Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 65 (2015) 76 – 85

Procedia Computer Science

International Conference on Communication, Management and Information Technology (ICCMIT 2015)

Automatically Provisioned Embedded Systems in Managed Networks

Jiri Slachta[a], Miroslav Voznak[a,*], Homero Toral Cruz[b], Peppino Fazio[c]

[a]*VSB-Technical University of Ostrava, 17. Listopadu 15/2172, Ostrava 708 33, Czech Republic*
[b]*University of Quintana Roo, Boulevard Bahía s/n Esq. Ignacio Comonfort, Col. del Bosque 77019, México*
[c]*University of Calabria, Via P. Bucci 41/C, Arcavacata di Rende (CS) 87036, Italy*

Abstract

The article deals with a design of a new automatically provisioned embedded system. Through the years of our active development a highly advanced platform has been created. This platform, called BEESIP, is meant for the embedded network devices, and allows them to act as telephony exchanges, secured access points, VPN concentrators, etc. As the key feature of the BEESIP platform a unique building and provisioning system of the network devices has been developed allowing the administrators to fully control the firmware and configuration of the devices even in the remote and inaccessible locations. The process of custom firmware building and device provisioning eases the mass deployment of the BEESIP based hardware to cover the needs of small to medium businesses in vast range of services. This paper describes the latest progress in development and the proposition of the BEESIP system, which is based on one of the popular Linux distributions for the embedded devices. The developed system is fully adoptable and each component is reusable on any other Linux distribution. This system introduces several components for several areas, such as security, PBX, provisioning or management. Several components have been developed from scratch and the rest of the components have been fully adopted.

Peer-review under responsibility of Universal Society for Applied Research

Keywords: VoIP; Configuration provisioning; Configuration management; Embedded Systems; VoIP Security; SIP.

* Corresponding author. Tel.: +420-59699-5940.
E-mail address: miroslav.voznak@vsb.cz

Peer-review under responsibility of Universal Society for Applied Research
doi:10.1016/j.procs.2015.09.080

1. Introduction

Nowadays, there is a trend to simplify management of network devices by moving the service infrastructure to cloud service providers. Such steps are considered appropriate in decisions to reduce costs for maintaining the devices and also the services running on them. However, during the movement of infrastructure to third party several questions might arise. Services in cloud infrastructure were designed to be used for everyone, but they usually lack the broad configurability. In addition to these issues the security questions has to be resolved, since the infrastructure is not under the control.

During the years of development, a platform to address the mentioned issues has been created [1], [2]. Among desired characteristics belongs an easy integration of such device into almost any computer network. The main intention of this open-source platform called BEESIP is to provide easily integrated multimedia services. This project serves as a robust and secure VoIP telephony infrastructure with additional key components that makes this solution easily adaptable and configurable even without the deep knowledge of the technologies used by the components. It also aims to be a scalable solution with unified configuration in mind [1].

2. State of the Art

As mentioned in the introduction, we discuss the implementation of a SIP communication server solution which would be an alternative to several current implementations. At present, there are several projects that offer multipurpose IP telephony solutions for embedded devices and for household or enterprise platforms [3], [4].

The initial project of a GNU/Linux distribution which offers an easy set-up of IP telephony in a few steps is the Asterisk@Home project. This project integrated a web interface for Asterisk, Flash Operators Panel to control and monitor PBX in real-time and also offered a full FAX support within one bootable image for almost any x86 PC. The development of this project was discontinued and was replaced by its successor Trixbox in 2006, however, the development of Trixbox does not seem to continue any more. Two existing projects - AsteriskNOW and Elastix – now offer an alternative to Trixbox. The former, AsteriskNOW appears to be similar to Trixbox – a packed GNU/Linux distribution with Asterisk with a FreePBX web interface on top of it. The latter, Elastix, is a bit more modular. Compared to any other project, it offers a slightly more modular hierarchy to facilitate the applicability to a multiple service server [5], [6], [7].

3. Platfrom Architecture

One of the biggest challenges during BEESIP development was to create or modify any existing Linux distribution to serve our expectations. We needed to create an environment that would be fully customizable to any purpose and also to be easily maintainable through the time the BEESIP would be developed. The advantage of portability to any platform was also welcomed. The choice of Linux distribution we wanted to modify fell on OpenWrt Linux distribution. The reason why we chose that system was the approach for building firmware, the toolchain, cross-compiler and all applications are downloaded, patched and built by scratch. This means that OpenWrt does not contain any source code, it does only have its build system with templates, patches and Makefiles with procedures how to build a system and its packages for targeted device. This approach allows us to create custom procedures for build system and packages that can be modified at any stage.

A simplified view on BEESIP architecture is depicted in Fig. 1 which describes how the architecture is designed. The first block, the build system, is a wrapper on the top of the OpenWrt build system. It is designed for easy creation of firmware images within the single text file which describes what should be built for specific architecture and device we are targeting on. The secondary part of BEESIP is the OpenWrt Linux distribution which uses packages that provides desired functionality. In this case to provide modules from packages that serves as PBX, monitoring system, security system, management system and the core connecting modules among themselves.

In almost each modern home and small office there has been distributed and deployed embedded networking equipment for routing the Internet connection, providing multiple media services or to secure the network behind the device. Despite the fact that there has been some focus on the security of network itself, those devices has received small attention to prevent the attackers to abuse the open vulnerabilities on such devices. The absence of