

Research of Embedded Ethernet Technology

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Abstract. With the development of electronic technology, embedded system in domestic and industrial fields has been widely used, such as smart appliances, mobile computing devices, network equipment and industrial control field, which greatly improves the efficiency of production and life of people. On the other hand, the Internet has become the infrastructure of the modern information society, through the Internet can quickly and easily access a variety of information, but the reality of embedded system is generally independent of the outside of the Internet. This situation has not adapted to the people's needs, the Internet should not be limited to the level of information management. Embedded system is also necessary to realize the remote control and parameters of network measurement, information sharing, so as to realize the networking between intelligent devices, so the embedded system access to Internet problem becomes more and more important. The Ethernet is used most widely network, and the TCP/IP protocol is the standardized protocol, the two techniques are applied in the embedded system is embedded Ethernet technology. The most critical is the realization of Embedded TCP/IP protocol. This paper discusses the implementation and application of the Embedded Ethernet technology.

1. Introduction

Since entering the 21st century, Internet is at a faster and faster speed in the world within the scope of popularity, it appears in all aspects of people's lives, for people to provide a wealth of advice and information. At the same time embedded systems is also more and more common in people's lives, laying the foundation for achieving intelligent life. But most of the embedded system is also isolated from Internet and is in a separate application stage, which brings great inconvenience to the large range of information exchange. So have Internet access function has already to become the direction of development of embedded system, in the embedded system introduced Internet technology, especially network technology, can be in different regions of multiple embedded system nodes form a unified whole, realize the data sharing and unified management, quickly and conveniently, any parts of the economy to transmit information to the world, which is the embedded Ethernet technology. In fact, the embedded Ethernet technology is refers in embedded devices in curing the TCP/IP protocol stack or through the network module is directly connected with the Ethernet. On the Internet as a medium to achieve the interactive information technology, but the basic and first of all, we should realize the TCP/IP protocol, and the difficulty of Embedded Ethernet technology is how to realize the related communication protocols in less hardware resources. The integration of embedded devices and Ethernet is future smart devices, which can bring a series of revolutionary progress for our life, and will certainly to have the profound influence to the smart home, smart factories and so on[1]. Therefore, the study of Embedded Ethernet technology has important theoretical and practical significance.

2. Related technology concept

2.1 Embedded system.

Embedded system is a special computer system, which is used for the purpose of professional application, the hardware can be customized, and the function, reliability, cost, volume and power consumption are strictly required. It consists of embedded microprocessor, peripheral hardware, embedded operating system and user application software. Embedded system has been more than 30

years of history the, it with the development of computer technology, semiconductor technology, electronic technology and network technology is closely related to the development, the development of embedded system divided into the following four stages: can programmable controller as the core, supplemented by monitoring, servo, indicating device of the system; based on Embedded MCU as the core, supplemented by simple fore-and-aft platform software system; embedded operating system for the embedded system; Embedded Internet Age.

2.2 Ethernet

Ethernet is the use of more general networking technology, in an Ethernet network, all the computer is connected to a twisted pair or coaxial cable, with collision detection carrier sense multiple access (CSMA / CD) method to avoid collisions by competition mechanism and the bus topological structure[2]. By sharing Ethernet transmission medium, such as twisted pair or coaxial cable and multi port hub, bridge or switch structure.

2.3 TCP/IP protocol

The original TCP/IP protocol by the U.S.Department of defense in order to ensure the network between different devices connection communication and the development of the communication of a set of open standards, to provide different network on node computer communication, and gradually evolved into a now the TCP/IP protocol family.By the reference OSI model, the TCP/IP network protocol family can be divided into four levels:

Link layer: by the control of the same physical network on the same machine number according to the underlying protocol transmission, responsible for handling the details of the underlying physics, in the embedded system for network on chip and driver.

Network layer: also known as the Internet layer, processing the activities of the group in the network, such as the routing of the group. In TCP/IP protocol, network layer protocols include IP protocol, ICMP protocol, and IGMP protocol;

Transport layer: this layer has two different transport protocols: TCP and UDP, which provide the communication of the end to end to the application of the two hosts;

Application layer: provides application interfaces

TCP/IP protocol family is hierarchical structure, each protocol has its own specific data format. When data is transmitted, first add the layer protocol header information and send the data to the lower layer protocols, the same underlying protocols to add their own header information and sent to the lower, in turn until the last layer protocol. This process is called data encapsulation or package. The user's data is processed by the above levels to be transmitted and received.

3. Implementation of Embedded Ethernet

3.1 Difference between General TCP/IP and Embedded TCP/IP

Because embedded systems are often used in special fields, and its hardware resource is not sufficient, the TCP/IP protocol can be fully supported in general computer, but in the embedded system it is difficult to achieve, so embedded system only provides general the basic communication protocol. Embedded TCP/IP protocol stack is the most prominent feature of the standard TCP/IP protocol stack. It is very good to be cut, strong portability, code simplification.

Now there are a lot of embedded operating system vendors in their operating system to provide support for the TCP/IP protocol, such as WinCE, VxWorks, NucleuS and other systems. In this paper the author will use the UIP [3] protocol stack is used in low to 8-bit or 16 bit microprocessor embedded system a can achieve the minimum of the TCP/IP protocol stack and its code size and ram requirements than other general TCP/IP stack to small UIP using the C programming language, it can be to achieve free transplantation.

3.2 Implement by Using UIP

UIP using an event based programming module, and the module is application is implemented as a C function call UIP UIP response event, call UIP application in receiving data. Data successfully delivered on the other side suspended connection! A new connection setup! Data need to be retransmitted application provides a response function, which improves the application processing different network services between different port and connected mapping.

From the position of the system, UIP consists of the three C function :UIP_init (),UIP_input () and UIP Uip_periodiC(), UIP_init() function for UIP stack initialization and start-up of the system during a call. When the network device driver read an IP packet to the packet buffer, call the function uIP - input (), cycle of operation call for UIP Uip_periodiC (),representing a second time. Calling UIP function is system of responsibility.UIP implements the four basic protocols of the TCP/IP protocol group:ARP, IP, ICMP and TCP.

ARP protocol. ARP protocol mapped the IP address and Ethernet MAC physical address. ARP in uIP to achieve the mapping contains a IP to MAC address. When a IP packet to be sent on the Ethernet, it query ARP table, finding out the MAC address the package will be sented to, if the IP address is not found in the exterior, ARP request packet will be issued. Request packets in the network broadcast and request the IP address of the MAC address of the host by issuing an ARP response, responding to the request IP address. When uIP gives a ARP response, it update the ARP table.ARP data structure is:

```

struck arpkt{
unsignedint hw_tyPe;      /*hardware type*/
unsignedintProtocol;     /*protocol type*/
unsignedcharhw_len;     /*hardware length*/
unsigned charPro_len;    /*protocol length*/
unsignedintopcode;      /*operate code*/
unsigned charsha[6];     /*sending hardware address*/
unsigned charspa=4];    /*sending IP address*/
unsigned chardha=68;    /*receiving hardware address*/
unsigned charPhI4]     /*receiving IP address*/
}

```

IP protocol. IP protocol is the basis of the TCP/IP for different network hosts to send data between the operating sequence, providing a non connected service.IP data format(table 1):

Table 1 IP head

0	15	16	31
4 bit(version)	4 bit (head length)	8 bit type ofservice (TOS)	16 bit length
16 bit Identifier			3 bit sign 13 bit offset
8 bit Survival time		8 bit protocol	16 bit Header Check
32 bit source IP address			
32 bit destination IP address			
Option (if exist)			
Data			

IP protocol for different network hosts to send data between the operating sequence, providing the service is not connected. IP's uIP layer is greatly simplified, and it has not been realized by fragmentation and recombination. In system design, only IP is used as a transmission tool..In uIP IP layer code has two responsibilities: verify the correctness of the IP header of the input packet and ICMP and TCP protocol. IP layer code is very simple, consisting of 9 statements. In fact, IP's uIP layer is greatly simplified, and it has not been realized by fragmentation and recombination.

ICMP protocol. In uIP, only one kind of ICMP information is realized: ICMP echo information. ICMP recalls that information is often used to check the host in the Ping program.

3.2.4 TCP protocol

Because the design of the embedded system is aimed at some specific applications, it can be simplified to the standard Tcp state machine.In order to reduce the use of memory, the TCP in the uIP did not realize the adjustment window to send and receive data. The input TCP is not being cached by uIP, but it must be processed by the application. Note that this can't be avoided by using your own buffer data. When the output data is uIP, the TCP can't be in each connection with more than one

unresolved segment. Fig.1 and Fig.2 present the process of establishing the server and client, respectively.

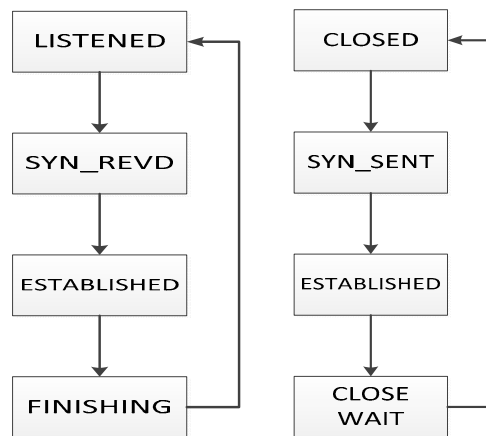


Fig. 1 TCP State of Server

Fig. 2 TCP State of Client

In UIP. Complete state of each TCP connection include: local and remote TCP port number, the IP address of the remote host, three serial number three, data retransmission timer values, retransmission on a piece of data the number of, MSS (maximum length of reported the end). The processing sequence of correct input and output is: Data input processing; Output processing; TCP reset; retransmission.

4. Summary

In this paper, we researched Embedded Ethernet technology, using the UIP protocol stack. it is proved that under the existing technical conditions through proper design realization, embedded system and Ethernet technology perfect combination. In the future people can control everything they want to control, as long as the device is next to Internet, regardless of where the device is now or in the future[4].

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