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Research Article

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Analog, ISDN and IP Phones support PABX system Implemented on Raspberry PI 3 Model B+

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Abstract PABX (Private Automatic Branch Exchange) system is an essential communication system in modern organization. This project is aimed to design and implemented a PBX system on a Raspberry PI 3 Model B+ board which support IP phones, analog phones and Integrated Services Digital Network (ISDN) phones in a same network. Designed system is cost effective and low power consume. And it supports all PABX functions like other traditional PABX does.

Keywords ISDN, Voice over IP, PABX (Private Automatic Branch Exchange), Raspberry PI 3 Model B+

1. Introduction

Private Automatic Branch Exchange (PABX) is a technology that uses by most of the call centers and large scale organizations to communicate within the organizations and also to make telephone calls with outside world. PABX performs all the switching necessary for making internal calls between extensions within the organizations. It also allows provides a connection between extensions and external phone lines. The proposed system is implemented mainly on a Raspberry PI 3 platform, which contains ARM Cortex processors. A popular PABX operating system called Asterisks will run on Raspberry PI. FreePBX is used as the operating system for the system. All the ISDN phones, IP Phones and analog phone connects with the Raspberry PI via a L2 switch. Designed system also capable of running soft phones which available in Asterisks.

2. System Overview

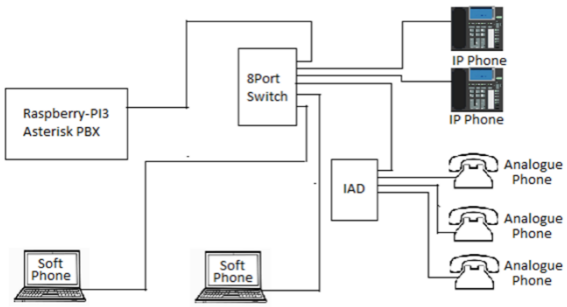

Figure 1: System Overview

As shown in figure 1, we have connected 8 ports layer 2 Ethernet switch with Raspberry pi model B+ module directly by using Ethernet cable. Similarly IP phones (Cisco SPA 942), IAD (Integrated Access Device), and PCs which installed softphone (X-Lite) connected with Raspberry Pi. All the analog telephones are connected via the IAD unit.

3. Implementation

As the operating system we used freePBX (Asterisk for Raspberry pi). FreePBX is a web-based open source GUI which support for Asterisk. Figure 2 shows user interface of freePBX. FreePBX is licensed under the GNU General Public License (GPL).[1]

Figure 2: FreePBX user interface

Once navigated in the application menu, we selected the second option, which is Applications, next selected the fourth option, which is labeled Extensions. After that we created a New Chan Sip extension. Configured a Sip extension user with a password After completing above configurations as shown in Figure 6.IP phones configurations process is done as follows [2].

As show in figure 4, CISCO SPA 942 IP Phone is a 4 line IP Phone with 2-Port Switch. The Cisco SPA942 uses industry leading voice over IP (VoIP) technology from Cisco to deliver an upgradeable high-quality IP phone that is unparalleled in features and support.[3]

Figure 4: CISCO SPA 942 IP Phone

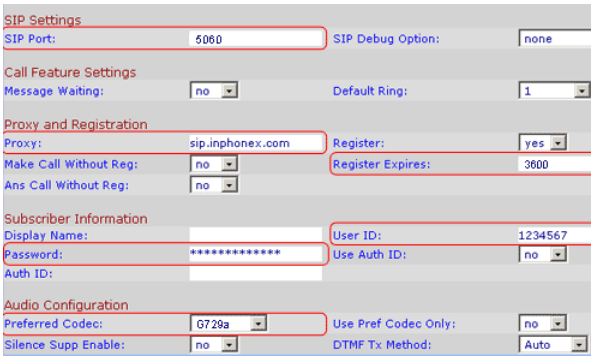

Figure 5: Cisco SPA 942 Configuration interface

We used SMC (SMCFS8) Networks 8 port Ethernet switch. Which shows in Figure 7 The switch is plug and play device, hence no needed to do any configurations. This is an unmanaged device and speed of this port 10/100Mbps.

Figure 6: SMCFS8 Ethernet Switch

This switch out-put is Ethernet. Therefore it was unable to use analogue phones with this module. That was next challenge for us. TO overcome this InnoMedia's MTA6328-4 unit used to as a solution for this problem. Figure7 show the physical appearance of the device, InnoMedia's MTA 6328-4[3]. There is two Ethernet ports function as WAN and LAN ports. Ethernet input can be converted in to analogue outputs by using this device. It is designed to offer features and performance demanded by the enterprise markets. Its versatile and open system interfaces provide the flexibility to work with many different networks (HFC cable, ADSL, fiber, wireless) and broadband access devices close

Figure 7: InnoMedia Device

Other than that this device allows users to share their broadband connection by either connecting a PC or a hub into the MTA downlink port. Its data rate limiting feature ensures voice quality during phone calls by automatically throttling down data throughput and reserving bandwidth for voice whenever a call is in progress. It is highly interoperable and can be used with SIP-based Soft switches or MGCP/NCS Call Agents. For remote provisioning, monitoring and testing, the MTA 6328-4 supports HTTP, SNMP, TFTP, FTP, and Telnet. It can also be remotely accessed and managed through InnoMedia's Device Management System [4-5].

Figure 8: Physical Interface of IAD

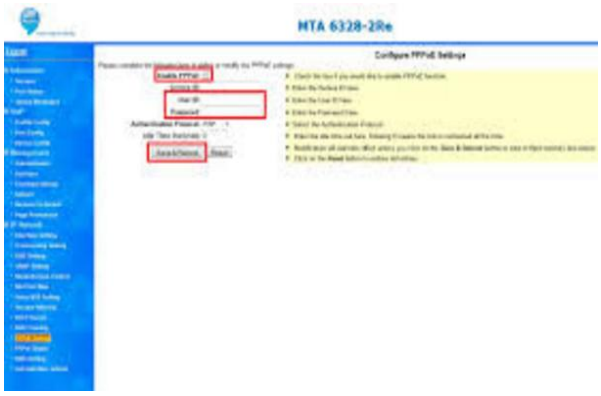

Figure 9: Configuring MTA 6328 device

3. Testing and Results

We tested calls between IP phone and Soft phone. Here we used X-Light soft phone for 30 minutes each and call quality were really good throughout the conversation. Following figure12 shows result of connection between one IP phone and soft phone as shown the configurations in Figure 11.After established the connection we can do the monitoring status by using GUI as shown in Figure 10.

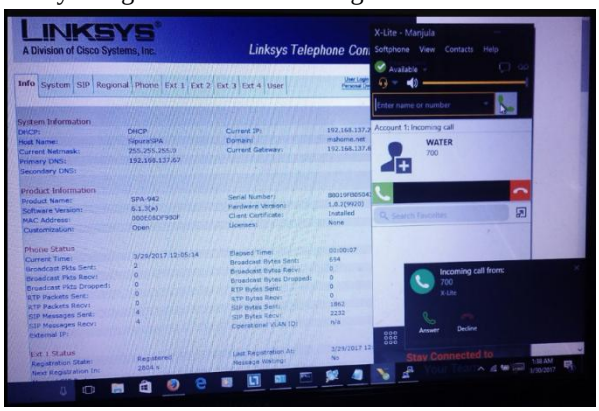

Figure 10: Configuring soft phones

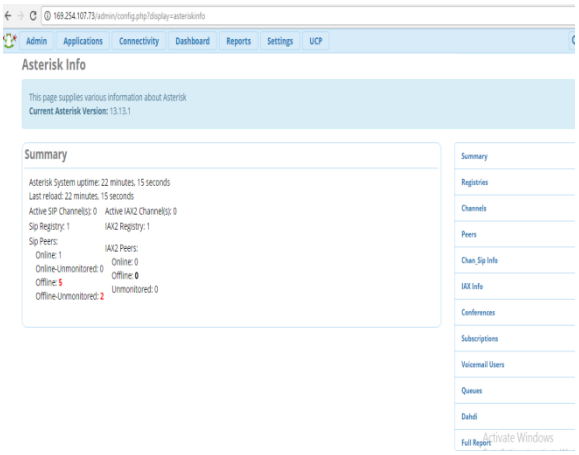

Figure 11: Configuring IP Phones

Name/Username	Host	Dyn	Forcerport	Comedia	ACL	Port	Status
300/300	169.254.107.100	D	No	No	A	5060	UNREACHABLE
400/400	169.254.107.50	D	No	No	A	5060	UNREACHABLE
500	(Unspecified)	D	No	No	A	0	UNKNOWN
600	(Unspecified)	D	No	No	A	0	UNKNOWN
700/700	169.254.121.250	D	No	No	A	52320	OK (12 ms)
800	(Unspecified)	D	No	No	A	0	UNKNOWN
Manjula/***user	(Unspecified)		Yes	Yes		0	Unmonitored
Star Communication	(Unspecified)		Yes	Yes		0	Unmonitored

Figure 12: Establishment of Calls

4. Conclusion

This project has demonstrated how to get a fully functional PABX system product developed from Raspberry-PI 3 platform, which allows analog phones, IP phones and ISDN phones and soft phones to connect in a same network and make calls among any two or many connected phones. System was tested generating several test calls among each telephones and call quality were good throughout the conversations. As drawbacks, the system getting heat up when call runs more than 30 minutes. As a solution we suggest Raspberry Pi clustering to share the load. In conclusion, this project was a success in evaluating all of the effects of the different parameters of Raspbx.

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