Design of High Throughput Wireless Printer Server Based on IEEE 802.11n

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Abstract— One of the problems in printing a document is the desired application program is not available on the computer that connected to the desired printer. In this case, a user must install all the application programs to the dedicated computer or server. Other problem arises when multiple users want to print on the same printer. This is solved by using a Printer Auto Sharing Switch that allows a printer to be accessed by multiple users, but the number of the user is limited by the number of port and the length of the cable. Sharing the printers via local area network also allows multiple users to access the printers, but the connected computer should be always on during the printing process. A wireless printer can be accessed by several users wirelessly, but the price is still relatively expensive. Wireless Printer Server can change the general printer to be wirelessly accessed, but it can only handle one printer. The recent expensive wireless printer server can handle some printers, but the data rate is low. This paper presents the design of high throughput wireless printer server based on IEEE 802.11n. This device can handle several local traditional printers and allows several users to print documents wirelessly. It also provides high data rate transmission up to 300 Mbps between user's computers to the desired printers.

Keywords— *High throughput, wireless printer, wireless printer server, IEEE 802.11n,*

I. INTRODUCTION

A printer is a device to print documents. The problem occurs when the server connected to the desired printer does not have the application programs of documents to be printed (e.g. Auto Cad, Corel Draw, etc.) or a computer has the application program but does not have the driver of the desired printer. In these cases, a user must first install all the application programs on the connected server or install the printer driver on his computer. Another problem arises when several users want to print on the same printer. This can be solved by using Printer Auto Sharing Switch which allows a printer to be accessed by several users. [1] However the number of the user is limited by the number of the port, the length of the cable, and the printer cannot be accessed wirelessly. To be able to access the printer wirelessly, it can be shared via a local area network, but there must be a single computer that is always on during the printing process. [2] A wireless printer can be accessed by several users wirelessly, but the price is still relatively expensive. Wireless printer server extends the printer server with wireless technology. It allows a printer to be accessed by several users wirelessly without requiring a master computer. However, it only can handle one printer. [3]. The recent expensive wireless printer server can handle a max of four printers, but the data rate transmission is still low, i.e. 54 Mbps and the product is already discontinued [4].

Design of wireless printer server using Raspberry pi allows printing a document directly through handheld devices to a traditional local printer. This design not only eliminates the need for wireless printer but also the use of the desktop computer which is connected to the printer. However, the used wi-fi technology is still low, i.e. 54 Mbps. [5].

Another discussion accessing printer wirelessly is reported in [6]. A text which is sent via short message service (SMS) is received by 8051 microcontrollers, then forwarded to the printer for printing. This system is applied to fast food reservations. However, it only can handle short text.

This paper presents the design of high throughput wireless printer server using wireless router TL-MR3420 which is based on IEEE 802.11n. This device can handle several Inkjet/ Deskjet printers and allows several users to print documents wirelessly. It also provides up to 300 Mbps high data rate transmission to the desired printers.

II. DESIGN OF HIGH THROUGHPUT WIRELESS PRINTER SERVER

The scenario of the proposed high throughput wireless printer server (HT WPS) system is illustrated in Fig. 1. There are three local traditional printers want to be shared wirelessly. Instead of using an expensive but low - throughput wireless printer server, a high throughput wireless router is employed. Some users can access those printers to print their documents wirelessly.

Hardware and software used in this design are: one Wireless Router TL-MR3420, one universal serial bus (USB) hub 7 ports, three printers: Canon IP2770, Canon IP1800, and HP Deskjet 3920, 8GB USB Flash Drive, OpenWRT Attitude Adjustment 12.09 Beta [7], CUPS [8], Putty, App. Serv., and Web Browser. Diagram of the design steps is shown in Fig.2.

A. Configuring the wireless router

The heart of the proposed system is a high throughput wireless router TL-MR3420 [9]. Wi-fi technology used by this device is IEEE 802.11b/g/n which can provide physical layer (PHY) data transfer up to 300 Mbps. [10, 11, 12]. It has one USB port which can be used to insert a custom firmware to change it from a general router into desired wireless printer server. The factory firmware is replaced or flashed using OpenWRT. The

167

configuration needs to be done to the router are setting the user's IP address, flashing by OpenWRT, and changing the password. These steps are shown in Fig. 2.A.
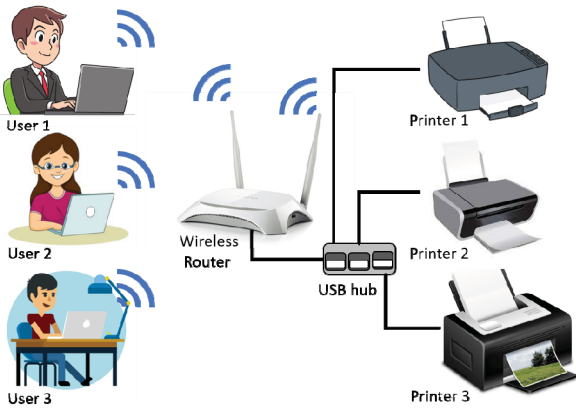

Fig. 1.   The scenario of the proposed HT Wireless Printer Server system.

B. Creating The Ex-root

Storage space on embedded devices is usually limited. By using ex-root OpenWRT, the storage capacity of the root file system can be expanded using additional space for additional storage devices. At some point, in the boot process, the external storage space is installed as the root file system or in the overlay configuration on the original file system. The steps for making ex-root are shown in Fig. 2.B.

C. Configuring Common UNIX Printing System (CUPS)

CUPS is an open source printing system developed by Apple Inc. for macOS® and other UNIX®-like operating systems. It uses the Internet Printing Protocol to support printing to local and network printers. [13].

To run CUPS, some other packages are needed, e.g. zlib, libpthread, libpng, libjpeg, libstdcpp, and cups-bjnp. The steps of configuring CUPS are shown in Fig. 2.C.
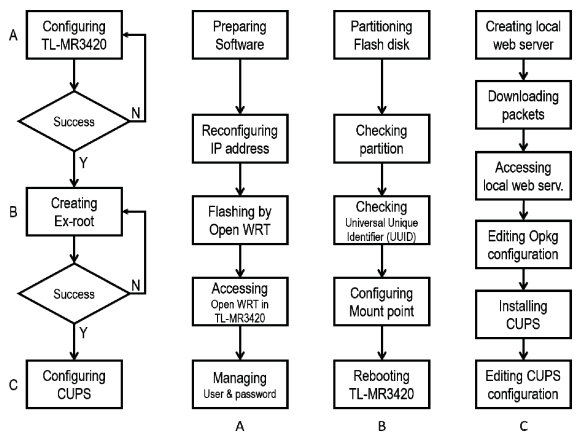

Fig. 2. Block diagram of the design steps, consists of A. Configuring the wireless router TL-MR3420, B.Creating the Ex-root, C. Configuring CUPS.

After three design steps are done successfully, the printers which are connected to TL-MR3420 can be detected in the network and can be seen in the Administration menu as shown in Fig. 3.

Fig. 3. Connected printers to TL-MR3420 can be seen in the Available Printers menu.

To be accessible by the user, the printers should be configured by clicking "Add This Printer" on the printer to be activated. Fig. 4, shows the activation of Canon iP2770 Printer which is detected as Canon iP2700. To share the printers with other users on the network, "Share This Printer" should be clicked. After clicking "Continue" the authentication page to enter the user ID and password occurs. The ID and password are the same as the ID and password used to access OpenWRT. Next, there is confirmation that the printer has been added. Other printers can be enabled in the same way.
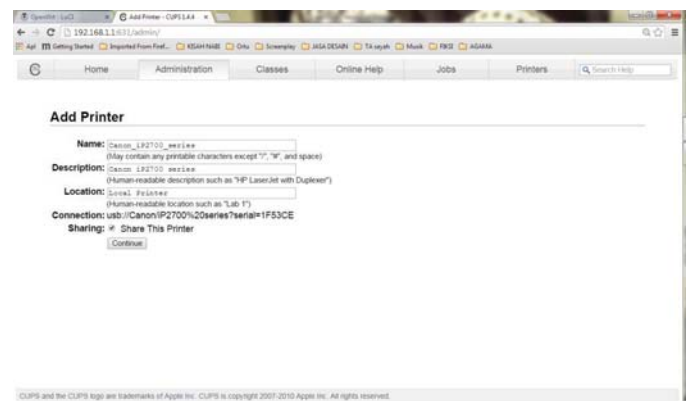

Fig. 4. Adding printer to be accessible by the user.

D. Configuring Users

Users that want to access the connected printers to the proposed HT WPS need to do configuration. This is done by four steps as follow: connect to a wireless network of the proposed HT WPS, add a printer by TCP/IP address, select a shared printer by name, and install it. Three printers that have been connected to the proposed HT WPS can be seen in the user's devices menu as shown in Fig. 5.
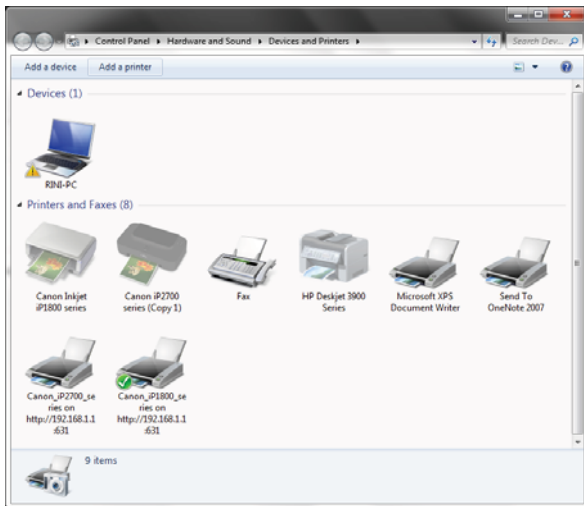
Fig. 5. Three printers that have been connected to the proposed HT wireless printer server can be seen in the user's devices menu.

III. RUN TEST OF HT WIRELESS PRINTER SERVER SYSTEM

Complete configuration of the proposed high throughput wireless printer server is shown in Fig. 6. Some tests are conducted to examine its functionality.
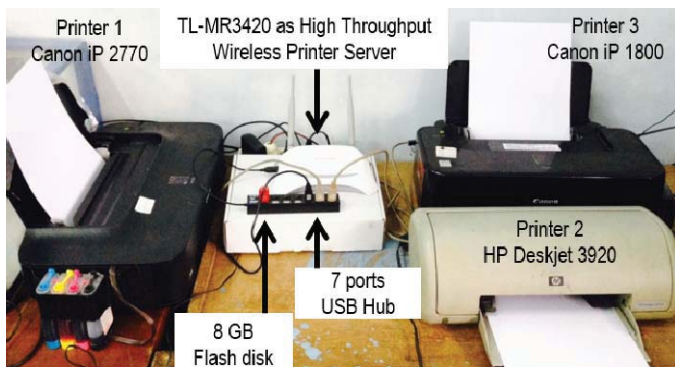

Fig. 6. Complete configuration of the proposed HT wireless printer server.

A. One user to each printer wireless printing test

This test is conducted by sending five different sizes and document format to each printer by one user and measuring the transfer time for the printer to start printing. Five different sizes of the document with the extension .doc are sent to printer 1 Canon IP 2770. Five different sizes of a document with extension .pdf are sent to printer 2 HP Deskjet 3920. Five different sizes of a document with extension .jpg are sent to printer 3 Canon IP 1800. Table I, II, and III list the test results. As the size of the documents is increased the transfer time becomes longer.

TABLE I.   TEST RESULT OF PRINTER 1 CANON IP 2770

No	Doc	Size (MB)	Transfer time (s)
1	Chapter 1.doc	0.3	3
2	Chapter 2.doc	0.5	2
3	Paper1.doc	1.1	4
4	Article1.doc	4.5	6
5	Chapter 3.doc	7.5	10

TABLE II.   TEST RESULT OF PRINTER 2 HP DESKJET 3920

No	Doc	Size (MB)	Transfer time (s)
1	Form.pdf	0.1	3
2	Chapter4.pdf	0.6	4
3	MIMO.pdf	1	4
4	Antena.pdf	2	6
5	Paper.pdf	4	7

TABLE III.   TEST RESULT OF PRINTER 3 CANON IP 1800

No	Doc	Size (MB)	Transfer time (s)
1	Senior.jpg	0.2	3
2	Map.jpg	1	3
3	Students.jpg	2.2	4
4	Training.jpg	3.1	4
5	Ira.jpg	4	4

B. One user to three printer wireless printing test

In this test, User 1 sends three different type and size documents to three printers through the proposed HT WPS, sequentially. The applications opened for printing documents are MS Word, Corel Draw, and Foxit Reader PDF Document with file formats .doc, .jpg, and .pdf. The test consists of three stages. In stage 1, User 1 sends the same type and document size (.doc, 1.1 MB) to three printers. The document is printed successfully by all printers within 3 seconds transfer time. In stage 2, User 1 sends same type (.pdf) but different size to three printers. All documents are printed successfully within different transfer time. The bigger size of a document the longer transfer time. In stage 3, User 1 sends different type and document size to three printers. As expected, all documents are printed successfully within different transfer time depends on document size. The test result of the one user accessing three printers is listed in Table IV.

TABLE IV.   TEST RESULT OF ONE USER ACCESSING THREE PRINTERS

Stage	Printer	Doctype	Size (MB)	Transfer time (s)
1	Canon iP2770	.doc	1.1	3
	HP 39202	.doc	1.1	3
	Canon iP1800	.doc	1.1	3
2	Canon iP2770	.pdf	1.1	3
	HP 39202	.pdf	0.6	2
	Canon iP1800	.pdf	4.5	4
3	Canon iP2770	.pdf	2	4
	HP 39202	.doc	0.5	2
	Canon iP1800	.jpg	3.1	6

C. Three users to one printer wireless printing test

This test consists of three stages. Three users access one printer that is Canon iP2770 while two other printers are in idle condition. The applications opened for printing documents are MS Word, Corel Draw, and Foxit Reader PDF Document with file formats .doc, .jpg, and .pdf. In the first stage, User 1, 2 and 3 send the same document (.doc) and the same size to the proposed HT WPS, sequentially. In the second stage, each user sends the same document (.pdf) but different in size. Finally, in the third stage, each user sends a

different document format and different size to the HT WPS. As expected, all the sent documents are printed successfully within different transfer time determined by document size. The test result of three users accessing one printer is shown in Table V.

TABLE V.   TEST RESULT OF THREE USERS ACCESSING ONE PRINTER

Stage	User	Doctype	Size (MB)	Transfer time (s)
1	1	.doc	1.1	3
	2	.doc	1.1	3
	3	.doc	1.1	3
2	1	.pdf	1.1	3
	2	.pdf	0.6	2
	3	.pdf	4.5	4
3	1	.jpg	4	4
	2	.doc	7	8
	3	.pdf	4	6

IV. CONCLUSION

We have developed a high throughput wireless printer server using wireless router TL-MR3420 which is based on IEEE 802.11b/g/n standard. This device can handle several Inkjet and Deskjet printers and allows several users to print documents, wirelessly. It also provides up to 300 Mbps high data rate transmission from users to the desired printers. All sent documents with different type and size are printed successfully within transfer time determined by the size of a document.

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