1.1.0	Fenrir Lin	2020-06-04	Add ispserver and onvif_server
V1.1.1	CWW	2020-06-29	Update RK_OEM build and pack command
V1.2.0	Allen Chen	2020-08-24	Update ipcweb-ng
V1.3.0	Fenrir Lin	2020-09-16	Add dbserver external interface, update onvif_server development environment

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1. Overview

1.1 Applications

Applications are mainly located in the app directory of the SDK project, and the corresponding functions are as follows:

Application Name	Module Function
ipcweb-ng	web front-end project
ipcweb-backend	web back-end project
ipc-daemon	system management and guard the applications
storage_manager	storage management
netserver	internet service
mediaserver	multimedia service
dbserver	database service
ispserver	image signal processing server
onvif_server	onvif protocol server

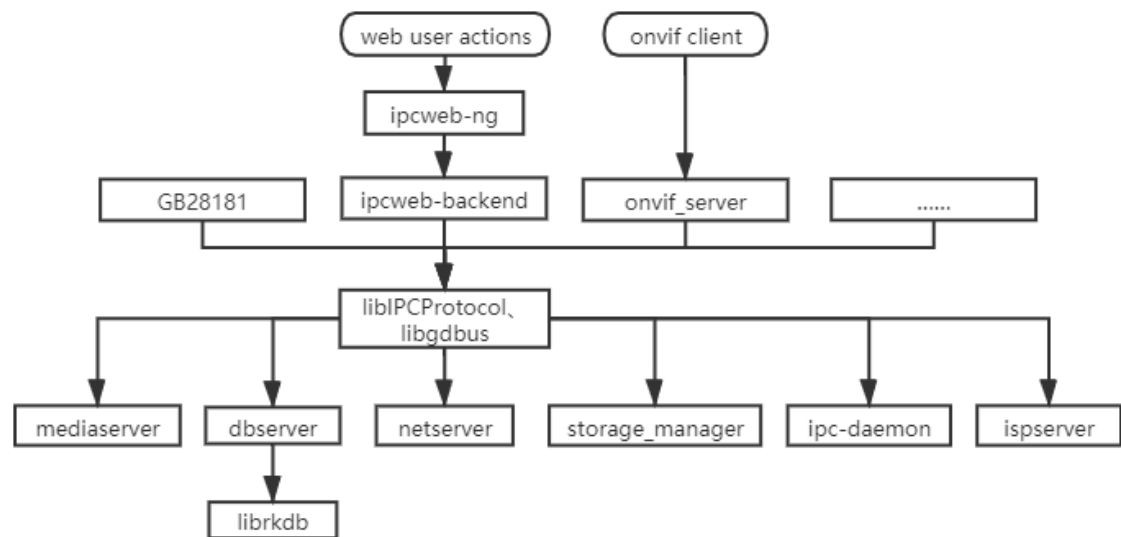
1.2 Libraries

The libraries are mainly located in the app directory of the SDK project, and take dbus inter-process communication mechanism. Mainly develop libIPCProtocol.

Libraries Name	Main Functions
libIPCProtocol	based on dbus, provides inter-process communication interface to call functions across processes.
librkdb	based on sql, provides an interface to database operations.
libgdbus	provide dbus support.

1.3 Application Framework

The Application framework is as follows:



Currently, the following two ways are supported:

1. According to the user's operation, the web front-end calls different interfaces of web back-end in these four ways: GET/PUT/POST/DELETE. In the web back-end, the functions provided by libIPCProtocol are used to communicate between processes through dbus to call the corresponding services.
2. The onvif client or NVR that supports onvif protocol, can call the interface of onvif_server directly, and use the functions provided by libIPCProtocol to call the corresponding service through onvif standard protocol.

In a specific service, operations will be done according to the incoming parameters, so that the user's operation will take effect.

In addition to the above two ways, other ways such as GB28181 protocol can also be added. This framework can be compatible with different applications and could be decoupled.

2. Data Stream

Data stream is mainly HTTP protocol between web front-end and back-end and the communication data on dbus. both of them are JSON format.

2.1 GET

Take getting the current network card information as an example. First of all, when web enters the configuration-network-basic settings, it will automatically refresh and send a request to the web back-end. The abstract is as follows:

```

1 | Request URL: http://{IP address of the board}}/cgi-bin/entry.cgi/network/lan
2 | Request Method: GET

```

After receiving this request, the web back-end will judge URL and Method information, call the netserver_get_networkip function provided by libIPCProtocol, and send the following message to the dbus (**can be monitored by dbus-monitor tool**):

```

1 method call time=1588045737.411643 sender=:1.371 ->
  destination=rockchip.netserver serial=2 path=/;
  interface=rockchip.netserver.server; member=GetNetworkIP
2 string "eth0"

```

After receiving this message, netserver service obtains the current IP address of eth0 network card, and then replies via dbus.

```

1 method return time=1588045737.419339 sender=:1.4 -> destination=:1.371
  serial=357 reply_serial=2
2 string "[ { \"link\": { \"sInterface\": \"eth0\", \"sAddress\":
  \"72:94:20:67:b4:b8\", \"iNicSpeed\": 1000, \"iDuplex\": 1, \"sDNS1\":
  \"10.10.10.188\", \"sDNS2\": \"58.22.96.66\" }, \"ipv4\": { \"sV4Address\":
  \"172.16.21.204\", \"sV4Netmask\": \"255.255.255.0\", \"sV4Gateway\": \"172.16.21.1\"
  }, \"dbconfig\": { \"sV4Method\": \"dhcp\", \"sV4Address\": \"\", \"sV4Netmask\": \"\",
  \"sV4Gateway\": \"\", \"sDNS1\": \"\", \"sDNS2\": \"\" } } ]"

```

After web back-end processes the dbus message, it will send the following information to the web front-end via http, which is then displayed on the web interface.

```

1 response:
2 {
3     "ipv4": {
4         "sV4Address": "172.16.21.204",
5         "sV4Gateway": "172.16.21.1",
6         "sV4Method": "dhcp",
7         "sV4Netmask": "255.255.255.0"
8     },
9     "link": {
10        "sAddress": "72:94:20:67:b4:b8",
11        "sDNS1": "10.10.10.188",
12        "sDNS2": "58.22.96.66",
13        "sInterface": "eth0",
14        "sNicType": "1000MD"
15    }
16 }

```

2.2 PUT

Take setting an IP address as an example, web front-end sends the following request:

```

1 Request URL: http://172.16.21.204/cgi-bin/entry.cgi/network/lan
2 Request Method: PUT
3 Request Payload:
4 {
5     "ipv4": {
6         "sV4Address": "172.16.21.205",
7         "sV4Gateway": "172.16.21.1",
8         "sV4Method": "manual",
9         "sV4Netmask": "255.255.255.0"
10    },
11    "link": {
12        "sAddress": "72:94:20:67:b4:b8",

```

```

13         "sInterface": "eth0",
14         "sNicType": "1000MD",
15         "sDNS1": "10.10.10.188",
16         "sDNS2": "58.22.96.66"
17     }
18 }

```

The web back-end calls the `dbserver_network_ipv4_set` function provided by `libIPCProtocol` to send the following message to dbus:

```

1 method call time=1588054078.249193 sender=:1.447 ->
  destination=rockchip.dbserver serial=3 path=/;
  interface=rockchip.dbserver.net; member=Cmd
2 string "{ \"table\": \"NetworkIP\", \"key\": { \"sInterface\": \"eth0\" }, \"data\": {
  \"sV4Method\": \"manual\", \"sV4Address\": \"172.16.21.205\", \"sV4Netmask\":
  \"255.255.255.0\", \"sV4Gateway\": \"172.16.21.1\" }, \"cmd\": \"Update\" }"

```

The message is sent to `rockchip.dbserver.net` interface, which will update the data in the `NetworkIP` table in the database. At the same time, `netserver` will monitor the broadcast of this interface and set according to the IP address in the message.

Some interfaces of the web back-end will obtain the latest value again and return it to the front-end.

3. ipcweb-ng

3.1 Development Preparation

The web front-end takes Angular 8 framework.

Development language: Typescript, JavaScript, HTML5, SCSS

Reference documents:

[Angular Official Quick Started Tutorial](#) [TypeScript Chinese website](#) [w3school](#)

Code path: `app/ipcweb-ng`

Build command:

```

1 # The development environment needs to be installed for the first use, see
  3.2 Development Environment
2 # In app/ipcweb-ng directory
3 ng build --prod
4 # Move the compiled files in the app/ipcweb-ng/dist directory to the
  app/ipcweb-backend/www path. After this operation, the www will be copied
  while compiling ipcweb-backend
5 # In SDK root directory
6 make ipcweb-backend-rebuild # Recompile the back-end file and copy www to the
  corresponding path according to the configuration
7 make rk_oem-dirclean && make rk_oem target-finalize # rebuild oem
8 ./mkfirmware.sh # pack oem.img, and then flash again

```

Common compilation conflicts:

```

1  # The error message is as follows, for the type definition conflict
2  ERROR in ./src/app/shared/player/download.worker.ts (./node_modules/worker-
   plugin/dist/loader.js?
   {"name":"0"}!./src/app/shared/player/download.worker.ts)
3  Module build failed (from ./node_modules/worker-plugin/dist/loader.js):
4  # You should modify node_modules\@types\emscripten\index.d.ts as following
5  # conflict
6  declare function addFunction(func: () => any, signature?: string): number;
7  # modify
8  declare function addFunction(func: Function, signature?: string): number;
9
10 # The error message is as follows, which is an alias conflict
11 Type alias 'PluginConfig' circularly reference
12 Type alias 'ProtractorPlugin' circularly reference
13 # You should modify node_modules\protractor\built\index.d.ts as following
14 # conflict
15 import { PluginConfig, ProtractorPlugin } from './plugins';
16 export declare type PluginConfig = PluginConfig;
17 export declare type ProtractorPlugin = ProtractorPlugin;
18 # modify
19 import { PluginConfig as PluginCfg, ProtractorPlugin as ProtractorPlu } from
   './plugins';
20 export declare type PluginConfig = PluginCfg;
21 export declare type ProtractorPlugin = ProtractorPlu;

```

3.2 Development Environment

```

1  # Ubuntu
2  sudo apt update
3  sudo apt install nodejs
4  sudo apt install npm
5  sudo npm install -g n # Install n module
6  sudo n stable # Upgrade with n module
7  npm npm --version # Confirm the npm version
8  sudo npm install -g @angular/cli # Install Angular command line tool
9  # in app/ipcweb-ng
10 sudo npm install # Install Angular and related dependencies
11
12 # Windows
13 # view https://nodejs.org/en/download/ to download nodejs
14 # Check whether the npm&node installation is successful, if it fails, go to
   the official website to download the latest version and install it
15 npm --version
16 node --version
17 npm install -g @angular/cli # Install Angular command line tool
18 # in pcweb-ng
19 npm install # Install Angular and related dependencies

```


3.3 Online Debug

Start webpack development service:

```
1 | ng serve
```

If successful, you will see the following log:

```
1 | ** Angular Live Development Server is listening on 0.0.0.0:4200, open your
   | browser on http://localhost:4200/ **
```

Then use chrome browser to visit <http://localhost:4200/> to debug online.

You can also build with `ng build --prod` command, and the files generated in the dist directory need to be pushed to the board and replace the files under /oem/www. If the browser access page is not updated, you need to clear the browser pictures and files cache.

3.4 Code Framework

```
1 | src/
2 | └─ app
3 |   └─ about # About page and project description
4 |   └─ app.component.html # Application main entrance
5 |   └─ app.component.scss # scss style file
6 |   └─ app.component.spec.ts # Test spec file
7 |   └─ app.component.ts # APP components
8 |   └─ app.module.ts # APP module
9 |   └─ app-routing.module.ts # Master routing
10 |   └─ auth # Authentication module, including login page, user
      authentication
11 |   └─ config # Configuration module, including all configuration
      subcomponents
12 |   └─ config.service.spec.ts # Configure module test spec files
13 |   └─ config.service.ts # Configure module services for communication with
      devices and communication between modules
14 |   └─ footer # The footer module, copyright notice
15 |   └─ header # The header modules, navigation routing, user login/logout
16 |   └─ preview # Preview module, stream player of the main page
17 |   └─ download # Video/screenshot download module, query and download of
      video/screenshot
18 |   └─ face # Face module, total face module, including parameters and
      management functions
19 |   └─ face-manage # Management module, face recognition registration and
      face recognition record management functions
20 |   └─ face-para # Face parameter configuration module
21 |   └─ shared # Share resource
22 |     └─ func-service # General services and functions
23 |     └─ player # Player module, player function module
24 |     └─ validators # Angular validators functions
25 |   └─ tip #Tip Box Management Module
26 |   └─ assets
27 |   └─ css # Style
28 |   └─ i18n # Multilingual translation
```

```

29 | └─ images # Icon
30 | └─ json # Json database file for debugging
31 └─ environments # Angular released environment configuration
32 | └─ environment.prod.ts
33 | └─ environment.ts
34 └─ favicon.ico # Icon
35 └─ index.html # Project entrance
36 └─ main.ts # Project entrance
37 └─ polyfills.ts
38 └─ styles.scss # Total style profile of the project
39 └─ test.ts

```

Detailed modules are located in src/app/config.

```

1  $ tree -L 2 src/app/config
2  └─ config-audio # Audio configuration
3  └─ config.component.html # Main page of config component
4  └─ config.component.scss # Main page style
5  └─ config.component.spec.ts
6  └─ config.component.ts # config component
7  └─ config-event # Event configuration
8  └─ config-image # ISP/OSD image configuration
9  └─ config-intel # Intelligent analysis configuration
10 └─ config.module.ts # Module configuration
11 └─ config-network # Network configuration
12 └─ config-routing.module.ts # Configure module subrouting
13 └─ config-storage # Storage configuration
14 └─ config-system # System Configuration
15 └─ config-video # Video encoding configuration
16 └─ MenuGroup.ts # Menu data
17 └─ NetworkInterface.ts # Network interface data
18 └─ peripherals # Peripheral expansion module
19 └─ shared # Some shared sub-modules can be reused to facilitate further
    adjustment of the main module
20     └─ abnormal
21     └─ advanced-encoder
22     └─ alarm-input
23     └─ alarm-output
24     └─ cloud
25     └─ ddns
26     └─ email
27     └─ encoder-param
28     └─ ftp
29     └─ gate-config
30     └─ hard-disk-management
31     └─ info
32     └─ intrusion-detection
33     └─ intrusion-region
34     └─ isp
35     └─ motion-arming
36     └─ motion-detect
37     └─ motion-linkage
38     └─ motion-region
39     └─ ntp
40     └─ osd
41     └─ overlay-snap
42     └─ picture-mask

```

```
43 | |— port
44 | |— pppoe
45 | |— privacy-mask
46 | |— protocol
47 | |— region-crop
48 | |— roi
49 | |— screen-config
50 | |— screenshot
51 | |— smtp
52 | |— tcpip
53 | |— time-table
54 | |— upgrade
55 | |— upnp
56 | |— user-manage
57 | |— wifi
```

4. ipcweb-backend

4.1 Development Preparation

The web back-end takes nginx+fastcgi, and debugs by curl and postman, or directly debugs with the web front-end.

Development language: C++

reference documents:

[HTTP Protocol Knowledge](#) [RESTful API Specification](#) [Nginx + CGI/FastCGI + C/Cpp](#) [POSTMAN](#)

Code path: app/ipcweb-backend

Build command:

```
1 | #In the SDK root directory
2 | make ipcweb-backend-dirclean && make ipcweb-backend
3 | make rk_oem-dirclean && make rk_oem target-finalize #Rebuild oem
4 | ./mkfirmware.sh #Pack oem.img, and then flash
```

Configuration files:

The nginx configuration file is located in buildroot/board/rockchip/puma/fs-overlay/etc/nginx/nginx.conf, part of the summary is as follows:

```
1 | location /cgi-bin/ {
2 |     gzip off;
3 |     # Web root directory
4 |     root /oem/www;
5 |     fastcgi_pass unix:/run/fcgiwrap.sock;
6 |     fastcgi_index entry.cgi;
7 |     fastcgi_param DOCUMENT_ROOT /oem/www/cgi-bin;
8 |     # The only entry to the CGI application
9 |     fastcgi_param SCRIPT_NAME /entry.cgi;
10 |    include fastcgi_params;
```

```

11
12     # Solve the PATH_INFO variable problem
13     set $path_info "";
14     set $real_script_name $fastcgi_script_name;
15     if ($fastcgi_script_name ~ "^(.+\?.cgi) (/.+)$") {
16         set $real_script_name $1;
17         set $path_info $2;
18     }
19     fastcgi_param PATH_INFO $path_info;
20     fastcgi_param SCRIPT_FILENAME $document_root$real_script_name;
21     fastcgi_param SCRIPT_NAME $real_script_name;
22 }

```

4.2 Building Environment

Please build `make ipcweb-backend` in the SDK root directory, or use the following command to build.

```

1  mkdir build && cd build
2  [Optional] The project takes Google Test as a testing framework. Initialize
   googletest submodule to use it.
3  git submodule init
4  git submodule update
5
6  cmake .. -DCMAKE_TOOLCHAIN_FILE=
   <path_of_sdk_root>/buildroot/output/rockchip_puma/host/share/buildroot/toolch
   ain .cmake
7
8  make

```

4.3 Debug Environment

1. Push the built entry.cgi file to the /oem/www/cgi-bin/ directory of the device, and ensure that the permissions and user groups of entry.cgi file are as follows:

```

1  -rwxr-xr-x 1 www-data www-data 235832 Apr 26 20:51 entry.cgi

```

2. Ensure that nginx service on the device has been started, which can be checked by ps command.

```

1  538 root      12772 S      nginx: master process /usr/sbin/nginx
2  539 www-data 13076 S      nginx: worker process

```

3. Use ifconfig -a command to obtain the IP address of the device.
4. Use curl command to debug, the example is as follows:

```

1  $ curl -X GET http://172.16.21.217/cgi-bin/entry.cgi/network/lan
2  {"ipv4":
   {"sV4Address":"172.16.21.217","sV4Gateway":"172.16.21.1","sV4Method":"dhcp",
   "sV4Netmask":"255.255.255.0"},"link":
   {"sAddress":"84:c2:e4:1b:66:d8","sDNS1":"10.10.10.188","sDNS2":"58.22.96.66",
   "sInterface":"eth0","sNicType":"10MD"}}

```

5. Since CGI cannot use the standard output stream, the log is saved in the following path.

```
1 $ cat /var/log/messages
2 # Debug log output to syslog
3 $ cat /var/log/nginx/error.log
4 # Web server error log
5 $ cat /var/log/nginx/access.log
6 # Web server access log
```

5. ipc-daemon

5.1 Development Preparation

A system daemon, provide system maintenance services, initialize and ensure the operation of dbserver/netserver/storage_manager/mediaserver.

Development language: C

Code path: app/ipc-daemon

Build command: in the SDK root directory, `make ipc-daemon-dirclean && make ipc-daemon`

5.2 External Interface

The following interfaces are located in: app/libIPProtocol/system_manager.h.

Function name	Functions
system_reboot	System restart
system_factory_reset	Reset the factory settings
system_export_db	Export database
system_import_db	Import database
system_export_log	Export debug logs
system_upgrade	OTA firmware upgrade

6. storage_manager

6.1 Development Preparation

A storage management service, providing file query, hard drive management, video snapshot, quota and other functions.

Development language: C

Code path: app/storage_manager

Build command: in the SDK root directory, `make storage_manager-dirclean && make storage_manager`

6.2 External Interface

The following interface is located in app/libIPCProtocol/storage_manager.h.

Function name	Functions
storage_manager_get_disks_status	Get hard drive status
storage_manager_get_filelist_id	Get file list by ID
storage_manager_get_filelist_path	Get file list by path
storage_manager_get_media_path	Get media file path information
storage_manager_diskformat	Hard drive format

7. netserver

7.1 Development Preparation

A network service, providing functions such as obtaining network information, scanning Wi-Fi, and configuring networks.

Development language: C

Code path: app/netserver

Build command: in the SDK root directory, `make netserver-dirclean && make netserver`

7.2 External Interface

The following interfaces are in the app/libIPCProtocol/netserver.h.

Function name	Functions
netserver_scan_wifi	Scan Wi-Fi
netserver_get_service	Get Wi-Fi or Ethernet service information
netserver_get_config	Get configuration information corresponding to service
netserver_get_networkip	Get network card information of eth0 or wlan0

8. dbserver

8.1 Development Preparation

A database service, initializes the database and provides related operation interfaces to the database.

Development language: C

Code path: app/dbserver

Build command: in the SDK root directory, `make dbserver-dirclean && make dbserver`

8.2 External Interface

The interfaces are located in app/libIPProtocol/dbserver.h, which are mainly used to select, update, delete and other operations on different tables of the database.

8.2.1 Storage configuration interface

Function name	Functions
dbserver_update_storage_media_folder_duty	Update media folder duty
dbserver_update_storage_config_mountpath	Update mount path
dbserver_update_storage_config_freesize	Update storage free size
dbserver_get_storage_disk_path	Get disk path
dbserver_get_storage_media_folder	Get media folder path
dbserver_get_storage_config	Get storage configuration
dbserver_get_storage_plan_snap	Get snap plan
dbserver_set_storage_plan_snap	Set snap plan
dbserver_storage_snap_plan_parse	Parse snap plan
dbserver_storage_video_plan_parse	Parse video plan
dbserver_storage_get	Get storage table
dbserver_storage_set	Set storage table

8.2.2 Network configuration interface

Function name	Functions
dbserver_network_power_get	Get network power status
dbserver_network_ipv4_set	Set IPv4 Configuration
dbserver_network_dns_set	Set DNS Configuration
dbserver_network_nicspeed_set	Set network interface controller speed
dbserver_network_ip_gets	Get IP
dbserver_network_service_delete	Delete Wi-Fi
dbserver_network_service_connect_set	Connect Wi-Fi
dbserver_network_service_get	get Wi-Fi configuration
dbserver_network_power_set	Set network power
dbserver_wifi_power_set	Set Wi-Fi power
dbserver_ethernet_power_set	Set ether net power
dbserver_wifi_power_get	Get Wi-Fi power status
dbserver_ethernet_power_get	Get ether net power status
dbserver_ntp_set	Set NTP
dbserver_ntp_get	Get NTP configuration
dbserver_zone_get	Get time zone configuration
dbserver_port_set	Set port
dbserver_port_get	Get port configuration

8.2.3 Media configuration interface

Function name	Functions
dbserver_media_set	Set media table
dbserver_media_set_by_token	Set media table by token
dbserver_media_del_by_token	Delete media table by token
dbserver_media_get	Get media table
dbserver_media_get_by_id	Get media table by id
dbserver_osd_get	Get OSD configuration
dbserver_audio_set	Set audio
dbserver_audio_get	Get audio configuration
dbserver_video_set	Set video
dbserver_video_get	Get video configuration
dbserver_video_region_clip_set	Set video region clip
dbserver_video_region_clip_get	Get video region clip configuration
dbserver_stream_url_set	Set stream URL
dbserver_stream_url_get	Get stream URL
dbserver_media_profile_get	Get media profile
dbserver_media_get_by_key_char	Get media table by the primary key of char type
dbserver_video_source_cfg_get	Get video source configuration
dbserver_video_source_get	Get video source
dbserver_video_enc_cfg_get	Get video encode configuration

8.2.4 System configuration interface

Function name	Functions
dbserver_system_set	Set system table
dbserver_system_get	Get system table
dbserver_system_get_by_key_char	Set system table by the primary key of char type
dbserver_system_para_get_by_name	Get system parameter by name
dbserver_system_para_set_by_name	Set system parameter by name
dbserver_set_static_cap_option	Set static capability options
dbserver_set_dynamic_cap_option	Set dynamic capability options
dbserver_set_static_cap_range	Set static capability range
dbserver_set_dynamic_cap_range	Set dynamic capability range
dbserver_system_user_delete	Delete user by id
dbserver_system_user_add	Add user by id
dbserver_system_user_del_username	Delete user by user name
dbserver_system_user_set	Set user information
dbserver_system_user_get	Get user information
dbserver_system_user_num_get	Get the number of users
dbserver_scopes_add	Add Scopes
dbserver_system_del_by_key_char	Delete system table by the primary key of char type
dbserver_system_del_by_key_int	Delete system table by the primary key of int type

8.2.5 Event configuration interface

Function name	Functions
dbserver_event_set	Set event table
dbserver_event_set_by_char_key	Set event table by the primary key of char type
dbserver_event_get	Get event table
dbserver_event_get_by_id	Get event table by id
dbserver_event_get_by_key_int	Get event table by the primary key of int type
dbserver_event_get_by_key_char	Get event table by the primary key of char type
dbserver_event_delete_by_key_int	Delete event table by the primary key of int type
dbserver_event_delete_by_key_char	Delete event table by the primary key of char type
dbserver_face_list_add	Add face to the face list
dbserver_face_load_complete	Write facial feature value recognition result
dbserver_face_load_complete_by_path	Write facial feature value recognition result through image path
dbserver_face_list_delete	Delete face from the face list
dbserver_snapshot_record_set	Add snapshot record
dbserver_face_reset	Delete all people
dbserver_control_record_set	Add control record
dbserver_event_schedules_parse	Parse event schedules
dbserver_event_triggers_parse	Parse event triggers

8.2.6 Peripherals configuration interface

Function name	Functions
dbserver_peripherals_set	Set peripherals table
dbserver_peripherals_get	Get peripherals table

8.2.7 Basic database configuration interface

Function name	Functions
dbserver_select	Select database
dbserver_update	Update database
dbserver_delete	Delete database
dbserver_sql	Use SQL to manipulate the database
dbserver_drop_table	Drop table
dbserver_create_table	Create table

8.3 Debug Environment

After modifying the code and rebuilding, the device needs following operations:

```

1 killall dbserver
2 rm /data/sysconfig.db
3 #Push the newly built dbserver to replace it
4 dbserver&

```

Please use the following commands to send dbus messages to query whether the data is normal.

```

1 # dbus-send --system --print-reply --dest=rockchip.dbserver /
  rockchip.dbserver.net.Cmd \
2 > string:"{ \"table\": \"ntp\", \"key\": { }, \"data\": \"*\", \"cmd\":
  \"Select\" }"
3
4 method return time=1588123823.096268 sender=:1.5 -> destination=:1.6 serial=7
  reply_serial=2
5 string "{ \"iReturn\": 0, \"sErrMsg\": \"\", \"jData\": [ { \"id\": 0,
  \"sNtpServers\": \"122.224.9.29 94.130.49.186\", \"sTimeZone\": \"posix/Etc/GMT-
  8\", \"iAutoMode\": 1, \"iRefreshTime\": 60 } ] }"

```

9. mediaserver

9.1 Development Preparation

Provides the main application of multimedia services, please refer to "MediaServer Development Basics" for details.

Development language: C++

Code path: app/mediaserver

Build command: in the SDK root directory, `make mediaserver-dirclean && make mediaserver`

10. libIPCProtocol

10.1 Development Preparation

Provides a functional interface for inter-process communication based on dbus.

Development language: C

Code path: app/LibIPCProtocol

Build command: in the SDK root directory, `make libIPCProtocol-dirclean && make libIPCProtocol`

10.2 External Interface

The interfaces are packages for dbus communication, and the external interfaces of each service are provided in this library. The core is calling methods of other applications through dbus, but there are two main interaction ways:

The first way: call the method of dbserver through dbus, write data into the database, and broadcast it at the same time. Applications that care about this parameter can do real-time processing through monitoring.

Advantages: when there are multiple applications that care about the same parameter, it is not necessary to call the interface of multiple applications, but let the applications process through monitoring by themselves. And the state is saved in the database, the application can call the function with the end of `_get` to read the data to initialize.

Disadvantages: the application needs to increase the monitoring part of dbus.

The sample is as follows:

```
1  char *dbserver_media_get(char *table);
2  /*
3   * Assign database table name, char *table = "audio"
4   * The return value is formatted as follows
5   */
6  {
7      "iReturn": 0,
8      "sErrMsg": "",
9      "jData": [
10         {
11             "id": 0,
12             "sEncodeType": "AAC",
13             "iSampleRate": 16000,
14             "iBitRate": 32000,
15             "sInput": "micIn",
16             "iVolume": 50,
17             "sANS": "close"
18         } ]
19     }
20
21 char *dbserver_media_set(char *table, char *json, int id);
22 /*
23  * Assign database table name, char *table = "audio".
24  * Assign database table index, id = 0.
```

```

25  * Assign data, char *json = "{\"iVolume\":50}", Multiple parameters can be
    transmitted at the same time, as long as these parameters are in this table.
26  * Other applications that monitor data changes in this table will receive
    the following dbus messages
27  */
28  {
29      "table": "audio",
30      "key": {
31          "id": 0
32      },
33      "data": {
34          "iVolume": 50
35      },
36      "cmd": "Update"
37  }

```

The second way: directly call the specific application method remotely through dbus, most of them are operations that do not need to save the state in the database. Such as taking pictures, hard drive formatting, system restart, etc.

Advantages: applications do not need to monitor, just provide a remote call interface, and reduce the amount of code.

Disadvantages: The state of operations cannot be saved. If a parameter involves multiple applications, multiple functions need to be call while modifying the parameter.

Take the system restart as an example, call the Reboot method of the rockchip.system.server interface remotely through dbus related function. After the application of the corresponding interface receives the message, it will execute the function corresponding to this method. The core code is as follows:

```

1  #define SYSTEM_MANAGER "rockchip.system"
2  #define SYSTEM_MANAGER_PATH "/"
3  #define SYSTEM_MANAGER_INTERFACE SYSTEM_MANAGER ".server"
4
5  dbus_method_call(userdata->connection,
6                  SYSTEM_MANAGER, SYSTEM_MANAGER_PATH,
7                  SYSTEM_MANAGER_INTERFACE, "Reboot",
8                  populate_get, userdata, NULL, NULL);

```

10.3 Notices

1. Because the length of the returned string is not fixed, some functions apply for memory dynamically, pay attention to memory free problem.
2. Mediaserver has no monitoring parameter changes currently, so in addition to writing audio and video related parameters, you need to call the interface provided by mediaserver.h for configuration.

11. ispserver

11.1 Development Preparation

For detailed development about image signal processing server, please refer to "ISP IPC Module Framework Description and Interface Specification"

Development language: C

Code path: external/isp2-ipc

Build command: in the SDK root directory, `make isp2-ipc-dirclean && make isp2-ipc`

12. onvif_server

12.1 Development Preparation

onvif protocol server.

Development language: C

Reference documents:

[WSDL Tutorial](#)

[SOAP Tutorial](#)

[Web Services Tutorial](#)

[onvif specification](#)

Code path: app/onvif_server

Build command: in the SDK root directory, `make onvif_server-dirclean && make onvif_server`

12.2 Development Environment

1. Download gSOAP toolkit, build and install it.
2. Confirm the required wsdl file according to the requirements of each profile on the onvif official website.
The typemap.dat file is located in the gsoap folder in the unzipped directory of the gSOAP toolkit. In order to recognize the event notification, you need to add the following content at the end of typemap.dat:

```
1 | _wsnt__NotificationMessageHolderType_Message = $ struct _tt__Message*  
   | tt__Message;
```

3. Convert wsdl file to pure C style header file onvif.h by wsdl2h tool.


```

1 | wsdl2h -P -x -c -s -t typemap.dat -o onvif.h
   http://www.onvif.org/onvif/ver10/network/wsdl/remotediscovery.wsdl
   http://www.onvif.org/onvif/ver20/analytics/wsdl/analytics.wsdl
   http://www.onvif.org/onvif/ver10/analyticsdevice.wsdl
   http://www.onvif.org/onvif/ver10/media/wsdl/media.wsdl
   http://www.onvif.org/onvif/ver20/media/wsdl/media.wsdl
   http://www.onvif.org/onvif/ver10/deviceio.wsdl
   http://www.onvif.org/onvif/ver10/display.wsdl
   http://www.onvif.org/onvif/ver20/imaging/wsdl/imaging.wsdl
   http://www.onvif.org/onvif/ver10/recording.wsdl
   http://www.onvif.org/onvif/ver10/replay.wsdl
   http://www.onvif.org/onvif/ver10/search.wsdl
   http://www.onvif.org/onvif/ver10/receiver.wsdl
   http://www.onvif.org/onvif/ver20/ptz/wsdl/ptz.wsdl

```

4. In onvif.h, add `#import "wsse.h"`, and modify `tev__StringAttrList` to `tt__StringAttrList`.
5. In wsa5.h, modify `SOAP_ENV__Fault` to `SOAP_ENV__Fault_alex`.
6. Generate the .h and .c files needed for server development with the onvif.h header file by soapcpp2 tool.

```

1 | soapcpp2 -s -2 onvif.h -x -I import/ -I .

```

7. Select the required parts and move to the app/onvif_server directory, taking care not to overwrite the implemented functions.
8. Implement the functions in server_operation.c according to the detailed needs. The structures of input parameters and output parameters have been defined in soapStub.h in details, which can be filled in according to the specifications.

12.3 Debug Environment

1. Make sure that the device running onvif_server is on the same local area network as the NVR or PC that needs to be connected.
2. Run discovering device on the NVR, or run ONVIF Device Manager, ONVIF Device Test Tool or other tools on the personal computer to discover the device, and then debug.
3. When debugging specific functions, you can judge whether the corresponding function is called by the printed log.
4. If you use ONVIF Device Test Tool or other packet capture tools, you will see the following data flow.

Request:

```

1 | <?xml version="1.0" encoding="utf-8"?>
2 | <soap:Envelope xmlns:soap="http://www.w3.org/2003/05/soap-envelope"
   xmlns:tds="http://www.onvif.org/ver10/device/wsdl"
   xmlns:tt="http://www.onvif.org/ver10/schema">
3 |   <soap:Body>
4 |     <tds:GetDNS />
5 |   </soap:Body>
6 | </soap:Envelope>

```

Response:

```

1 | HTTP/1.1 200 OK
2 | Server: gSOAP/2.8

```

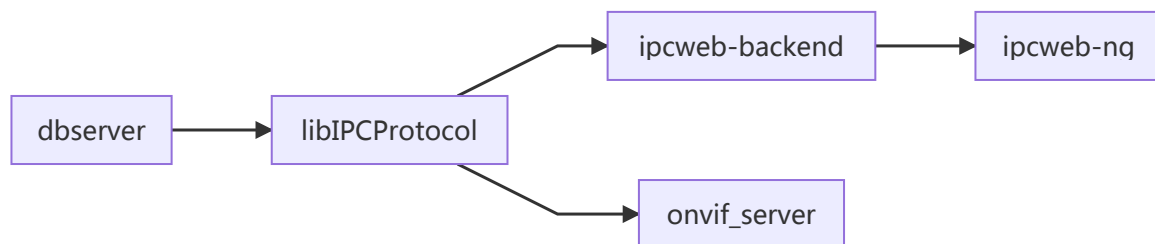
```
3 X-Frame-Options: SAMEORIGIN
4 Content-Type: application/soap+xml; charset=utf-8
5 Content-Length: 2109
6 Connection: close
7
8
9 <?xml version="1.0" encoding="UTF-8"?>
10 <SOAP-ENV:Envelope
11     xmlns:SOAP-ENV="http://www.w3.org/2003/05/soap-envelope"
12     xmlns:SOAP-ENC="http://www.w3.org/2003/05/soap-encoding"
13     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
14     xmlns:xsd="http://www.w3.org/2001/XMLSchema"
15     xmlns:wsa="http://schemas.xmlsoap.org/ws/2004/08/addressing"
16     xmlns:wsdd="http://schemas.xmlsoap.org/ws/2005/04/discovery"
17     xmlns:chan="http://schemas.microsoft.com/ws/2005/02/duplex"
18     xmlns:wsa5="http://www.w3.org/2005/08/addressing"
19     xmlns:xmime="http://tempuri.org/xmime.xsd"
20     xmlns:xop="http://www.w3.org/2004/08/xop/include"
21     xmlns:ns1="http://www.onvif.org/ver20/analytics/humanface"
22     xmlns:ns2="http://www.onvif.org/ver20/analytics/humanbody"
23     xmlns:tt="http://www.onvif.org/ver10/schema"
24     xmlns:wsrfbf="http://docs.oasis-open.org/wsr/bf-2"
25     xmlns:wstop="http://docs.oasis-open.org/wsn/t-1"
26     xmlns:wsrfr="http://docs.oasis-open.org/wsr/r-2"
27     xmlns:ns3="http://www.onvif.org/ver20/media/wsdl"
28     xmlns:tad="http://www.onvif.org/ver10/analyticsdevice/wsdl"
29     xmlns:tan="http://www.onvif.org/ver20/analytics/wsdl"
30     xmlns:tdn="http://www.onvif.org/ver10/network/wsdl"
31     xmlns:tds="http://www.onvif.org/ver10/device/wsdl"
32     xmlns:tev="http://www.onvif.org/ver10/events/wsdl"
33     xmlns:wsnt="http://docs.oasis-open.org/wsn/b-2"
34     xmlns:timg="http://www.onvif.org/ver20/imaging/wsdl"
35     xmlns:tls="http://www.onvif.org/ver10/display/wsdl"
36     xmlns:tmd="http://www.onvif.org/ver10/deviceIO/wsdl"
37     xmlns:tptz="http://www.onvif.org/ver20/ptz/wsdl"
38     xmlns:trc="http://www.onvif.org/ver10/recording/wsdl"
39     xmlns:trp="http://www.onvif.org/ver10/replay/wsdl"
40     xmlns:trt="http://www.onvif.org/ver10/media/wsdl"
41     xmlns:trv="http://www.onvif.org/ver10/receiver/wsdl"
42     xmlns:tse="http://www.onvif.org/ver10/search/wsdl">
43     <SOAP-ENV:Body>
44         <tds:GetDNSResponse>
45             <tds:DNSInformation>
46                 <tt:FromDHCP>true</tt:FromDHCP>
47                 <tt:DNSFromDHCP>
48                     <tt:Type>IPv4</tt:Type>
49                     <tt:IPv4Address>10.10.10.188</tt:IPv4Address>
50                 </tt:DNSFromDHCP>
51                 <tt:DNSFromDHCP>
52                     <tt:Type>IPv4</tt:Type>
53                     <tt:IPv4Address>58.22.96.66</tt:IPv4Address>
54                 </tt:DNSFromDHCP>
55             </tds:DNSInformation>
56         </tds:GetDNSResponse>
57     </SOAP-ENV:Body>
58 </SOAP-ENV:Envelope>
```

12.4 Notices

1. All pointers need to call `soap_malloc` directly or indirectly to apply for memory.
2. After the structure applies for memory, don't forget to call the function at the beginning of `soap_default_tt__` to assign a default value, or manually assign a value or NULL to each member. Otherwise, although build successfully and there is no error within the function, but when checking the response structure, it will directly exit and it is difficult to troubleshoot.

13. Application Framework Development Process

From database to web application development, the bottom-up development process is as follows:



1. `dbserver`: build tables and initialize data.
2. `libIPCProtocol`: package the function of reading and writing to this table. For debugging, you can refer to the code in the demo path to write a test program, or you can use the `dbus-monitor` tool to monitor `dbus`. When testing, push the built `libIPCProtocol.so` and the test program to the device.
3. `ipcweb-backend`: call the packaged function under the corresponding `ApiHandler`. Use `curl` or `postman` test to get/put URL normally. During the test, push the `entry.cgi` generated from building to the device.
4. `ipcweb-ng`: develop the corresponding interface and registration callback to ensure that the web front-end can read and write the database normally. During the test, you can directly specify the IP address in the URL as the device's IP address on the PC for debugging, or you can push the built folder to the device and directly access the device's IP address for debugging.
5. `onvif_server`: package interface functions conforming to `onvif` protocol specification for other client devices conforming to the `onvif` protocol to call.

Specific applications can be developed in parallel after the completion of the second step above. If you do not need to save the states of operations, you can skip the first step.

There are two ways for applications to obtain configuration information actively, one is to read the configuration of the database, and the other is to monitor to the corresponding `dbus` interface.

The former way is usually used for initialization, and can be initialized by reading the database configuration after restarting.

The latter way is usually used for real-time configuration, when the commands on the web side are converted to messages on `dbus`, they can be broadcast one-to-many. While writing to the database to save the configuration, you can also configure the service that monitor this message in real time.

Applications can also provide an interface for `dbus` remote calling, which is called by the application without actively acquiring configuration information.

