SNTP Server and Client System for Home Use

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***Abstract*— This paper proposes a compact time sharing system for home use applying the Simple Network Time Protocol. The compact SNTP server/client system for home appliances has been developed as an extension of an SNTP client application the authors previously proposed. The newly developed system can obtain the time from time detection sensors directly without upper layer NTP servers. For verification, the developed system operated on a real-time operating system, T-Kernel/Standard Extension, with a 32-bit RISC MPU, SH7727.**

Keywords- *Simple network time protocol; time synchronization; T-Kernel/Standard Extension.*

I. INTRODUCTION

Current analog broadcasting supports regular time signal broadcasting, but recent digital broadcasting cannot. Therefore time signal broadcasting will disappear in the near future. This is because of an uncertain time delay of approximately two to four seconds which takes place due to the digital demodulation and decoding processing of the broadcast wave.

However, all home appliances are becoming multifunctional, and the system that controls these functions is also becoming larger. Regarding appliance usage, it may be planned to synchronize the operation of the devices in a system using the same time standard (i.e. time base). In such a situation, an accurate time sharing system will be required to give precise time information to each device and synchronize operations between them. In addition, such time information should preferably be available at low cost and be stable inside the home.

To realize this desired system, various means of capturing the necessary time information are conceivable, such as using the real time clock (RTC) of the micro processor unit (MPU) incorporated in a number of appliances. However, this alternative is low in accuracy because it is based on the principle of a cheap quartz crystal oscillation circuit. The authors [2] have already proposed a compact client system for home use applying the Simple Network Time Protocol [1] (SNTP). However, this does not ensure connection to an upper level SNTP server outside of the home at all times. Therefore, this paper proposes a compact SNTP server for home use and an SNTP client server system, and verifies their operational performance.

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II. PROPOSAL OF SIMPLE NETWORK TIME PROTOCOL FOR HOME USE

A. Structure of SNTP server for home use

This paper describes a newly developed compact SNTP server combined with the SNTP client that was previously reported, and a compact and low cost SNTP sever system which is available for home use.

The following three methods are proposed in order to obtain time data for the SNTP server, they are: (1) a method of using a radio-controlled clock; (2) a method of using the Global Positioning System (GPS); and (3) a method of obtaining time data from an upper level SNTP server. The method using a radio-controlled clock is applicable to areas where the waves emitted from a standard time delivery site can be received. The method using GPS is applicable for homes with a window through which waves from more than one GPS satellite can be obtained. If these two methods cannot be used, a communication tool to connect to the Internet is supplied in order to obtain the time data from an upper level SNTP server.

Fig.1 shows the structure of the proposed SNTP for home use. As shown in the figure, the system is adaptable to all the three methods. When SNTP server acquires an accurate time, it will use one of those methods.

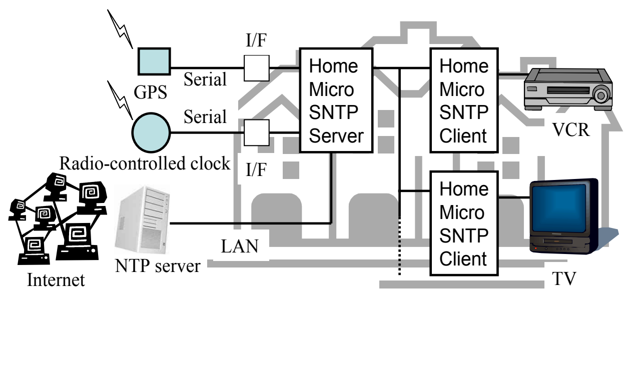

Figure 1. Concept image of the proposed SNTP server for home use.

First, the SNTP client in the AV component demands the precise time and obtains it from the SNTP server. Second, the input time is corrected to the precise time if the internal RTC can be controlled from outside. Further, the multiple components in the system will perform synchronous operations with the corrected component being the central part.

B. *Prototype SNTP server and client server system*

Assuming that the SNTP server will be used for household purposes, an SNTP server with a limited-resource structure was manufactured for trial using a built-in MPU, a real-time OS and the minimum of necessary software.

Fig.2 shows the hardware and software structures of our prototype SNTP server, and Table I shows the hardware and software specifications of the SNTP server.

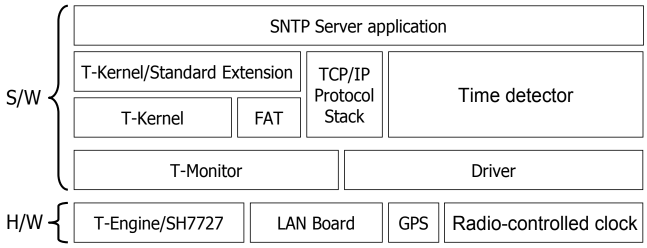

Figure 2. Hardware and software structures of our prototype SNTP server

TABLE I. HARDWARE AND SOFTWARE SPECIFICATIONS OF THE SNTP SERVER.

Item	Specifications	
Hardware size	120 × 75 × 50 mm	
MPU	SH7727	
	Internal freq.	96 MHz
	External freq.	48 MHz
Memory	Flash	8 MB
	SDRAM	32 MB
OS	T-Kernel/Standard Extension	
Software size	Total	1.66 MB
	OS	1.24 MB
	TCP/IP	0.28 MB
	SNTP server	0.07 MB
	SNTP client	0.07 MB

Fig.2 and Table I indicate the possibility of making this experimental device in a small single-chip unit at low cost for household use because it employs a built-in MPU. Since the device is structured with a real time OS and the minimum of necessary software, the device is small, with resources being almost one tenth or so of a conventional PC.

Fig.3 shows the developed SNTP server system acquiring the time data with the GPS and a radio-controlled clock.

The proposed compact SNTP server/client system for home use was built in combination with the developed SNTP client. For time correction we arranged that the RTC of an AV device was corrected every 15 minutes by means of the obtained time information.

(a) With a GPS (b) With a radio-controlled clock

Figure 3. Developed SNTP server systems.

III. OPERATIONAL VERIFICATION OF THE PROPOSED SYSTEM AND CONCLUSIONS

The test result obtained from the prototype SNTP server described in Section Ⅱ are as follows.

The prototype SNTP server successfully acquired the time data by, (1) the method using a radio-controlled clock, (2) the method using the GPS, and (3) the method using an upper level SNTP server.

The SNTP client obtained a time signal every 15 minutes from the prototype SNTP server. The measured error in this case was about 300 ms.

The time setting for the RTC was performed using the external setting function of the MPU.

A synchronous operation between two components was conducted, and the time data was sent and received between them. (The time setting was done for one component and was not done for the other component.) It was confirmed that the operation was performed as expected.

Figure 4. Experimental system to verify the operation of the SNTP server and the SNTP client

As described above, the compact SNTP server proposed in this paper makes precise time setting in each component possible, and precise time sharing between components for the purpose of synchronous operation for home use at low cost and in a stable manner.

IV. Conclusions

This paper has proposed a compact time sharing system for home use applying the Simple Network Time Protocol. The compact SNTP server/client system for home appliances was developed as extension of an SNTP client application the authors have previously proposed. The new developed system can obtain the time from time detection sensors directly without upper layer NTP servers. For verification, the developed system operated on a real-time operating system, T-Kernel/Standard Extension, with a 32-bit RISC MPU. The SNTP client obtained a time signal every 15 minutes from the prototype SNTP server. The measured error in this case was about 300 ms.

The time setting for the RTC was performed using the external setting function of the MPU.

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