Design of 10m/100m Ethernet Switch Based on Arm

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Abstract : In recent years, the rapid development of network technology, Ethernet is the dominant in the market. The design introduced the STM32F107 ARM microprocessor features and 88E6095F the switch chip functions, described in detail 10M/100M Ethernet switch hardware and software design, compares the advantages and disadvantages of this design and the design of single chip Ethernet. Implementation of embedded Ethernet data transmission and data exchange, and successfully applied to the communications system.

Keywords : Ethernet; 88E6095F Exchange chips; STM32F107; TCP/IP

I. INTRODUCTION

Ethernet is to comply with IEEE 802.3 series standard specifications, involving open communication model link layer and the physical layer network model. From 20 century 80 years since its inception, its performance and flexibility, which are rapid development, is one of the most widely used local area.

NET technology: In the field of embedded Ethernet technology has been widely used. Exchange function refers to the Ethernet switch: by looking for the media access control (MAC) sheet, set the incoming Ethernet frames from a source port correctly sent to the port of destination. In MAC table, the MAC address corresponding to the port, this correspondence is established through the address learning process, without human intervention. Forwarding decisions depends on the specific exchange mechanism.

This design uses the Marvell company switching chip 88E6095F as core switching chips, ARM microprocessor chip STM32F107 as the main control chip, system settings, and chips.

II. 10M/100M ETHERNET SWITCH BASED ON ARM

A. Introduced Switch Chips

This design switches using Marvell introduced the 88E6095F switch chip, the chip MAC and PHY provides 8FE+3GE total 11 network port, clock frequency of 25MHz. Where P0~P7 ports support 10BASE-T and the 100 BASE-TX twisted pair interface and 100BASE-FX fiber interface; P8.P9 and P10 port supports three interfaces, SERDESC ascades extension interface, add-ins, 10/10/1000MB Copper PHYs, and 1000BASE-X fibre ports, connect directly to a Gigabit fiber module[1].88E6095F each of the IEEE 802.3 Ethernet frame according to a certain strategy of importation into the chip, sent to different output queue by its controller, and according to some exit strategy out of the chip port . [2]

Main functions:

1) Supporting QoS-IEEE802.1p/1Q and TOS/Diff Serv, business data transfer settings for optimal choices.

2) Supporting port-based VLAN and IEEE802. 1 QVLAN, the user can be applied for different regional division, effective control and management of the network.

3) Supporting IGMP Snooping feature, that is multicast. Used to filter multicast traffic in the industrial Ethernet protocols, effectively reduce the bandwidth utilization, improved audio and video transmission, such as available bandwidth.

4) SNMP functions through the WEB is good for network management and control.

5) Supporting STP spanning tree protocol, appeared to avoid loops in the network.

B. ARM Host Processor (model: STM32F107)

This design uses the STM32F107 chip configuration management Ethernet switch chip. STM32F107 is the STMicroelectronics introduces new STM32 interconnect (Connectivity), a strong performance in the microcontroller products, this chip contains all sorts of high performance industrial label. Interface and STM32 different models in the PIN and software compatibility with the well, you can easily adapt to more applications.

New STM32 standard peripherals including 10timer, two 12-bit 1-M sample/s AD (analog-digital converter) (fast alternative mode 2M sample/s), two 12-bit DA (digital to analog converter), two I2Cinterface, five USART interfaces and three SPI ports and high quality

Digital audio interface for IIS, and STM32F107 with full speed USB (OTG) interface, two CAN2.0 bus interface and Ethernet 10/100 MAC module. In the area of network communications, STM32F107 comes with one RJ45 network interface support 10M/100M adaptive networks, with 1a ZigBee wireless network communication interface, one WiFi WLAN wireless broadband network communication interface. This chip can better meet the needs of control switch chips, and is widely used in the industry.

microprocessor chip STM32F107 as the main control chip, system settings, and chips.

III. SYSTEM DESIGN

Hardware consists of the main system switch module and CPU module is composed of two parts, as shown in Figure 1.
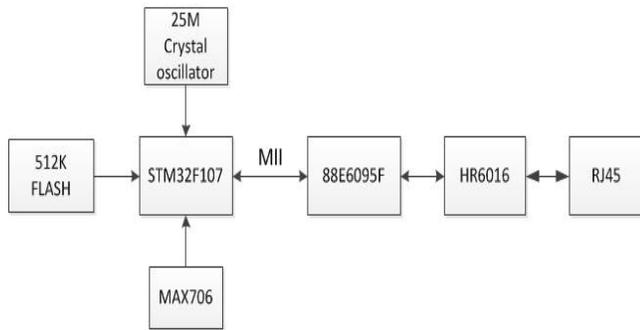
Fig. 1. Switching system hardware diagram

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ARM Cortex-M3 nuclear STM32F107 master control chip, maximum operating frequency of 72MHz, built-in high-speed memory, has a wealth of enhanced I/O ports and peripheral resource: its interior contains the Ethernet MAC controllers, but they do not provide physical layer interface, select 88E6095F as the Ethernet physical layer interface device to achieve CS-MA/CD function, test data is transmitted on the network, if there is a wait, if the network is idle, wait a random time after sending the data out. If a conflict is detected, it waits a random time to send the data, in order to ensure the reliable transfer of data.

STM32F107 embedded Ethernet MAC controller through the MII interface and 88E6095F chipsP10 ports (MII PHY Interface mode) connection for transferring and MGMT and network layer data frames ; 88E6095F provides read and write chip internal registers of the serial management SMI interface, administration and configuration of the switch can be achieved[3]. SMI management ports comply with IEEE802. 3U provided by MDC clock and MDIO data signal.

ARM microprocessor chip STM32F107 as the main control chip, data receiving and processing to construct IP packets, then the network switch chip 88E6095F additional network protocols, and chips for Ethernet transformer HY601680E level and power conversion, signal to meet the requirements of optical transceiver.

IV. SOFTWARE DESIGN

STM32F107 with free development tools, Keil C51 is United States Keil Software companies produced 51series-compatible MCU C Language software development system , ARM Keil based on μ Vision interface for debugging ARM7, ARM9,Cortex-M kernel MDK-ARM development tools, you can implement C/C++ programming language, makes the code more readable. Its software design implements the following functions:

(1) Initialization

Accomplish the STM32F107 the initial value of the register set and sets the initial value of the switching modules in all registers. STM32F107 before work, you must make the necessary initialization, including circuit, reset the clock generator, general purpose register. When the juice is powered up.STM32F107 I/O port switching module sends a reset signal, making switching module ports for input, and then read the State of the port, start

switching module to start work on 88E6095F port registers are initialized, so that they can work properly.

(2) Rapid Spanning Tree Algorithm

Switch of this design is the design of fiber self-healing, after initialization, into the main program, perform the spanning tree algorithm to remove Loop Redundancy circuit, determining topology.

(3) Network Protocol

Power over Ethernet switch with Ethernet communication with other devices, only has to implement. TCP/IP Protocol is OK. ARM sufficient in-house resources, depending on the system you need to configure specific TCP/IP Protocol, implementation-dependent functions, such as the ARP Protocol, IP Protocol, UDP Protocol, TCP Protocol, the HTTP Protocol.

(4) Network Management And Functions

Through the STM32F107RS232interface to transmit and receive network data, in achieving the network protocol on the basis of the above, straight through RS232 debug port, realization of parameter settings of the switch and real-time status monitoring.

(5) The Failure Diagnostics And Self-healing

When power fails and switch parts, self-diagnosis and alarm function, a hardware node alarm signal is output. When the program runs, or into an infinite loop, the watchdog circuit is able to new start switch to achieve self-healing function.

Its software signal flow figure 2 shows, the reception process is similar.
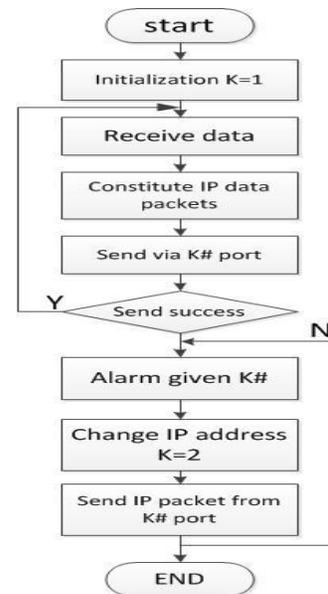

Fig.2. Signal flow diagrams

V. CONCLUSIONS

The design uses STM32F107 microcontroller for CPU,88E609Ffor externalPHY,designed10M/100MEthernetswitch.STM32F107microcontroller to receive and process MGMTframes,link monitoring andmanagement.Meanwhile,STM32F107microcontroller

embedded developers offers TCP/IPprotocol stack. Switch parameters can be configured by a network management software,increased flexibility,users can configure the switch you want. By cascading multiple pieces of 8E6095F,can be used to extend industrial Ethernet and Gigabit Ethernet interfaces.

ACKNOWLEDGMENT (*Heading 5*)

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