Raspberry Pi as a Thin Client in Business

by

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Submitted to
the Faculty of the School of Information Technology
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Technology

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April 2015
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Abstract

The Raspberry Pi is a thirty-five dollar credit card sized personal computer (Warner). Computers are a business expense that can easily add up on an IT manager’s budget. Tristan Jensen has been researching the viability and cost-effectiveness of using a Raspberry Pi as a thin client in the business world. His previous co-op employer, Cast-Fab Technologies, is littered with metal dust from its foundry. This dust destroys full-sized desktops. The Raspberry Pi is an alternative replacement and allows blue-collor workers in this environment to connect to a Windows virtual machine and view and print valuable safety documents from a file share that can save lives. The Raspberry Pi uses less power than a PC and has no moving parts, so there are no fans to be damaged. The Raspberry Pi could be the solution that Cast-Fab Technologies needs.
Introduction

Cast-Fab Technologies is a foundry located in Cincinnati, Ohio that supplies customers with different types of steel castings, patterns, and sheet metal components (Cast-Fab.com). This project is being carried out by a former co-op employee by the name of Tristan Jensen. Tristan had been fascinated with a piece of technology called the Raspberry Pi and he wanted to do some kind of research with it for his project. He came to his former boss and asked him about any business needs he might have that could possibly be solved with a small, very cheap computer. The IT manager told him that the workers in the foundry needed a way to obtain safety documents without bothering their superiors all of the time.

Problem

This business relies on workers doing their best job and part of that relies on being safe. In order to be safe, workers need to know how to be safe. Knowledge is power, after all. Workers rely on safety documents to learn how to safely operate machines and follow different processes in the work place. For years now, the only way someone could obtain these safety documents were through asking their superiors. This causes a few problems. The first problem is that when a worker asks a superior for a safety document, it wastes valuable time that could be used working the job they have. Not only does the superior suffer and not only does the worker suffer, the whole company suffers. This is two people who are not doing their job that they were hired to do. If the supervisor is busy or sick, the worker may not be able to do the job they need to do for hours or even days. The other constraint is the budget to fix this problem needs to be minimal. The IT department already has a lot of work to do to maintain the current facilities and bigger problems to focus on. They also do not have a big budget to implement an over-the-top solution
to this. Tristan chose the Raspberry Pi in part because he knows that it can be used to connect to other machines as a thin client, but some research reveals that only people at home have implemented the Raspberry Pi this way as a do-it-yourself project. There is not a whole lot of information about how to actually implement this into a business environment.

**Solution**

The solution was to allow Tristan to research using the Raspberry Pi in a business environment as a thin client, specifically for the use of finding and printing safety and procedural documents. This benefits Tristan because he gets to research a piece of technology he finds under-used and it benefits Cast-Fab Technologies because Tristan is researching a solution to a problem they have but aren’t available to work on. After implementation, this will also benefit the workers who desperately need a way to access and print off safety documents without disrupting their supervisors.

The research required creating a virtual testing environment using the University of Cincinnati’s Information Technology VMWare Sandbox. Using this, Tristan created a vApp and created virtual machines (VMs) to simulate a network similar to that of Cast-Fab Technologies. He created an ESXi server for VMWare and vSphere because Cast-Fab Technologies already has a VMWare server and that is what they plan to use if this goes into implementation. Unfortunately, the sandbox gave Tristan many problems. He could not get VMs to connect to the internet. Alternatively, he came up with a solution that included setting up a single test thin client terminal at Cast-Fab Technologies. This seemed to work very well because he got direct user feedback, he was able to use the existing network infrastructure at Cast-Fab, and he could test how the device held up in the hostile foundry environment. A virtual private network (VPN) router was needed to do a live demonstration of the Raspberry Pi’s functionality off-site. With
this router, the Raspberry Pi can sit on the local network at Cast-Fab Technologies and have the
ability to use Remote Desktop Protocol (RDP) to connect to the Windows VM. The VM Tristan
used is a repurposed, already-licensed Windows VM on their Microsoft Hyper-V server. The test
terminal can now use the existing network infrastructure, such as the Active Directory (AD) to
log in, the file server to actually access the real files, and the network printers so that workers can
print off the procedural and safety documents they need. Figure 1 shows the network layout of
Cast-Fab Technologies.

Figure 1 – Network Diagram
The Raspberry Pi was specifically chosen because of how cost-effective it is. It is a thirty-five dollar computer. If it breaks, it is easily replaceable for only thirty-five dollars. It also runs on a Linux-based operating system (OS). The OS that was chosen is called Raspberry Pi Thin Client (or RPiTC). This is an operating system that Raspberry Pi enthusiasts have been working on and developing over several years to serve the purposes of using the Raspberry Pi as a thin client device. The OS is free and available to all who wish to use it.

Tristan was curious about other thin clients so he did an Amazon.com search for “thin client computer” and there were no thin clients on the first page of results that was less than one hundred dollars. Most of the thin clients were around three hundred dollars. A particular thin client, the HP 501096-001, has a list price of three hundred sixty-nine dollars and is being sold for three hundred and two dollars. This is also a thin client with a Linux OS. Assuming all other licensing is the same, when comparing the thirty-five dollar Raspberry Pi to this thin client, you would save two hundred sixty-seven dollars.

Security is a concern that needs to be addressed. The Raspberry Pi devices themselves are not very secure. The OS automatically logs into the device upon boot. This is a risk but it is not very high because no proprietary information will be stored on the device itself. Everything will be done on the remote machine that we will access via RDP. The only way to access the VM will be using the Active Directory (AD) server for authentication. Only people who have usernames and passwords can log into the VM through the Raspberry Pi. The VM that the worker will be connecting to will only have access to the “SafeDoc” file share that is set up on the file server on the sandbox network. The terminal is only secure as the AD, so this depends on the strength and requirements of passwords for users. Upon implementation, there will also be physical security.
There is a gate surrounding the property and security cameras are used on the premises. People also need RFID tags to enter into the building beyond the lobby.

**User Profile**

There is only one type of user that will be using the Raspberry Pi thin client terminals and those are the workers at Cast-Fab Technologies who work on the foundry floor. These users have very little software and interface experience. They spend most of their time doing manual labor in the foundry and a lot of them only know how to check their email. None of them have experience with a similar technology. The tasks they need to perform are logging into a Windows computer. They need to know how to use the Windows file browser. The user also needs to be able to open a PDF file and print to a network printer. Based on this profile, the design needs to be simple. Tristan has decided to have a shortcut sitting on the desktop that executes code to RDP into the VM. Once they click that shortcut, the environment should look normal for them. The VM will use AD to log in, which is something familiar to the user.

![Use Case Diagram](image)

**Figure 2 – Use Case Diagram**

This use case diagram demonstrates that the system will only have one user, the worker. He must be able to connect to the Windows VM on the Raspberry Pi using remote desktop. After accomplishing this task, the worker must be able to access the file share that contains the safety
documents and the worker must be able to open the safety document. Finally, the worker must be able to print the safety document.

**Timeline**

![Timeline Diagram](image)

Figure 3 – Timeline

Figure 3 is the timeline for the project. The beginning of the school year, August to the middle of October, was used for preparing for the project. This involves getting the project approved, getting the environment set up, and create some deliverables. From about November to December involved trying to set up the virtual sandbox environment and getting it in working order. This was not successful and Tristan moved on to setting up the environment on-site at Cast-Fab Technologies. After it was set up on-site, testing the device began. This includes testing the RDP connection, the ability to open files, the Active Directory, etc. The testing was ongoing until the live demonstration in April.

**Budget**

The budget for this project was very small. A total of $48.02 was spent on the B+ model of the Raspberry Pi. An eight gigabyte microSD card was provided by Tristan to load the operating system on to and a power supply and microUSB cable were also provided. As mentioned before, Cast-Fab already had a licensed Windows VM that was originally being used...
for an email migration that was provided for the repurposing for the test VM. A plastic case for the Raspberry Pi was purchased for $8.99. A VPN router, which was purchased for presentation reasons, came to a total of $69.99. The total amount spent over the semester is $127.

**Lessons Learned**

For this project, Tristan would have done a few things differently if he was given a chance to do it all over again. He would have gone directly to Cast-Fab Technologies in the beginning of the assignment instead of trying to set up a sandbox environment which wasted a lot of time in the first semester of the project. Tristan could have used that time to do more testing, improve the thin client itself, and get more feedback from the users. There was also a lot of time being used waiting for responses to emails to try to resolve problems and get things approved for the project. Tristan learned that waiting for approvals and other emails are the nature of a collaborative project with a business.

**Conclusion**

In conclusion, the Raspberry Pi, although not the most secure device, makes an incredibly cheap solution as a thin client for businesses to use for all kinds of solutions. In this case, it was used as a terminal for workers to access and print off safety documents. This stops the workers at Cast-Fab Technologies from disturbing their supervisors and allows them to do their job uninterrupted. The Raspberry Pi uses the RPiTC OS, which is a free operating system that has remote desktop capabilities to connect to a virtual machine on the same network.
Works Cited

