

Implementation of smart home terminal based on OpenWrt

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Abstract. With the advances in technology and the quality of life, the family of the growing number and variety of terminals, a demand that automatic networking, shared resources, interconnected and mutual control and for users of home network is growing. This paper aims to design and implement an intelligent terminal with OpenWrt system based on Linux. The terminal is a gateway which has router management control functions, and load and run the compiled modules based on OpenWrt SDK in OpenWrt routing system. The intelligent terminal has completed a preliminary functional tests can be run in real network environments. The terminal will do as a prototype for future improvements and extensions of the home gateway.

Introduction

With the increase of mobile terminal equipment type and the lower prices of Electronic products, more and more mobile devices come into today's home network, and bring a large amount of digital media resources. But these media resource distribution discretely, equipment is not associated with each other, family members cannot share these digital media resources and printing service. Home user urgently need a device which can manage comprehensively the equipment and information data in home network, making the coordinated control of whole home network gradually clear.

Building intelligent home network will integrate the household appliance, share information resources and mobile services, such as printers, digital cameras, digital TV, etc., it also benefit a lot of families and the office environment which is similar with home network. This paper used routing equipment in home network, putting forward a smart home network architecture, designed and implementation of smart control equipment based on route control system [1, 2]. Our intelligent home control system based on route control system consisted of various functions as follows:

Router: Routing function was the basic function of the smart home terminal, in addition to providing a common network services for home users, but also as a family-managed AP devices, mobile client devices connected to the home network to become a member, sharing resources within the network.

Discover mobile devices. Smart home terminal can discover mobile device in the network by discovery protocol, there was a network that the mobile device and displayed on the corresponding management software.

Share network resources. Through intelligent home network management, better integration of media and entertainment resources and print services to make life and work became more convenient.

Routing control terminal

Intelligent control terminal system was based on OpenWrt, developing it not only achieved the basic functions of a router, but also by modifying the source code to implement additional features, such as network acceleration, private cloud services, video surveillance, energy-saving algorithms, such as sharing agreement. Its overall design diagram is shown in Fig.1.

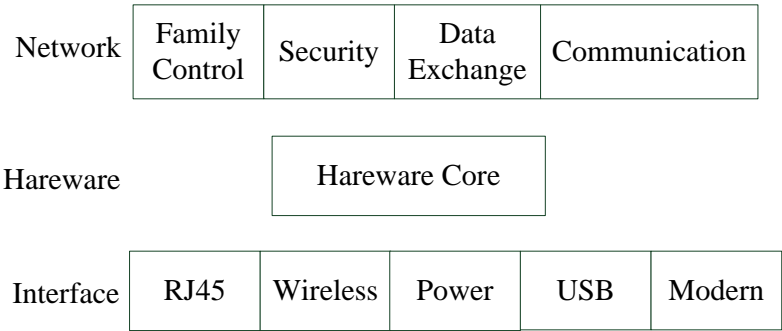


Fig. 1 The routing system overview

Fig.1 showed that routing system provided physical interface of network cable, wireless, USB and modern, and other peripheral interfaces, the smart home network was composed of various sub network, including the family control, security, data exchange, communication network, each part works together, to complete the functional requirement of the whole system.

Routing control system consisted of hardware and software, the core of hardware is a routing chip, there are some famous manufacturers, such Atheros, Broadcom, Realtek, Ralink, Marvell, etc. Choosing ARM processor with high processing performance was a good choice, software system using OpenWrt system which is belong to Linux, but firmware also needed to be compiled.

User management system

User management provided users with interactive interface, for users to view the home network inside information, and get device list and resource list, forming a "family private clouds". The interaction process was shown in Fig.2. The mobile device joined home network by WLAN, and called the API to request serves. The request was mainly two parts as follows.

1 Query: users only needed to connected to the Internet, browsing the content inside the home network, viewing all devices which connected to the home network, check the sharing files and computer peripherals, also realized the function of Internet sharing;

2 Management: users debugged and diagnosed fault by controlling the environment management system, meanwhile, configuring the network system, make the system become more stable and reliable.

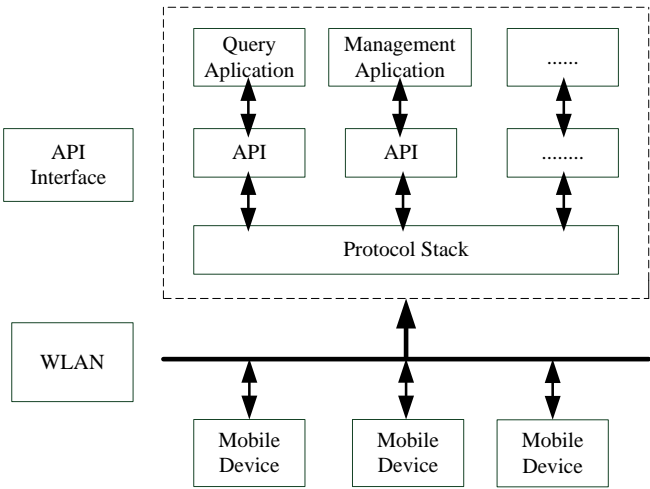


Fig. 2 The interaction of user management system

Discover devices and sharing resources module

In order to effectively manage mobile devices in the home network, sharing of resources between devices, to meet the user to implement dynamic networking and intelligent interconnect within the

scope of the limited space, we compiled functions based on Intelligent Grouping and Resource Sharing(IGRS) into a module program, and loaded them into OpenWrt system [5, 6].

Discover devices. Mobile devices declared by sending online messages to the network declared existence. Meanwhile, Mobile devices declared by receiving online news, that there are other devices on the network, the condition of home network would be known. This function module can sense the presence of other devices, to lay the foundation for the subsequent sharing of resources.

Share resources. Under the sharing protocol specification, each device is a small HTTP server and receives an HTTP request and returns the HTTP response. Whenever a service line, the service sends an online declaration existence.

Results and discussion

To show the feasibility of the proposed architecture, we implemented our home network system, and developed all of related hardware and software for our system. In the whole of the intelligent home network scheme, transplanting the OpenWrt system based on hardware platform of Mini6410 and installing relative program to OpenWrt were most important works.

Transplant OpenWrt. OpenWrt is an open source routing system, providing developers with a completely customizable interface, including the Linux kernel and LuCI. We built the development environment in Ubuntu 10.04 Linux system before Transplant it, compiled the IGRS application to a ipk module, and imported it into Linux kernel as a kernel module. After rebooting the terminal system, the system would begin. When a user wants to log on to the routing management system, he needed to login in the Web page firstly, and enter the user name and password predefined in compilation process, and viewed the default LuCI interface. It was shown in Fig. 3. The biggest difference between this system and the general management of the router management system that based Openwrt routing management system according to the needs of users, customize many extra features, like BT download, agent services, network acceleration, etc [3, 4, 7].

Fig. 4 shown the board used to transplant was the FriendlyARM Mini6410 development board which is with 667MHz Samsung S3C6410 ARM11 processor.

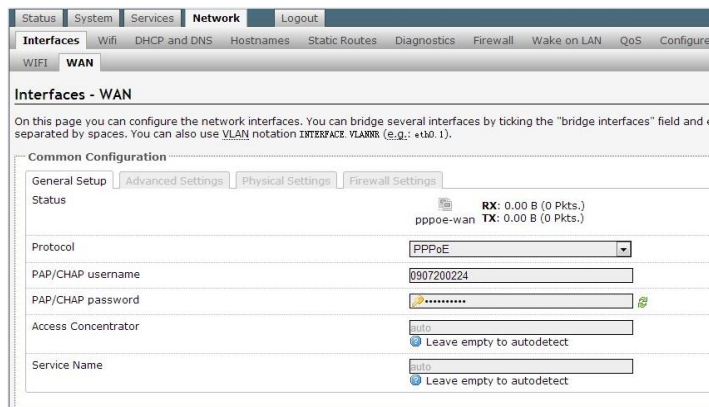
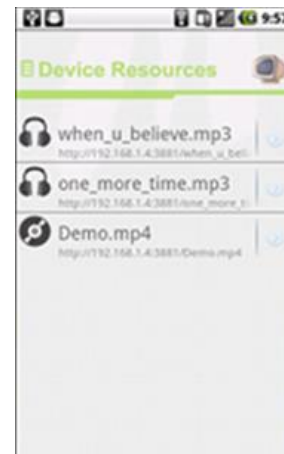


Fig. 3 The interface of OpenWrt



Fig. 4 The hardware board

Discovered device and shared resources. To test IGRS module installed on the OpenWrt was working properly, and installed and ran IGRS client software on the Android mobile device. The running result was shown in Fig.5 and Fig.6. Fig.5 showed that two devices were discovered in the home network, the U880 of a phone and Mini6410 of a development board. When we touched a device, the inside sharing resources displayed on the client, just like Fig.6, we could see some mp3 and mp4 files.

**Fig.5** Discover devices**Fig.6.**Sharing resources

Conclusions

In this paper, the digital home network needs to be analyzed separately from the data, control and management of the overall structure of the three levels of the digital home network design, and finally, on this framework, we propose a OpenWrt and IGRS protocol based solutions the program through the implementation of appropriate quality of service control and management, device discovery and network resource sharing home, OpenWrt system was transplanted into mini6410 development board, and added to IGRS module, successfully found mobile devices within a home network, and get a list of resources, laying the foundation for a wide range of applications of intelligent home network.

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