PROJECT TITLE: ECONOMICAL DUCK

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OUTLINE BUSINESS CASE & PROJECT PLAN

Version Number: 2.0
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VERSION HISTORY

Version Number	Implemented By	Revision Date	Approved By	Approval Date	Description of Change
1.0	CC, LG, CD, SS	18/09/18	CC	18/09/18	Sections 2, 3 and 4 were split between each member of the team to complete individually.
1.1	CC, LG, CD, SS	20/09/18	CC	20/09/18	Meetings updated, section 6 was filled out.
1.2	CC, LG, CD, SS	22/09/18	CC	22/09/18	Key Terms given content.
1.3	CC, LG, CD, SS	25/09/18	CC	25/09/18	Meetings updated.
1.4	CC, LG, CD, SS	02/10/18	CC	02/10/18	Given information on section 7 of the proposal.
1.5	CC, LG, CD, SS	04/10/18	CC	04/10/18	Risk section updated by Connor and Lewis and section 7.9 was completed as a result. Sunny also created the Gantt chart.
1.6	CC, LG, CD, SS	10/10/18	CC	10/10/18	Meetings updated, steps 1.1 and 7 updated.
1.7	CC, LG, CD, SS	23/10/18	CC	23/10/18	Connor updated the minutes and completed section 6.2 and edited 7.5.1/2. Sunny added in some costs and removed irrelevant details. Lewis updated section 5 and added in a summary. Chris added notes to 7.7 and created the product breakdown structure.
1.8	CC, LG, CD, SS	06/11/18	CC	06/11/18	Going through and reviewing the entire proposal.
1.9	CC, LG, CD, SS	07/11/18	CC	07/11/18	Ensuring the proposal is correct against the marking scheme and has no errors.
2.0	CC, LG, CD, SS	13/11/18	CC	13/11/18	Final grammar check and signed document.

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1 EXCUTIVE SUMMARY

The brief that the team have been provided by Abertay University is the creation of a physical penetration testing device under the supervision of the client Dr. Xavier Bellekens, a lecturer at Abertay University.

The team was intrigued by the ability to plug a device into a target machine and cause it to become instantly compromised. When considering the different aspects of a computer, Team 404 realized that the keyboard can control every part of a computer because it trusts a user typing upon it, and as such, the team decided to make a device that looks like a USB pen drive but acts as a keyboard.

The group researched for pre-existing products with similar functionality to what was described above and discovered the USB 'Rubber Ducky' by Hak5™. Although this product is very capable of what the team originally envisioned, it is expensive, sourced from the US, and cannot be further developed for extra functionality.

Team 404 aims to create an alternative to a Rubber Ducky in the form of a Raspberry Pi Zero - a fully functional computer that is small, low cost, and developed in the UK. It is about the size of a USB pen drive, runs a full Linux operating system, and has the capability to act like a keyboard on another computer.

Once the project is complete, a student can be provided a Raspberry Pi Zero which will have the same functionality as a Rubber Ducky, alongside a manual which explains how to create a plaintext file that tells the device what keys to "press" when it is plugged into another computer.

We have named this the "Economical Duck" due to it being almost half the price of a Rubber Ducky.

This product will give Ethical Hacking students a better learning experience by increasing their understanding of physical cybersecurity risks due to having access to more penetration testing devices. As the Raspberry Pi Zero the team are building upon is flexible, students could also reprogram them with their own tools, further enhancing their learning experience. This will increase the reputation of the Abertay University and encourage more students to apply.

The development costs for this project would involve two Raspberry Pi Zero kits - which include a Raspberry Pi Zero, 8GB micro SD card, power cable and a micro USB cable. This is to allow the team to work on different parts of the project without scheduling issues and has the added benefit of redundancy within the project, meaning that if one kit fails, the team can continue work on the other one until a replacement arrives.

Due to all members of Team 404 being University students, the team will not be taking a salary for the project. As such the overall budget of this project has been set at £50.

Once the project is completed, the University will be able to provide a low cost alternative to a Rubber Ducky. A Rubber Ducky would cost the University £35 per unit and the price would be further increased due to import and shipping costs, making it unfeasible to provide one to every student.

A Raspberry Pi Zero kit can be provided at a cost of £17.40 per unit. These could be used for multiple course modules or projects, including the Economical Duck, which will provide the same functionality as a Rubber Ducky for almost half the price – making it a much more feasible option to provide one to every student on the course.

The plan of action that will be followed can be seen in the Gantt chart in section 7.3. Christopher Clark will confirm that every member is strictly following these guidelines, ensuring that each member is on track with their deadlines. Christopher will also map the critical path against the Gantt chart, in order to view that deadlines have been met, and inform each member of any approaching deadlines.

The methodology that the team will be implementing throughout the course of the project is Agile. The framework that will accompany the Agile methodology is SCRUM. Christopher Clark will be responsible for overseeing the project from start to finish and will therefore be responsible for making sure the SCRUM framework is followed. To comply with SCRUM, the team will have at least two meetings every week, to update each other on the progress that each member has made. They will also discuss what tasks still need to be completed, and which tasks should be prioritized. Throughout the project, the team will regularly iterate back to previous stages after new information has been found, and any errors discovered during the testing stage will result in the coding stage needing to be revised.

The team will be using the ISO 9126 Software Quality characteristics as the key performance indicators for the project. This can be used to decide the importance of Functionality, Reliability, Usability, Efficiency, Maintainability and Portability for the teams' project.

Team 404 conducted a survey with these key performance indicators in mind to receive a third-party insight. By doing this it allowed the stakeholders to voice what aspects they believe hold the most value for the product to succeed. This was used to create the table in section 7.5.1.

Upon creation of the product, the team will measure its success by making two separate focus groups. One group will use the Economical Duck, then the Rubber Ducky in that order for twenty minutes each, and the other group will do the reverse. This is to make it an unbiased test when it comes to finding out how well the key performance indicators set originally have been met, mapped against the speculative numbers acquired via the survey mentioned above. If the combined key performance indicators are within ten percent of the original number acquired, the product is deemed a success. This gives Abertay University the option to supply the Economical Duck to Ethical Hacking students at a fraction of the cost, motivating students to

study physical cyber security risks, and therefore increase the reputation of the university. This would mean that Team 404 has succeed in advancing the business goals of the university, thus making the project a success.

Team 404 have performed a risk analysis of the project by creating a risk matrix to weigh the impact of a risk against the probability of occurrence. In total Team 404 found seven risks to the project, however the team only consider two risks to be above the tolerance line. This means they are critical risks and therefore must be mitigated. They have been identified as: the project specification taking longer than anticipated, and unexpected errors during the creation of the Economical Duck delaying the project.

Either of these risks will result in the project taking more time to complete than anticipated and could lead to the completion of the project surpassing the deadline date. As a result, the team has allocated extra time during the development stages, and a large buffer of time at the end of the project to ensure that the final product will be completed by the team's deadline date.

Christopher Clark is the client's main point of contact for this project and can be reached at:

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2 INTRODUCTION

2.1 Purpose of this Document

The main purpose of this document is to allow the team's client, Dr. Xavier Bellekens, to gain an in-depth knowledge and understanding of what the Economical Duck is, how it will be used to help the client with his profession, and the benefits and potential costs that are associated with the creation and development of the project.

The viability of the project is going to be closely monitored by Christopher Clark. Christopher will be responsible for overseeing the entire project and ensuring that each individual part is delivered to a high standard. It will also comply with all requirements given by the client and meet the deadline that is specified.

A project can be considered viable if the total cost of the project is calculated as less than the expected value of the project. It is Christopher's responsibility for keeping track of the total costs and ensuring that they never exceed what the project is expected to cost.

3 GENERAL PROJECT INFORMATION

Submission Date	13 November 2018
Requested By	Dr. Xavier Bellekens
Business Owner	Dr. Xavier Bellekens / Dr. Andrea Szymkowiak
Contact Info.	Email – x.bellekens@abertay.ac.uk; Phone – 01382 308 482
Project Name	Economical Duck
Desired Start Date	9 January 2019
Desired End Date	18 April 2019

3.1 Business Need

Team 404's client is Dr. Xavier Bellekens, a university lecturer who works in the educational sector for Abertay University. Dr. Bellekens' main position at Abertay is educating students who have an interest in the field of Ethical Hacking and Computer Networking.

The project that Team 404 are working to create will address how purchasing Rubber Duckys for an entire university class is not cost effective. While a single device could be used as a demo within a lecture to raise awareness of malicious USBs - it is important for students to get hands on experience with the device. This is so they can begin to understand how they work, as much more can be learned by gaining hands on experience with the device.

One of the major benefits of investing in Team 404's project is that the client will gain an increased reputation within the university due to having the tools required to provide a very captivating lecture on the physical security risks that computers are susceptible to.

Another benefit of this project could be the creation of a lab on how to develop payloads for the device. This will be highly engaging for students as they will be able to get hands on experience with the device, a better understanding of how penetration testing devices can interact with machines, and what malicious payloads can be delivered to a target.

Due to the high monetary value, the idea of the university supplying a Rubber Ducky to every student in a lab would be unfeasible. The cost of one Economical Duck is approximately half the price of a Rubber Ducky (Hak5, 2010) and is significantly more flexible due to the large number of features that could be developed for a Raspberry Pi Zero.

These extra features allow the Raspberry Pi Zero to be developed further in other projects that Ethical Hacking students could undertake and create new tools or penetration testing devices based on the code supplied by Team 404. Such tools could include a wireless packet sniffer, a drop-off back door, or a port scan of a device over a USB port.

This is possible as the Raspberry Pi has a full operating system, as well as functionality beyond simple USB communication. Developing anything like this on a Rubber Ducky would either be

impossible due to hardware limitations, or extremely difficult as it is closer related to an Arduino in terms of performance. (Raspberry Pi Foundation, 2017)

3.2 Legal Issues

One of the major legal issues that needs to be complied with during the development of this project is the Computer Misuse Act (1990) . The Computer Misuse Act is designed to protect the users against both physical and digital attacks, as well as theft of personal and confidential information from a computer system. These offences include hacking and unauthorized access to computer systems. Unauthorized access can include modifying software and data on the machine, changing passwords and settings as well as interfering with the everyday operation of the system. (Crown, 1990)

The Computer Misuse Act makes it an offence to access or even attempt to access a computer system without the proper authorization. In terms of the Economical Duck, this means that any use of the device will require the targets' permission as its intended purpose is to extract personal information from a target machine.

Another large-scale legal issue that the team is facing is the Data Protection Act (2018). The Act ensures that everyone responsible for holding personal data must follow certain rules called data protection principles. (Crown, 2018)

These rules make sure that the information is used lawfully and fairly, kept for no longer than necessary, and handled in a way that ensures the information is given appropriate security measures where necessary. This is so that the information is protected against unauthorized processing and access as well as destruction or damage.

In conjunction with these rules, the Data Protection Act also gives the users the right to know what information is being stored by the Government and other organisations.

If the data is successfully extracted from the system, the owner or user of the Economical Duck could potentially be in violation of the Data Protection Act, depending on what information was on the target machine at the time of the insertion of the device.

To ensure neither of these acts are violated, full testing of the device will only be carried out in the Hack Lab (Abertay University, n.d.). This space is designed for the use and development of malicious code and tools. Therefore, permission is granted to carry out rigorous testing in this workspace without the risk of breaching either of these acts.

Once the device is in possession of the University, it will be their legal obligation to inform students of the potential legal ramifications that using such a tool bears, in order to avoid accidental misuse.

3.3 Team Structure

Team 404 consists of Christopher Clark, Lewis Goor, Connor Duncan and Sunny Sherry, four Abertay University students who are currently in their third year of study in the field of Ethical Hacking. Due to the nature of this degree, it has allowed them the opportunity to gain an in-depth knowledge and understanding into the cybersecurity field. This project is aimed at helping Ethical Hacking students understand the damage that a device such as the Economical Duck can cause on a computer system.

Dr. Xavier Bellekens is one of the lecturers on the course and has agreed to act as the subject matter expert and client for the project as part of the CMP308 Professional Project Planning and Prototyping module.

Each member of the team has been assigned a different part of the project to focus on.

Christopher Clark is the manager of the team and responsible for ensuring consistent progress is being maintained throughout the project. Christopher will act as the SCRUM Master, meaning he will establish an environment where the team can be effective and clear any obstacles to ensure the team's progress throughout the project. (Agile Alliance, n.d.) During the development phase, he will also supervise both the hardware and software teams – resolving any issues that arise during the project. He will also help in resolving any disputes within the team and if a decision comes to a split vote, he will be responsible for making the final decision.

Sunny Sherry will be responsible for the development of the hardware side of the project. Along side this, Sunny will be assuring the quality of the Economical Duck and act a user for software testing.

Connor Duncan will act as the secertary for any meetings during the project. This means he will keep track of the minutes and organise any discussion points. Connor will also be one of the primary software developers for the project.

Lewis Goor will be responsible for mantaining version control throughout the project. This will include keeping a version log of any documents and any changes to code through the project. Lewis will also be the second software developer for the project.

These specific roles within the team are not fixed and would be considered flexible. This is due to the possibility that for the team to meet a specific deadline, they may need to assist other members in carrying out their tasks and objectives, or a team member could be vacant for an extended period of time, in which case the other members will have to pick up the work until their return.

3.4 Goals and Objectives

The main objective of the project is to create a cheaper alternative to a USB Rubber Ducky that Ethical Hacking students can use during their time at Abertay University. This is a device which has the capability to input user-defined key presses into any computer that it is plugged into at a high rate of input. The Economical Duck can be used to complete any tasks that a human is capable of doing on a computer, but can execute the commands in a fraction of the time.

There are three major short-term goals for the project. The first is to research and develop a keypress injector for the Raspberry Pi Zero. This will be configured to use the Economical Duck Scripting language (EDS) which will define the keypresses that the Economical Duck will send to the target PC.

The second goal is to configure the Raspberry Pi to simultaneously act as a Human Interface Device and USB Mass Storage device. This will allow a student to extract files from a target PC back onto the Economical Duck for future examination.

The final goal is to develop a manual that explains how to configure a remote server to receive data and files from a target PC. This will demonstrate to students how they can extract data over the internet through this type of device.

Due to the client being a computing lecturer, this project would be of significant use to their personal goals as Dr. Xavier Bellekens' objective is to educate students. With this device, the client can show the effects of plugging an unknown USB device into a computer, and the damage that can be caused by something that appears to be innocent and benign.

The intended long-term goal of the project is to continue maintenance by fixing any bugs that the users have discovered. By doing so, this will increase the lifespan of the Economical Duck and decrease the user's frustration when the device does not work as anticipated.

In order to ensure the success of the project, the daily operational goal is to be as organised as possible. This will be achieved through setting up meetings twice a week to allow group members to raise any concerns or issues that they have encountered since the last meeting and give the group an update on the current stage that they are at with their part of the project. Team 404 also plans to have fortnightly meetings with the client so that they are kept up to date with the teams' progress and to gain informative feedback on the current iteration of the Economical Duck. This will help ensure the client will be satisfied with the final product and allows for plenty of opportunity to give valuable input on what sort of features they are looking to be included.

3.5 Stakeholders

For the Economical Duck, there are three major stakeholders that are interested in the final creation of the project. The first stakeholder is Dr. Xavier Bellekens. Dr. Bellekens is the client for this project and as such has a major influence over it. The team plans to have fortnightly meetings with the client in order to update him on the progress of the project and for the team to gain feedback about the progress that has been made. However due to the client being extremely busy with his own personal projects, the team will be more flexible with the arrangement of meetings and will work around what is convenient for him.

The second stakeholder in the project is Team 404 as a group. As the people developing and creating the Economical Duck, the team have a vested interest in making sure the project succeeds and ensuring the client is satisfied with what is being produced. The team will have bi-weekly meetings to discuss the progress that each individual member has made towards the final development of the device, as well as talking about any challenges that they may have come across. In addition to these meetings, the team also communicate on Slack, which is a platform that lets the team members talk about the project, as well as set up their bi-weekly meetings. Slack also allows them to share files and links across the platform that could help in the research and development stages of the device.

The remaining stakeholders are the other Ethical Hacking students. These students are who the team is pitching and creating the device for. This will be so that they can use it in their course to gain an understanding into how penetration testing devices work and how they can be used to extract information. It can also be used for any other projects that they want to use the Raspberry Pi Zeros for. The team created a survey to give to the students which had questions for them relating to the device and what they would require of it in terms of the six key performance indicators.

Once the device has been successfully created and is functional for the students to use, the team will have two focus groups with Ethical Hacking students to get input on what they think of the Economical Duck in terms of the teams performance indicators.

3.6 Risks and Issues

There are two critical risks that can have a serious impact on the project. These risks are the specification taking longer than expected, and unexpected errors arising during the creation of the Economical Duck. The specification may take longer than anticipated for several reasons, such as forces of nature, coding or testing stages taking longer than expected, or scope creep. Unexpected errors may arise during the coding and testing stages. This will naturally result in a delay of progress towards the affected stage. In order to reduce these risks, extra time has

been allocated to the coding and testing stages, and a large buffer has been added to the end of the project.

Another risk identified is the failure of a Raspberry Pi Zero whilst developing the device. This could happen while either putting the code onto the device in which the Raspberry Pi could corrupt, or a hardware failure that could arise. The team already had an electrical fault break one of the Raspberry Pis that they were given for research. In order to reduce the risk of any more Raspberry Pis breaking, Team 404 will develop their code on a different computer and then test it on the Raspberry Pi separately. By doing this it will reduce the wear on the Raspberry Pi and stop the team losing any progress if the Raspberry Pi does break.

An additional smaller risk that could be harmful to the development of the device could be either the device itself or the key presses that the Economical Duck will send to the target PC, therefore breaking or harming the computer. It is possible that if the Raspberry Pi is setup incorrectly and not given the right commands, then the device could crash the target PC or Raspberry Pi. To reduce the risk of this occurring, the team will only plug the device into one of the computers in the Hack Lab, as they can be easily reset if the software on them becomes corrupt as they are provisioned for this type of work.

4 HIGH-LEVEL BUSINESS IMPACT

Dr. Xavier Bellekens and Team 404 both have several ongoing activities outside of this project which could potentially impact the development of this product. This could disrupt the team's availability throughout the week, meaning that the team will need to be flexible in their scheduling of meetings.

In terms of the client's ongoing activities, the majority of these will be significantly more important than meeting with the team and keeping an eye on the Economical Duck project. Since Dr. Xavier Bellekens is a university lecturer, there will be multiple lectures to spend time creating and presenting to the students, as well as creating course content and marking coursework.

In addition to this, the client will also have their own personal projects to study and work on in their personal time, which could mean that the team may be unable to regularly organise a meeting to discuss any challenges or queries in relation to the project.

For Team 404, the members of the team will have additional coursework for their other modules to complete that could take precedence over the project at certain stages of its development. They will also require time to study for their other modules.

Some team members also have part-time jobs or hobbies that will require their time and will need to be considered when arranging meetings or giving time for the development of the project. In most cases, this will be completely unavoidable and will take priority over consistent scheduling for the project.

As seen above, both Team 404 and the client will be occupied with tasks outside the project throughout the development of the product. It is possible that this could impede the progress of the Economical Duck due to delays or the scarce availability of the client due to their other commitments.

To avoid any major disruptions to the project which would affect the development time, these factors will be kept in mind by re-arranging meeting times to suit both the team and the client, and organising extra project sessions to catchup should Team 404 fall behind from these delays.

Should Dr. Xavier Bellekens be unavailable for an extended period of time, Christopher Clark will be the team member responsible to use the key information he has gathered from previous conversations with the client to make a decision regarding the project.

Throughout the project, Team 404 will measure its performance by using the SCRUM 'Burndown Chart'. This will be used to get a visual representation and a clear estimation of how well the team is on schedule with respect to the deadline, and how much work is required to finish the project on time.

5 ALTERNATIVES AND ANALYSIS

Team 404 researched and compared possible alternatives to decisions made in the project in order to justify the conclusions the team have come to.

Arduino VS Raspberry Pi Zero

An Arduino runs real-time C/C++ and does not boot from an operating system, meaning the device has faster execution of a payload as well as lower power requirements. Alongside this, Arduino's are much smaller in size when compared to a Raspberry Pi, thus more portable and easier to conceal. (Arduino, n.d.)

However, when compared to a Raspberry Pi, they are much more difficult to debug, and thus might take up more time to develop. Alongside this, an Arduino has a limited memory capacity for compiled code, which may restrict the number of features that the team can include in the final product.

In comparison, a Raspberry Pi is essentially a mini-computer, offering a much larger storage and memory capacity, a GUI that will make development simpler, a faster processor as well as more compatibility for other features and code - for example Python, C/C++ and Java.

The issue with using a Raspberry Pi is that it is a much larger device and will require an external power source to remain powered on between computers. Otherwise, it would have to be booted up each time, which could take longer than the team would want it to. This in turn will increase the size of the full device, making it more obvious that it is more than just a normal USB device.

After considering the advantages and disadvantages of each product, the team decided that it would be best to go with the Raspberry Pi for the project over the Arduino. This is largely because the team can add more features to a Raspberry Pi than an Arduino, and even though the product may be bigger in size and won't appear to be a normal USB device, that isn't a concern as its intended purpose is for students to use as an educational tool.

Rubber Ducky VS Raspberry Pi Zero

A Rubber Ducky is a "Commercial off the Shelf" product from Hak5™, which acts like a keyboard when plugged into a computer and will type in a set of keystrokes defined on a Micro SD card on the device (hak5darren, 2017).

The advantages of this when compared to a bespoke solution developed on something such as a Raspberry Pi Zero is that it is much more compact as it has been specifically designed and custom made to look like a USB pen drive. Although this gives the product the appealing advantage of looking inconspicuous, this isn't entirely necessary for the team as their main objective is creating a device that Ethical Hacking students can use to gain an understanding of what these types of penetration testing devices can do to a computer system.

The device will also come with a warranty which means that it has been thoroughly tested and will be covered for a certain amount of time before the device would not be replaced if it were to fail. This means Hak5™ has a responsibility to ensure that the device will not fail easily or damage someone's computer.

The disadvantages of using a Rubber Ducky is that it is much more expensive, making it economically unviable to give one to every student in a class. It also has no room for expansion or future development beyond making payloads for the device. This makes it much less of a learning device and makes it less suitable for a student environment.

After considering the advantages and disadvantages of each product, the team decided to go with the Raspberry Pi for the project over a commercial solution such as the Rubber Ducky.

Team 404 creating their own Driver VS using existing Drivers

Making your own drivers is extremely difficult and complex. For them to function properly they must strictly conform to USB standards and be implemented in a way that all computers and devices will understand. There is very little room for customization or any real reason for this project to have a bespoke driver for the team's device. This would greatly increase the time required to create such a device.

The only possible reason this would be done is that it would be a learning experience during the team's time at University. Even though this would be something that could help them in their careers past University, there is no real basis that creating the driver would help in this project.

The only other advantage that the team feels could be gained from creating their drivers would be a small potential performance increases in the projects' specific scenario. However, it is highly unlikely that the team has more experience than the Linux developers to find these sorts of minor performance gains and as such, the team saw little reason to waste development time for no real advantages to the project, they decided to use the drivers that come included with the Linux Kernel. (kernel.org, 2013)

Local Storage and Remote Exfiltration

Local storage exfiltration has some advantages when compared to remote exfiltration. The one main advantage is that network security features cannot block or log the outgoing packets as the data is sent entirely on the local device. Where the network is tightly controlled, or in air-gapped systems where there is no external network connectivity, the data can still be removed from the computer system in a high security environment.

The disadvantages are that the device could be lost or damaged before someone recovers the information from it. This is much more likely than a server failure as the device will be subject to many external factors. These external factors could include the weather - where the device could be subject to getting wet and therefore has the possibility to short-circuit the Raspberry

Pi, wear and tear as it could be dropped and potentially damaged, as well as other unforeseen circumstances that could occur during the recovery of the data. It is also possible that USB storage devices will be blocked on the local device, meaning that no unknown USB storage devices can be plugged into the computer and mounted. This would prevent the files from being transferred on the device to begin with, and the operator may not notice this until after they are finished with the device.

The advantages of remote exfiltration are that once the data has left the local network, they will no longer have any control over what data has been sent. In addition to this, if the device is lost or broken the extracted data will still have been remotely sent across to the server where it will reside for the attacker to read and potentially use to gain access to the system.

After considering the advantages and disadvantages of both approaches, the team decided that they would primarily develop the local storage exfiltration and create a manual for the remote extraction, which will provide the relevant details on how to set up the web server and how the student can take the information from the target machine and upload it to that server.

Network Adapter viability

Early in the project, having the device also appear as a RNDIS (Remote Network Driver Interface Specification) USB to Ethernet adapter was discussed. The advantages of this would be that the team could configure it to probe firewalls, fingerprint the device, snoop on DNS requests, and use it as a third form of exfiltration. You could also use the connectivity to control the other functions (Mass Storage and Keyboard) through the Wi-Fi or Bluetooth connectivity if you have left it plugged into a computer.

The disadvantages are that it could potentially be very complex to develop and configure fully and take a lot of development time to get working correctly. As well as development time, it would also take up a lot of the teams' research time to understand how to make the feature work as reliably as they would want it to. As such, they decided to not go with the idea of a network adapter and only research it further if they have more development time than they anticipated.

Summary

In summary, the team have decided to use a Raspberry Pi Zero as their choice of hardware for the project. This is due to the Raspberry Pi being flexible and having extra features, which allow the device to be configured for projects other than the Economical Duck.

The team will be using the pre-existing drivers for the Raspberry Pi rather than creating their own drivers. This is because the development time that would be spent on creating the drivers could be more useful elsewhere, such as the coding and testing stages of the project, with no real advantage coming of creating the driver.

Team 404 have also agreed on primarily using local storage as the means of extraction, however they will also be creating a manual as an example of remote exfiltration. This gives the user of the device an option to create a web server to send the information to, or to just use the local storage options included on the device.

In addition to not going with the creation of a driver, they have also decided to not go with the network adapter as a feature. Deciding against this was mainly due to the time it would take to research and develop this complex functionality, as it is unlikely that the team would be able to include this feature as well as providing a high quality product for the deadline.

6 PREFERED SOLUTION

6.1 Preliminary Work Breakdown Structure

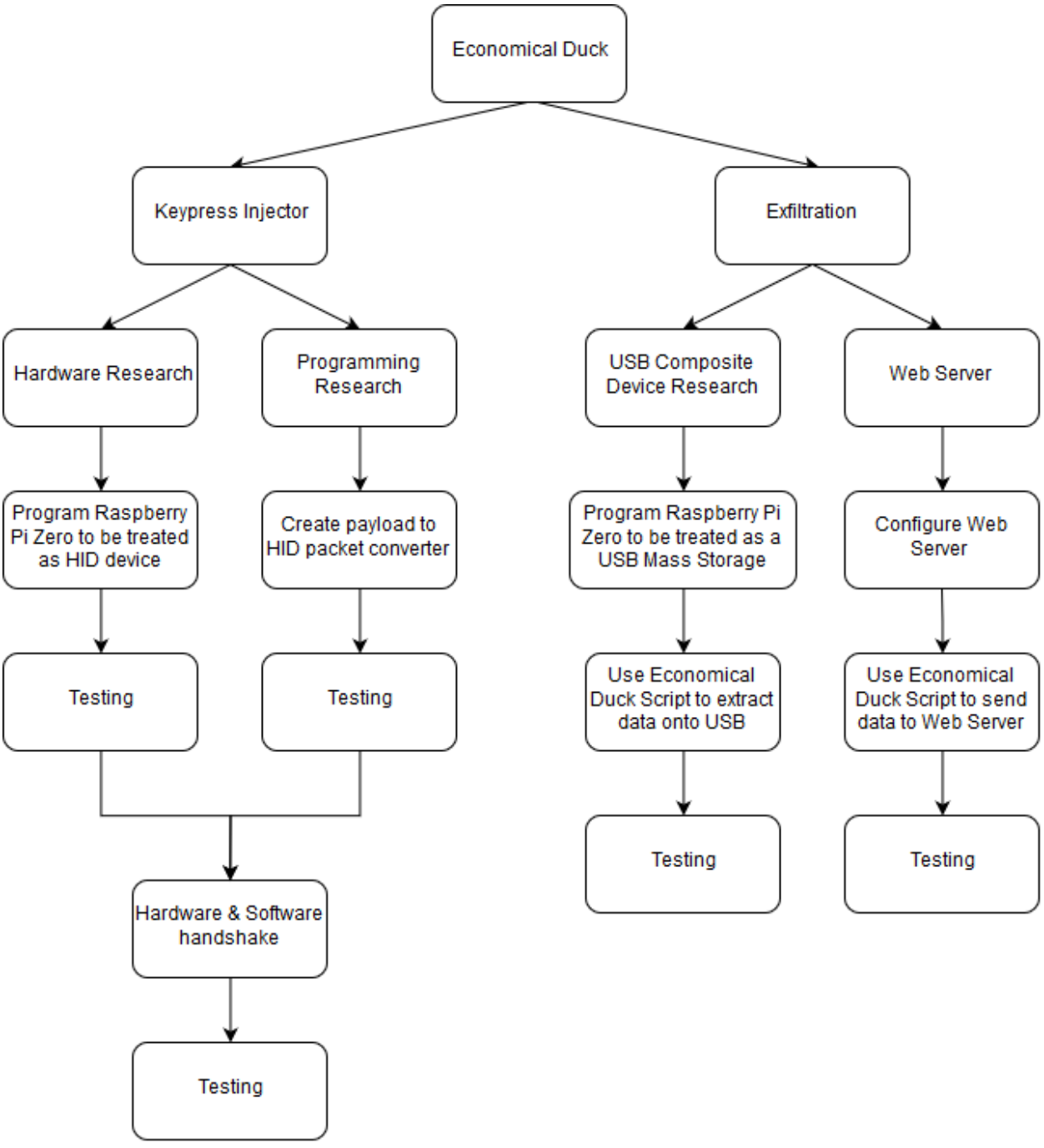


Figure 1 - Preliminary Work Breakdown Structure

Team 404 intends to use the SCRUM methodology to further breakdown tasks within the Work Breakdown Structure diagram above, and form them into sprints to get through work and testing in an efficient and organised manner.

6.2 Assumptions

Team 404 have made several assumptions throughout the course of this project.

It is assumed that all four team members will be available throughout the duration of the assignment. This is due to no team member having any significant planned absences in the future that would stop them being able to carry out their assigned tasks.

The team is expecting to have full access to the Hack Lab and the library throughout the full duration of the project. (Abertay University, 2018) The Hack Lab is required to carry out testing and development on the Raspberry Pi Zero, and the library is required for research purposes. Neither the Hack Lab nor the library are planned to undergo any significant work that would limit the accessibility and thus it can be taken as a given that it will be available during university hours.

Team 404 has assumed that all members are competent in the security field, due to all members being in their penultimate year studying an honours degree in Ethical Hacking.

For obvious reasons, access to a Raspberry Pi will be required throughout all stages of the project. This Raspberry Pi will be supplied by the university. It is therefore assumed that the Raspberry Pi will be available at any time.

Upon completion of the project, it is understood that the University will want to use the Economical Duck. This is due to the Economical Duck being an educational tool that is capable of advancing students' knowledge in the security industry and develop their hacking skills. This tool will also be able to assist lecturers in their lectures and labs.

It is understood that the client, Dr. Xavier Bellekens, will be available for consultation at regular intervals – approximately every other week. It is also assumed that contact with Xavier via email will always be possible.

The final assumption that has been made is that the Linux drivers will not change for the duration of the project. If they were to change, it could result in the Raspberry Pi needing to be setup differently. However, there appears to be no upcoming changes to the current driver, as it appears to be stable.

6.3 Constraints

Alongside the assumptions, several constraints have also been presumed. Team 404 understands that every team member has commitments outside of the group project. These commitments will in turn limit their times of availability and will need to be taken into consideration when organising group tasks such as meetings, or dedicating time to research and develop the product.

A similar constraint can be said for the client. The client will also have outside commitments that will limit their availability, such as their own personal projects. This constraint will need to be worked around, with meetings being set up at predefined times in advance, and not last minute.

The Hack Lab and library will not be available all the time. The Hack Lab will not be available due to other classes having booked out the lab, and due to university opening hours. The library will also not be available out with university hours, and it cannot be assumed that a private room will be available during the teams meeting times.

The final constraint is that there will be a limited timeframe to complete the project. This means that the team must work to the deadline date, and all work up until that point must be structured to maximize time usage.

7 DETAILED PROJECT PLAN

7.1 Project Breakdown Structure and Software Requirements

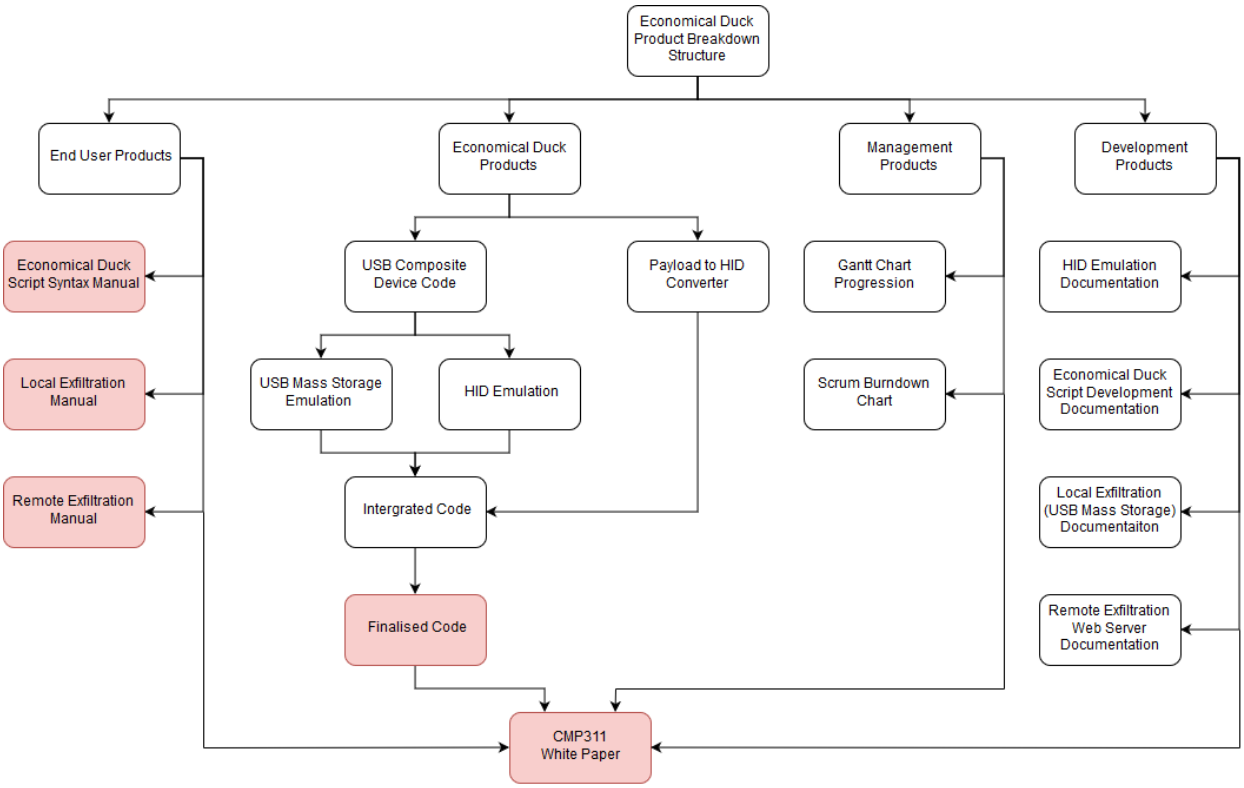


Figure 2 - Product Breakdown Structure Diagram

The boxes highlighted in Figure 2 represent the main products that have been identified within the work breakdown structure.

The 'Finalised Code' is the Economical Duck in its completed state, ready for use by the stakeholders. This product has three major requirements:

The first requirement is for it to be able to take the Economical Duck Script (EDS) and rapidly convert it to HID Packets to be sent to the target PC.

The second requirement is for EDS to allow a user to intuitively describe what keypresses they want the product to send to the target device, allowing them to easily create payloads for the Economical Duck.

The final requirement is for it to be able to act simultaneously as a USB mass storage device and a keyboard over one USB port. This will allow a user to extract files from a target PC, and copy it onto the Economical Duck for later examination.

The ‘End User Products’ are key in conveying to Students how to use the Economical Duck, and the capabilities that it has. By doing this, students will be inspired to experiment down other avenues, and develop other useful functionalities for their own purposes. This includes the EDS Manual, the Physical Exfiltration Manual, and the Remote Exfiltration Manual.

The EDS Manual will explain the syntax of the scripting language for the device. This manual will be the main document users will be referencing during the device. The main requirement for this manual is to express all the functionality of the Economical Duck to a complete beginner. This includes how to write scripts for the device and how to transfer new payloads onto the device.

The Physical Exfiltration Manual will explain how to transfer files from the target PC to the Economical Duck. This document will be aimed at intermediate users of the device who have experimented with EDS and understand its basic syntax. This will have two major requirements:

This first requirement is to provide examples for each major operating system in EDS of how to extract files to the Economical Duck with explanations of how they work.

The second requirement is to describe the process of how to transfer these files from the Economical Duck back to the user’s PC for examination.

The Remote Exfiltration Manual will explain how to set up a web server to receive data from a target PC. This will be aimed at advanced users who have a solid understanding of Linux and EDS. This document will have three major requirements:

This first requirement will be to explain how to set up a web server to receive data from the target PC.

The second requirement will be to explain how to retrieve this data for examination.

The final requirement of this document will be to provide examples for each major operating system in EDS on how to extract files to the web server with detailed explanations of how they work.

For the purpose of these manuals, the major supported operating systems will be Windows 10, Ubuntu 18.04 and macOS Mojave.

Finally, the ‘CMP311 White Paper’ encompasses the entirety of all the work the team does in this project and will be the most time-consuming product to create. This is a requirement of the CMP311 module and will layout all the research from the project, assess the viability and success of the product, and reflect on how the team worked during the creation of the device.

7.2 Activity Plan

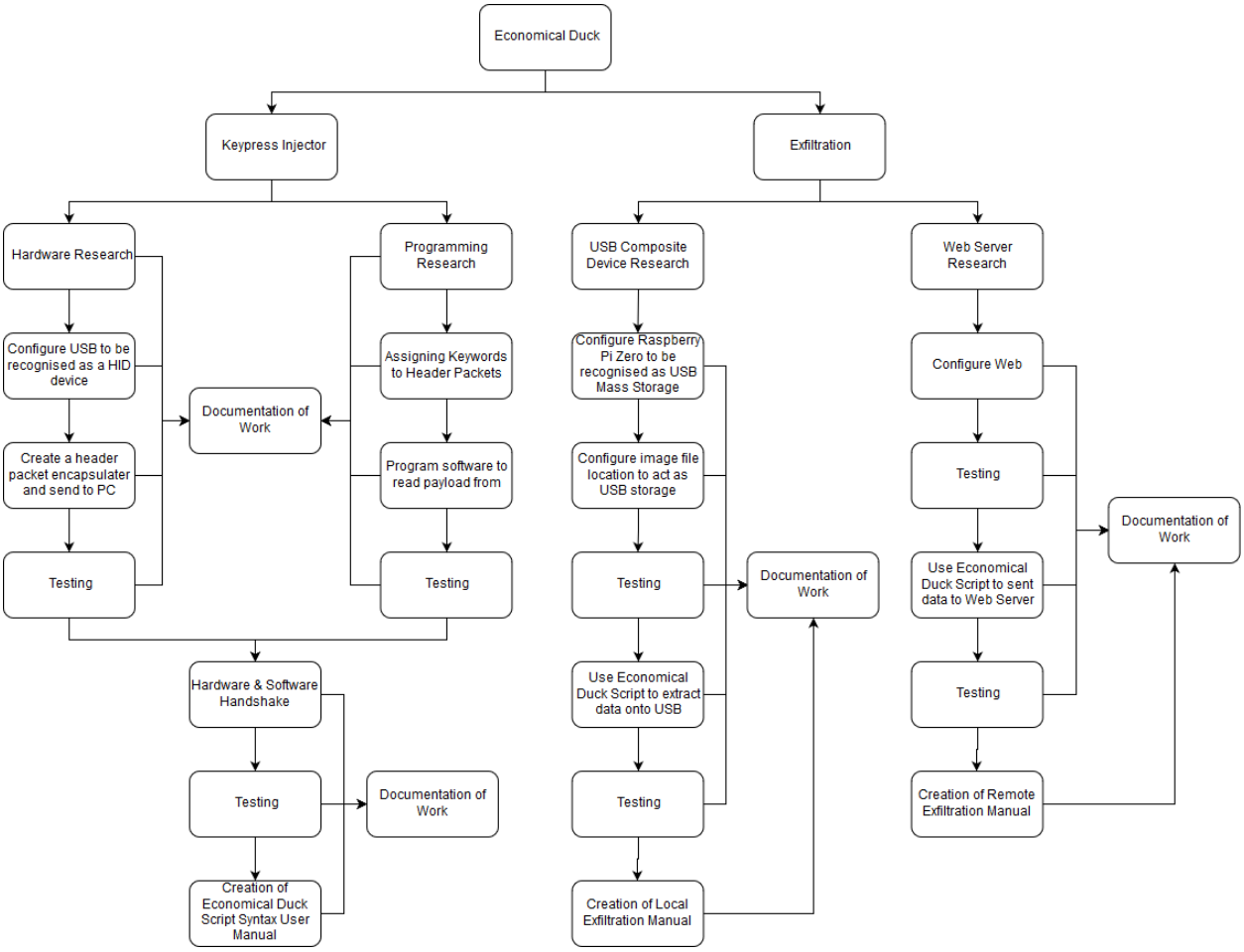


Figure 3 - Activity Plan

The Activity Plan for the team is divided into two sections - 'Keypress Injector' and 'Exfiltration', with subsections of work that are related to each area's main focus.

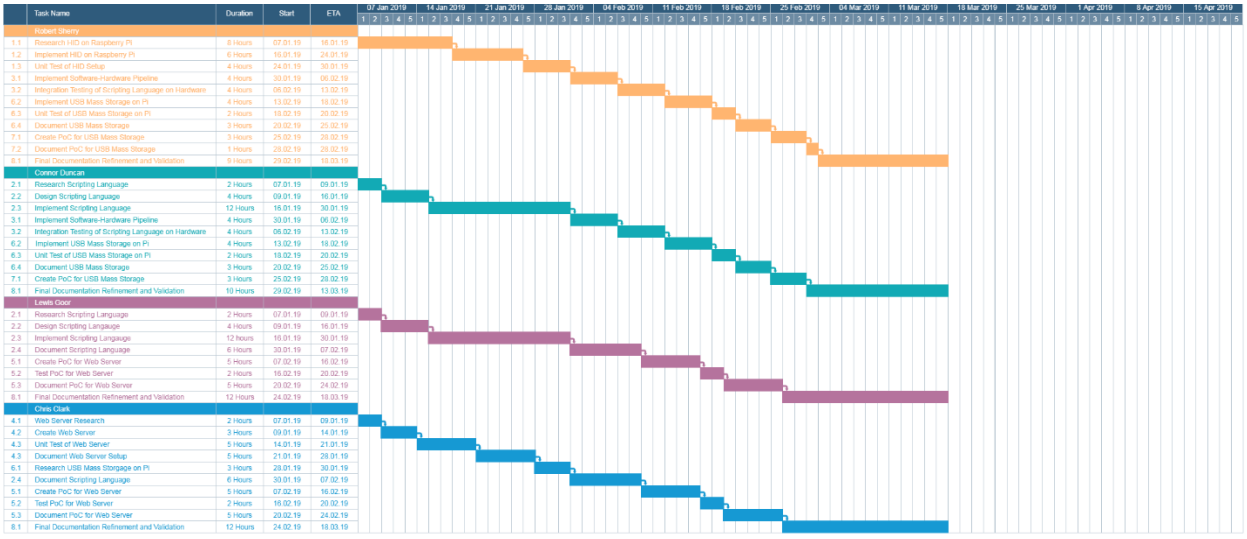
The Keypress Injector's side of work is regarding everything to do with the creation of the keyboard emulator, from being configured to be treated as a HID device and given a converter to translate payloads into HID packets to user manuals for the stakeholders to read and understand the device from.

The Exfiltration side of work is to do with all work that is related to the extraction of data from a plugged in machine. This will cover both local exfiltration via data storage upon the Economical Duck itself, as well as remote exfiltration through the use of a pre-setup web server to retrieve and store data sent from the plugged in machine.

Both sides will be performing testing after each main step to ensure the work done was performed as expected. This will avoid any glaring errors and ensure code is stable before moving onto the next stage.

Finally, all work will be documented into the White Paper mentioned in section 7.1 (Figure 2 - Product Breakdown Structure Diagram) throughout the course of the project to ensure thorough documentation exists on the process taken to create the product from start to finish.

7.3 Resource Allocation and Timeline



	Task Name	Duration	Start	ETA
	Robert Sherry			
1.1	Research HID on Raspberry Pi	8 Hours	07.01.19	16.01.19
1.2	Implement HID on Raspberry Pi	6 Hours	16.01.19	24.01.19
1.3	Unit Test of HID Setup	4 Hours	24.01.19	30.01.19
3.1	Implement Software-Hardware Pipeline	4 Hours	30.01.19	06.02.19
3.2	Integration Testing of Scripting Language on Hardware	4 Hours	06.02.19	13.02.19
6.2	Implement USB Mass Storage on Pi	4 Hours	13.02.19	18.02.19
6.3	Unit Test of USB Mass Storage on Pi	2 Hours	18.02.19	20.02.19
6.4	Document USB Mass Storage	3 Hours	20.02.19	25.02.19
7.1	Create PoC for USB Mass Storage	3 Hours	25.02.19	28.02.19
7.2	Document PoC for USB Mass Storage	1 Hours	28.02.19	28.02.19
8.1	Final Documentation Refinement and Validation	9 Hours	29.02.19	13.03.19
	Connor Duncan			
2.1	Research Scripting Language	2 Hours	07.01.19	09.01.19
2.2	Design Scripting Language	4 Hours	09.01.19	16.01.19
2.3	Implement Scripting Language	12 Hours	16.01.19	30.01.19
3.1	Implement Software-Hardware Pipeline	4 Hours	30.01.19	06.02.19
3.2	Integration Testing of Scripting Language on Hardware	4 Hours	06.02.19	13.02.19
6.2	Implement USB Mass Storage on Pi	4 Hours	13.02.19	18.02.19
6.3	Unit Test of USB Mass Storage on Pi	2 Hours	18.02.19	20.02.19
6.4	Document USB Mass Storage	3 Hours	20.02.19	25.02.19
7.1	Create PoC for USB Mass Storage	3 Hours	25.02.19	28.02.19
8.1	Final Documentation Refinement and Validation	10 Hours	29.02.19	13.03.19
	Lewis Goor			
2.1	Research Scripting Language	2 Hours	07.01.19	09.01.19
2.2	Design Scripting Language	4 Hours	09.01.19	16.01.19
2.3	Implement Scripting Language	12 hours	16.01.19	30.01.19
2.4	Document Scripting Language	6 Hours	30.01.19	07.02.19
5.1	Create PoC for Web Server	5 Hours	07.02.19	16.02.19
5.2	Test PoC for Web Server	2 Hours	16.02.19	20.02.19
5.3	Document PoC for Web Server	5 Hours	20.02.19	24.02.19
8.1	Final Documentation Refinement and Validation	12 Hours	24.02.19	13.03.19
	Chris Clark			
4.1	Web Server Research	2 Hours	07.01.19	09.01.19
4.2	Create Web Server	3 Hours	09.01.19	14.01.19
4.3	Unit Test of Web Server	5 Hours	14.01.19	21.01.19
4.3	Document Web Server Setup	5 Hours	21.01.19	28.01.19
6.1	Research USB Mass Storgage on Pi	3 Hours	28.01.19	30.01.19
2.4	Document Scripting Language	6 Hours	30.01.19	07.02.19
5.1	Create PoC for Web Server	5 Hours	07.02.19	16.02.19
5.2	Test PoC for Web Server	2 Hours	16.02.19	20.02.19
5.3	Document PoC for Web Server	5 Hours	20.02.19	24.02.19
8.1	Final Documentation Refinement and Validation	12 Hours	24.02.19	13.03.19

Figure 4 - Gantt Chart

Figure 4 shows a detailed workload breakdown for each member. The Gantt chart clearly breaks down what activities each member must undertake, and within what timescale each task needs to be completed. A buffer has been added at the end to cater towards the critical risks identified in section 7.9, regarding the specification taking longer than anticipated and unexpected errors during the creation of the Economical Duck.

In regards to allocation of Raspberry Pi Zeros throughout the team, this does not need to be taken into account at the start of the project as each side of development will have access to their own Rasperry Pi. However, the possibility of one of the Raspberry Pis failing still exisits. If this occurs, Christopher will allocate the remaining Raspberry Pis equal time between the two teams to ensure progress does not stall until the other team's Raspberry Pi is replaced.

A full-page version of the Gantt chart can be seen in Appendix F – Diagrams.

7.4 Identification of Critical Path

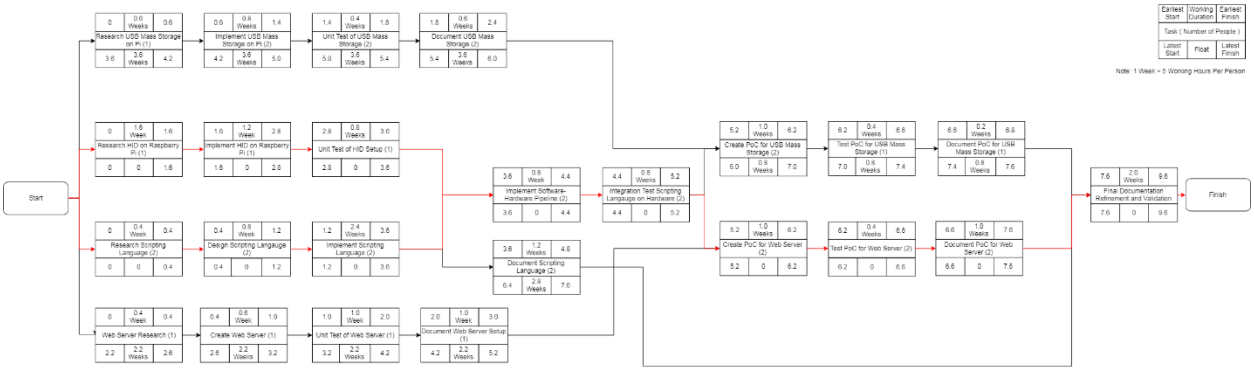


Figure 5 - Precedence network diagram

The critical path was determined from the precedence network seen in Figure 5. The precedence network shows what parts of the projects are dependent on previous tasks. Progress cannot be continued until all dependencies have been met for that part of the project. The critical path is the tasks that cannot be delayed without delaying the entire project, and hence have no float.

In this case, the critical path for the project is the development of the code required to create the HID keypress injector as the first half, as without this it is impossible to move onto the exfiltration step, due to a working EDS syntax being required. After integration testing moves on, remote exfiltration work is the next step along the critical path due to its documentation taking longer than that of USB mass storage, since a setup and step-by-step guide needs to be compiled.

7.5 Identification of Costs and Benefits

7.5.1 Benefits

The Economical Duck has numerous benefits for the client.

A standard Rubber Ducky costs £34.21, whereas a Raspberry Pi only costs £17.40. What this means for the client, is that if they were to buy ten Economical Ducks, then they would save on average £168 compared to a Rubber Ducky. It is apparent how much money could be saved by the university in the long run by buying Economical Ducks instead of Rubber Duckys. This will in turn also allow university students to have a better experience as they will have a wider range of educational tools to be used throughout their academic careers.

Due to the Economical Duck being built on a Raspberry Pi Zero, it has the all the extra functionality that comes with it. If the student wishes, then they will be able to reconfigure the Economical Duck to use other features that are included with Raspberry Pi.

The Economical Duck will also be able to demonstrate in lectures the hacking capability of penetration testing devices. This will allow lecturers to have additional content to teach students. Students will also then be able to gain hands on experience with pen-testing devices in the labs, thus increasing the quality of students graduating from the university.

By including manuals and documentation for the project, it allows students to be able to expand on the project and add other components to it. For example, a student could undertake the project of adding a network adapter to the Economical Duck. As a result of including the manual, it expands the opportunity for creativity with what the students can do with the device.

As a direct result of what has previously been mentioned, the client's reputation will increase, as they have made the university a better place for students to study.

7.5.2 Costs

The costs that will come throughout the creation and post-creation of the Economical Duck are, but not limited to: salary, cost of the Raspberry Pi Zero, and the possibility of the Raspberry Pi breaking the target PC.

It is estimated that 240 man-hours will be put into the creation of the Economical Duck. If Team 404 were to be paid minimum wage, then the total cost would be £1500. This is calculated from the minimum wage for Connor Duncan, Sunny Sherry and Lewis Goor being £5.90, and the minimum wage for Christopher Clark being £7.38.

There will also be the cost of running the facilities the team will be using to develop the Economical Duck. This will include things such as electricity, heating, and cleaning. However, as Team 404 is only using facilities provided by the university, the decision was made to have this excluded from the project costs.

As Team 404 is not being paid for this project, the team estimates the budget for this project to be around £80. This should cover the costs of the Raspberry Pis for development as well as any cost of replacing these if they should fail during development.

7.6 Justification of Project Approach and Project Methodology

The team has decided to use the Agile methodology and implement SCRUM as the framework for the project. Three different methodologies were considered – Agile, Waterfall and Spiral. The team considered the pros and cons of all methodologies and decided that Agile would fit this project the best.

One of the main reasons Agile was used is because of its iterative design. With Waterfall it is not designed to be able to move back to previous stages of design and development. This is because there should be no need to iterate backwards, as everything that is within the scope of the project is decided in a top-down fashion and should not need to be changed once completed. If changes are required, they will be costly as it will affect every stage after, and it will require a large amount of time to correct them.

With the Economical Duck project, it is likely that the team will frequently be switching between the coding and testing stages. Therefore, the decision to use a methodology with an iterative design was made. Agile is designed for developers who need to iterate backwards several times throughout the course of the project, thus making it an attractive option.

As previously mentioned, with Waterfall all features and functions of the product are set out at the start. This means that the product cannot be changed throughout the course of the project to include or remove features or functions. With the Economical Duck, this is not ideal as the client could decide to change their specification, or the team could decide that a feature is not worth developing. On the contrary, the team may also decide they want to add in more features. With the Agile design, it allows the team to make these changes throughout, thus not restricting the ability to adapt the product.

Another benefit is that Agile is better suited towards smaller teams. The reason for this is because Agile relies on communication between team members and for them to self-organise to solve the problems at hand.

The team has decided to use SCRUM as the team's implementation of Agile. This is because SCRUM is designed with frequent meetings both within the group and with the client. This allows for changes to be made at a much faster pace, and the increased interaction with the client gives them the opportunity to give input at every stage. Team meetings also ensure that all team members are kept up to date with what tasks have been completed, what tasks need to be prioritised, and what stage each team member is at with their tasks. This communication allows other team members to adjust their timeframe and workload to keep the project moving smoothly. A lack of good communication would seriously impact the project completion date, and due to the strict deadline, this was ultimately what solidified the decision to use Agile for this project.

On the other hand, Waterfall relies on documentation over team communication – this means every time a part of the project is changed, all the documentation must be updated. This is very time intensive, and the lack of frequent communication with the client means that their input will not be received until later in the project – meaning that if they are unhappy with the project, changes that need to be made will have significant costs attached to them as it is likely that every stage will need to be revised and any documentation already created will need to be updated.

The team also investigated using the Spiral methodology, however they decided against it for several reasons. One of the reasons is that Spiral is not good for completing a project within a specific timeframe. The Economical Duck has a very strict deadline for which it must be created. Team 404 believes that if the Spiral methodology were to be implemented, then there is a high possibility that the project will surpass the deadline date.

In addition, there is a large amount of planning overhead that is required with the Spiral methodology. This could be difficult with the project, as a lot of the specific details cannot be decided till further research and design work has been undertaken. Furthermore, Team 404 does not have the man power to dedicate to the planning overhead required.

7.7 Version Control and Requirements Changes

Version changes will be a common occurrence throughout the project, so there will be several means of communication in place to ensure that every stakeholder at the relevant phase is up to date.

Dr. Xavier Bellekens will primarily be contacted via email or organised meetings.
For deliverables or simple questions, an email will be sent to contact him and for physical products, demonstrations or other important matters that require a face-to-face discussion, a meeting shall be prepared.

Team 404 shall be using Slack as their main communication platform for instant messaging and anything that requires a fast response from the team.
For developed code, the team will be using GitHub; and for documentation, manuals, and other miscellaneous files the group will be using OneDrive.
This is because they both offer version control, so that any erroneous changes can be reverted, and cloud access functionality so that the group can easily access files from anywhere – whether they are at home or the university.

Although students are a stakeholder in this project, they are not required to be kept in the loop for most of the projects lifecycle with the exception of the testing phase, during which they will be contacted to take part in focus group testing.

7.8.1 Quality Assurance

Team 404 will use the ISO 9126 software quality characteristics in order to assure the quality of the product. (Software Quality Assurance, n.d.) To assist with this, the team conducted a survey with students in the Hack Lab in order to gain an insight to their priorities.

The students were asked questions based on the ISO 9126 software quality characteristics to determine the importance of each of them to an average user. The team then discussed the relative quality ratings of the Economical Duck versus the Rubber Ducky based on the strengths and weaknesses of each product.

This data was used to create the table seen below (Table 1) which weights the relative quality scores against the survey data of the importance of each quality.

Product Quality	Importance Rating	**Economical Duck** Quality Score	Weighted Score	**Rubber Ducky** Quality Score	Weighted Score
Functionality	4	4	16	3	12
Reliability	4	3	12	4	16
Usability	4	4	16	4	16
Efficiency	4	3	12	5	20
Maintainability	4	4	16	1	4
Portability	3	4	12	5	15
Overall Totals			84		83

Table 1 - Table of Weighted Quality Scores against Economical Duck and Rubber Ducky

The way that the scores are weighted is the Importance Rating multiplied by the Quality Score.

These initial results are very promising as it shows that despite a Raspberry Pi Zero being half the price of a Rubber Ducky, the Economical Duck has the potential to be better than the Rubber Ducky in the overall weighted quality score totals.

This initial assessment will be used retrospectively at the end of the project in order to ensure the quality of the product. Team 404 will conduct focus group testing with users in the Hack Lab to determine whether the team have reached these speculative numbers.

Team 404 will split a group of ten students from the Hack Lab into two equal focus groups. The first group will be given the Economical Duck followed by the Rubber Ducky, and the second group will be given the Rubber Ducky followed by the Economical Duck. After the testing, they will be given an opportunity to provide general feedback, as well as a rating on each of the software quality characteristics.

If the Economical Duck is within a ten percent margin with the numbers outlined above, the project will be considered a success; if not, the user feedback will be used to determine where improvement is required, and the product will be developed for a second round of focus group testing.

7.8.2 Test Plan

During software development, errors can arise at every stage. These errors can cause significant frustration to end users and have a major negative effect on the overall user experience. Therefore Team 404 will conduct testing at every stage of development, so that these errors can be found and patched before the product is deployed to the full target audience.

During the planning phases, team members will design code, and that code will be assessed for errors by their peers. This will provide an additional perspective which will help reveal design errors before they are implemented.

Before the development phase begins, the developer will create a set of test data or actions based on regular, edge-case, and invalid inputs.

Regular input would be classed as valid input for that section of code. Edge-case input is what would be on the edge of what would be considered valid by that section of code, therefore testing the boundaries and limits. Invalid input is what should be rejected by that section of code and is input that should not run. Together these will be paired with an expected output for that section of code to determine if it is functioning as intended.

These test cases will be used throughout development to test the code, and more test cases may be added as the code is developed to fully cover all cases. At the end of each sprint they will be used to test the product to make sure that it is working as expected. This cyclical testing will form the white box testing of the product.

Once each deliverable has been completed it will be reviewed by another team member to ensure that it meets the user requirements. In the case of coding, this will make up the black box testing as this will be conducted by a member which is unfamiliar with that section of the product. This team member will also assist in writing the manual, as they will be able to offer a user's perspective and will help to ensure that it is easy to understand. (Project Management Institute, 2014)

7.9 Risk Management Plan

A risk can be defined as "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives". Several risks could potentially influence the progress and production of the Economical Duck. This section will delve into detail about these risks and how they will be handled if they are to arise. The risks that Team 404 have identified are categorized by their probability to happen and the resulting impact. This can be seen in the resulting table and chart below:

No.	Risk	Probability	Impact
R1	Team member experiences significant illness	Low	High
R2	Team member is unavailable for vital meetings	Significant	Significant
R3	Specification takes longer than expected	High	Significant
R4	Changes To requirement Spec during coding	High	Moderate
R5	Hardware failure	Significant	Moderate
R6	Coding takes longer than anticipated	High	Moderate
R7	Unexpected errors during the creation of the Economical Duck	High	Significant

Table 2 - Risk Probability Impact Table

Table 2 displays every probable risk, and compares them against their probability, and the resulting impact that they will have.

Every risk can be placed into one of five different categories: Risk transfer, risk reduction, risk avoidance, Risk acceptance and risk mitigation/contingency measures.

Critical Risks

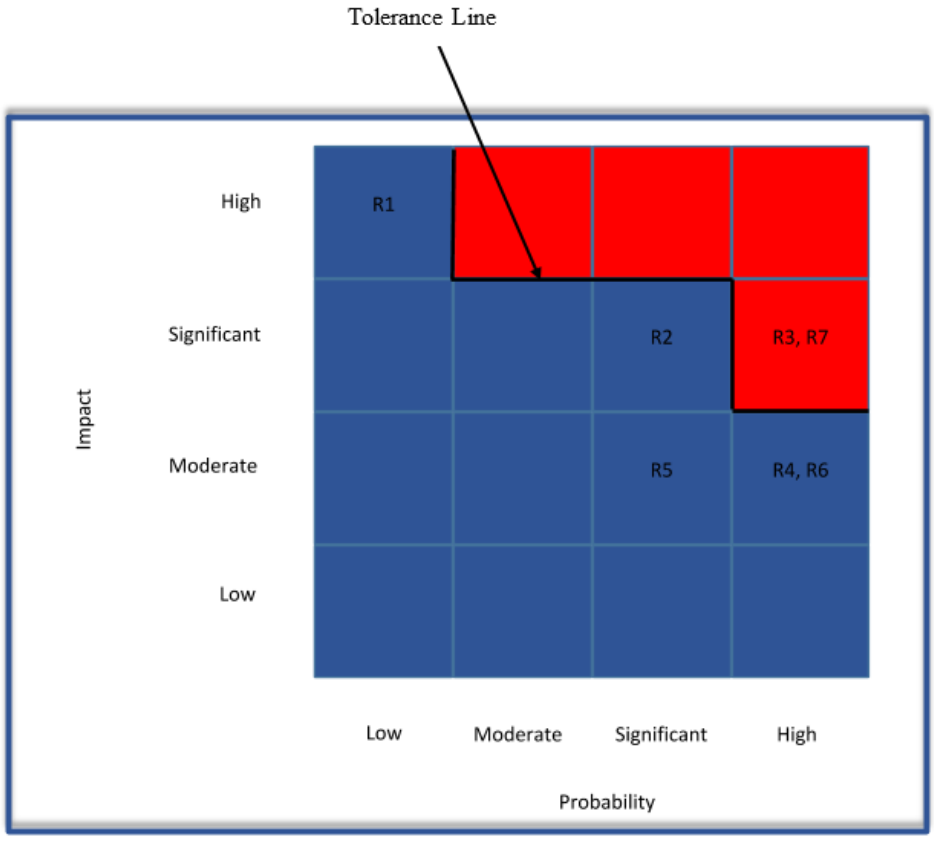


Figure 6 - Risk Probability Impact Matrix

Figure 6 shows the Risk Probability Impact Matrix. The risks that are above the tolerance line are deemed to have the highest probability vs impact rating. As a result, these risks will need to be investigated the most, with an effective plan being put in place if they were to occur.

Specification takes longer than expected

This critical risk falls into the risk reduction category. What this means is that Team 404 is aware that there is a high possibility of the risk occurring, and as a result have taken steps to reduce the likelihood.

The reason the team believes that there is a high possibility that the specification will take longer than expected is due to unforeseen issues arising during the creation of the Economical Duck that may require a greater depth of research than originally anticipated.

In order to compensate for the risk, the team has given themselves a large portion of extra time before the final product is due, to allow for these unexpected additional extended periods of development.

Unexpected errors during the creation of the Economical Duck

This risk also falls under the category of risk reduction and so steps must be taken to reduce the likelihood of it occurring. Unforeseen errors could arise during the creation of the device, which may result in a delay during the development process. Depending on the severity of the error, the time it takes to correct the issue could range from one hour to several days.

Due to this amount of time being entirely variable, Team 404 has allocated more time during the development and testing stages, and in addition has allowed a large remainder of time at the end of the project which can be used to fix any unexpected errors.

Non-Critical Risks

The five remaining risks that are below the tolerance line are not deemed critical. However, they still need to be addressed as there is still a possibility of them taking place which could delay the progress of the Economical Duck. These risks are highlighted below, along with their preventative measures that have been put in place.

Team Member Significant Sickness

This risk falls under the risk mitigation and contingency measure category. This means that there is no way to prevent the risk from arising. However, a plan can be put in place to limit the damage that would be caused if a team member was to become unavailable due to illness.

The team manager, Christopher Clark, will take up any work that has remained unfinished due to him being the one with the most knowledge across all sectors of the project and him having the most versatile workload out of everyone. If Christopher Clark was to fall ill, then the management across the group could potentially deteriorate. As a result of this, the team would ensure that more regular meetings would be put in place to compensate for the vacancy of Team 404's team leader and Sunny Sherry would take over as the first point of contact with the client until Christopher Clark returns.

Team member is unavailable for vital meetings

This type of risk falls under the category of risk acceptance. This means that it would be more cost-effective to continue the meeting without a team member than it would be to delay the meeting.

A team member could easily be unavailable for meetings. If the team agreed that their next meeting would be important to attend, then each team member should hopefully be able to make it. However, due to circumstances outside of the development of the project such as part-time jobs, other coursework and deadlines or personal issues, a team member may not be able to make the meeting. If this occurs, the team will continue having the meeting then inform the missing team member on what was discussed during the meeting and if they are required to complete any further actions.

Changes to requirement specification during coding

This risk falls into the risk reduction category. What this means is that Team 404 is aware that there is a high chance of the risk occurring, and as a result have taken vital steps to reduce this possibility.

The team have created a Gantt chart that shows the times and hours that are assigned to each individual part of the project, as well as each individual member. This preparation helps in keeping the team on track in terms of when specific parts of the project are to be completed. As the team knows that there is a high possibility of the specification changing during the coding stage, the Gantt chart can be consulted to determine whether the team has the time to add the feature and still reach the deadline.

Hardware failure

This risk falls under the risk mitigation and contingency measures. As previously stated, the risk cannot be prevented but a plan can be put in place to mitigate the potential damage.

Due to the Raspberry Pi Zero being a physical device, there was a possibility that it could break or fail. During the research stage of this proposal, the team was able to access a Raspberry Pi to conduct research and create an artefact to display. However due to an electrical fault that was out of the team's control, the Raspberry Pi failed and could not be used after this. The team spoke to the requisitions department that gave Team 404 the Raspberry Pi to put procedures in place to prevent this from occurring in the future. The team was then able to gain a second Raspberry Pi to create a hardcoded version of the product as a working demonstration in time for the presentation to the client.

Due to the Raspberry Pis wide availability, they can easily be replaced on short notice, which means that the plan would be to replace the broken Raspberry Pi.

Coding takes longer than anticipated

This risk also falls into the risk reduction category. As aforementioned, Team 404 is aware that there is a high possibility of the risk occurring, resulting in steps being taken to reduce this likelihood.

The team have accepted that there is a high possibility that the development of the code for the project is going to take longer than anticipated. This would be mainly due to not being sure on how long it will take to code a user-friendly script design that the team would be satisfied with having in the final product. As a result, the team have factored this probability into their plan and have given themselves extra time during the coding stage, as well as having kept a remainder of four weeks at the end of the project to compensate for any lost time.

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APPENDIX A: APPROVAL

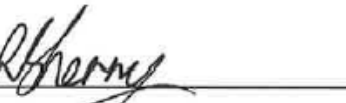
The undersigned acknowledge that they have reviewed the **Project Proposal** and agree with the information presented within this document. Changes to this document will be coordinated with, and approved by, the undersigned, or their designated representatives.

Signature Team Member:  Date: 13/11/18

Print Name: Christopher Clark

Mr.

Role: Team Leader

Signature Team Member:  Date: 13/11/18

Print Name: ROBERT SUNNY SHERRY

Title: Mr.

Role: Quality Assurance

Signature Team Member:  Date: 13/11/18

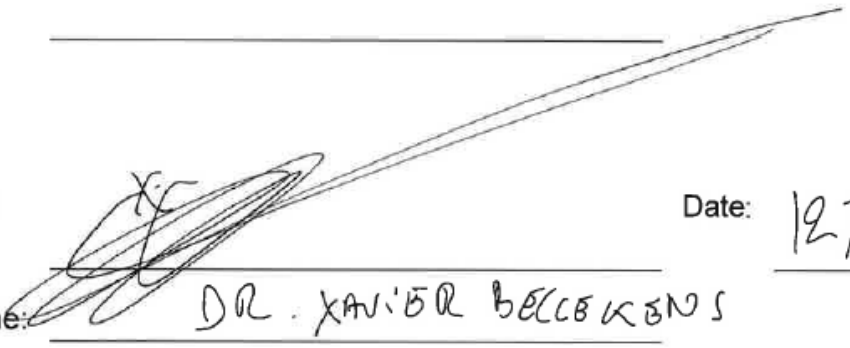
Print Name: CONNOR DUNCAN

Title: MR.

Role: SECRETARY

Signature Team Member:		Date:	13/11/18
Print Name:	Lewis Goor		
Title:	Mr.		
Role:	Version Controller		

Signature Team Member:		Date:	
Print Name:			
Title:			
Role:			

Signature Client:		Date:	12/11/2018
Print Name:	DR. XAVIER BECCKENS		
Title:	Lecturer		
Role:	client		

APPENDIX B: KEY TERMS

The following table provides definitions and explanations for terms and acronyms relevant to the content presented within this document.

Term	Definition
Rubber Ducky	The USB Rubber Ducky is a keystroke injection tool disguised as a generic flash drive.
Arduino	An Arduino is a is a complete USB-based microcontroller development system
Raspberry Pi Zero	The Raspberry Pi Zero is a low cost, small form factor computer
EDS	Economical Duck Script – A scripting language for describing key presses
Linux Kernel	Linux Kernel is a low-level part of a Linux operating system that controls communication between different devices.
Driver	Is the software that defines how a computer talks to a hardware device
SCRUM	SCRUM is an Agile framework for software development
PC	Personal Computer

APPENDIX C: TEAM RULES AND ROLES

In the event of a team member being absent:

- For a temporary period but can work:
  - The team will continue to work, the absent member will work remotely, and will be informed of information conveyed in the meetings over the Teams communication platform - Slack.
- For a temporary period and is unable to work:
  - The team will distribute the absent members work amongst the remaining team members. When the member comes back, they will continue work from the relevant point of time in the Gantt chart.
- For an unforeseeable amount of time but can work:
  - The team will continue to work, and the absent member will work remotely. They will be informed of any information discussed in the meetings over the teams' communication platform - Slack.
- For an unforeseeable amount of time and is unable work:
  - The team will pick up the aspects that the absent member covered and complete their work until further notice, should the team member eventually return, they will continue work from the relevant point of time in the Gantt chart.
- Due to no longer being a part of the team:
  - The leaving member must pass on all information, resources, and work regarding the project, to all remaining members of the team.

Any disagreements within the team will be discussed amongst all members to weigh the advantages and disadvantages on each side. A diplomatic vote will then be cast, with Christopher Clark's vote acting as the deciding vote in the event of a tie. However, an extended debate will continue for at least twenty minutes before the team consider the disagreement is at an impasse.

Conflict within the team will be resolved by having those within the conflict discuss their reasoning in the presence of at least one neutral member of the team. A win-win solution will be the first goal to reach for, and if not, a compromise must take place. In the event of all four members being in conflict, then Dr. Andrea Szymkowiak will be consulted.

Christopher Clark – Team Manager, First Point of Contact for Client, SCRUM Master, Supervisor for Hardware and Software Development

Sunny Sherry – Quality Assurer, Hardware Developer, Software Tester

Connor Duncan – Keeper of Minutes, Secretary, Software Developer

Lewis Goor – Version Controller, Software Developer

APPENDIX D: MINUTES & REFLECTION

Meeting 1:

Date and venue: 11/9/18, 10:00am, Hack Lab, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Team 404 discussed what project they would like to undertake. They decided to create a penetration-testing device by using an Arduino. The purpose of this device was to gather as much of the target's digital footprint as possible.

Challenges: One of the challenges encountered was that Team 404 needed to gain an extra member. The team was originally comprised of Sunny Sherry, Lewis Goor and Connor Duncan, leaving space for one more member to join. Towards the end of the meeting, they were approached by Christopher Clark who said he was interested in the project and would like to join the team. With the addition of Christopher, this completed Team 404. Another challenge was deciding which project to choose. The three original members looked at all the available projects, and crossed out the ones that they were not interested in. They quickly discovered that they had two projects in common. After some discussion, they opted for the creation of a penetration testing device.

Following Actions: In the next meeting, the group will go into further detail on how the device will be created and will begin to devise a plan.

Team Dynamic: The team had a certain uncertainty around them, as none of them knew exactly what was expected of them until the end of the meeting. With Christopher Clark only joining at the end, the original team members were anxious about how they would gain another member. Lewis Goor and Connor Duncan have worked on previous group projects together, and so knew what to expect from each other. Neither member had worked with Sunny Sherry before, and so were dubious about him. However, by the end of the meeting, the team was happy with the arrangements in place, and were looking forward to creating the product together. This created a positive and motivated atmosphere.

Next Meeting: 13/09/18, 16:30, Hack Lab, Abertay University

Meeting 2:

Date and Venue: 13/09/18, 16:30, Hack Lab, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Christopher Clark suggested that the project should be revised and possibly changed. It was then decided that an Arduino would not be suitable

for the project at hand, and a Raspberry Pi would be a more desirable device. The project idea was also amended from previous, to developing an alternative version of a Rubber Ducky on a Raspberry Pi. The team briefly discussed how the device would work, as well as how they would go about implementing the device. Such topics included USB storage vs network exfiltration, and how the device will be coded.

Challenges: The team had decided that they no longer wanted to complete the original project. This meant that they needed to decide on an alternate project to undertake. A large amount of brainstorming by every member on the team occurred, and after much discussion, the final project was agreed. The challenge here was choosing a new project that everyone agreed on. The team carried out many votes on what projects they thought would be ideal and came to a fair decision that every member was happy with.

Following actions: The group decided to start working on the project proposal in the next meeting.

Team Dynamic: When it was first suggested by Christopher Clark that the project should be changed, the team was hesitant at first. However, they wanted to understand why Christopher thought it would be a good idea to change the project. After hearing him out, the team then changed their opinion and agreed that an Arduino is not the most suitable device to use, thus changing the whole project. Although the team were hesitant at first, by the end of the meeting they were happy with the outcome and had an even clearer idea of what would be involved in the project.

Next meeting: 18/9/18, 9:00, Hack Lab, Abertay University

Meeting 3:

Date and Venue: 18/9/18, 9:00, Hack Lab, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, the group started to create the project proposal. They sat down together and mapped out what details they wanted to put in each section. They went into depth on each topic in order to gain a more detailed understanding of what was required from them. After they had discussed each topic, the proposal sections 2 – 4 were split up between each member of the group to complete individually.

Connor Duncan started working on the Business Need, Legal Issues and Team Structure in section 2.

Lewis Goor worked on the Goals/Objectives, Stakeholders and Risks/issues in section two.

Sunny Sherry started to work on the High-level Business Impact.

Christopher Clark begin working on the Alternatives and Analysis.
Once each member had completed the first draft of their individual sections, the other members of the group proofread each other's work to assure that it was accurate.

Challenges: The team needed to work out exactly what information was required in each section. Through consulting with each other, and Dr. Andrea Szymkowiak, an in-depth understanding was gained.

Following Actions: Complete the remaining sections of the project proposal (sections 6 and 7)

Team Dynamic: The team was very positive in this meeting and were all willing to help each other with any questions that they had. A large amount of work was completed in this meeting as a result of this positive behaviour.

Next Meeting: 20/09/18, 10:00, Library, Abertay University

Meeting 4:

Date and Venue: 20/09/18, 10:00, Library, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Team 404 filled out section six of the project proposal. Lewis Goor and Connor Duncan worked on 6.2, the Assumptions section

Sunny Sherry worked on 6.3, Constraints.

Christopher Clark began to develop a Work Breakdown Structure for section 6.1.

In order to help Christopher Clark, create the Work Breakdown Structure, the team discussed what steps are needed to create the device. This allowed Christopher to gain an understanding of what is needed in the structure.

Challenges: The main challenge the team faced was revising what was needed in each section and working out exactly what was required to create the device. To tackle this the team looked at the notes that they had left and consulted with each other about what was meant to be put in each section. Through some research and more consultation, the team worked out what was required to create the product.

Following Actions: In the next meeting, the team would investigate starting the client pitch.

Team Dynamic: The team all worked together in this meeting. Despite splitting off to complete individual sections, a large amount of communication and team work still occurred to produce high quality pieces of work. The team collaborated to help Christopher with the Work Breakdown Structure. This proves that the team are working together efficiently with minimal conflict.

Next Meeting: 24/09/18, 12:00pm, Library, Abertay University.

Meeting 5:

Date and Venue: 24/09/18, 12:00pm, Library, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Team 404 created the first draft of their client pitch. They touched upon some of the details on how they will create the scripting language and

refined each member's role in the group further. They decided that the scripting language will make use of HID packets, to transfer data to the target PC. The team successfully managed to create the first draft of the client pitch in this meeting. The slides that were created were as follows:

- Overview
- Keypress Injector – Hardware
- Keypress Injector – Handshake
- Exfiltration – Mass Storage Device
- Exfiltration – Web Server Upload
- Benefits
- Costs
- Risks
- Work
- Questions

The team will decide who will talk one each slide in the future.

Challenges: Some challenges that arose were deciding what information was required on each slide. Together the team discussed what they thought was necessary and drew their own conclusions together. When further clarification was required, the team made note, so that they could talk to Dr. Andrea Szymkowiak about the issue.

Following Actions: Discuss the client pitch with Dr. Andrea Szymkowiak**.**

Team Dynamic: The team atmosphere in this meeting remained positive. Everyone worked together on the client pitch, to ensure that it met all the standards that were required.

Next Meeting: 25/09/18, 9:00am, Hack lab, Abertay University.

Meeting 6:

Date and Venue: 25/09/18, 9:00am, Hack lab, Abertay University.

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Team 404 discussed with the client, Dr. Xavier Bellekens, to see if the project that was being undertaken met the brief specifications and client requirements. The outcome of this result was that all requirements within the specification will be met upon completion of the Economical Duck.

The team also sat down with Dr. Andrea Szymkowiak to look over the client pitch. Feedback was given on how the client pitch looked aesthetically, and if all the content in it was necessary. The team was told to test the PowerPoint on the main projector as often the colours were displayed differently to a computer. The team was also advised that they had too many bullet points on certain slides, and that they should keep to a maximum of seven bullet points per slide.

Sunny Sherry began creating a critical path for the product.

The last thing the team did was plan out the amount of man hours that will be required to complete each task, thus gaining an understanding of how long the project should take to create.

Challenges: The team's only challenge of the day was deciding how many man hours were needed at each stage. The team consulted with each other and negotiated on each section. This allowed the team to come to a reasonable standard of hours, with all team members satisfied.

Following Actions: In the next meeting the team plans on discussing the first draft of the project proposal with Andrea and breaking down who will be completing each individual part of section 7.

Team Dynamic: The team had a large amount of conflict during this meeting, about deciding how many man hours are required for each section. Everyone voiced their opinions, and the team negotiated on what was required. Each member explained why they believed a certain area should have as many man hours as it does, and from all this information a fair conclusion was drew. This left every member satisfied that their voice had been heard, and that they had an input on the decision-making process.

Next Meeting: 02/10/18, 9:00am, Hack lab, Abertay University.

Meeting 7:

Date and Venue: 02/10/18, 9:00am, Hack lab, Abertay University.

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Dr. Andrea Szymkowiak went over the first draft of the project proposal. Andrea advised that a product breakdown structure of the project should be developed, and this should include any documentation, created items and deliverables. Christopher Clark then began undertaking this task. Andrea also gave a better insight as to what is required in each part of section 7. Following this advice, Lewis Goor and Connor Duncan began creating a risk management plan, and Sunny Sherry began creating a Gantt chart. Andrea also viewed the critical path and gave feedback upon it.

Challenges: One of the challenges that occurred involved the critical path. Following feedback from Andrea, it was found that the critical path needed to be restructured in order to be more accurate, and floats needed to be created for the activity / Precedence network diagram. Another challenge that occurred was that the way Sunny Sherry created the Gantt chart, was not compatible with word and will therefore need to be changed so that it is compatible.

Following Actions: In the next meeting, Lewis Goor and Connor Duncan will continue to complete the risk management plan; Sunny Sherry will edit the Gantt chart into a compatible format; Christopher Clark will begin editing the slides for the client pitch.

Team Dynamic: In this meeting the team worked very well together. They received constructive feedback from Andrea and reacted positively to it. This allowed them to iterate back to their previous work and redraft it to a higher quality.

Next Meeting: 04/10/18, 11:00am, Library, Abertay University.

Meeting 8:

Date and Venue: 04/10/18, 11:00am, Library, Abertay University.

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Lewis Goor and Connor Duncan continued to create the risk management plan, and as a result completed the first draft of section 7.9 in the project proposal. Sunny Sherry continued creating the Gantt chart and completed it to a satisfactory, and compatible standard. Christopher Clark continued working on the presentation, editing the format and layout, along with some adding and modifying notes on each slide. These notes covered what needed to be discussed on the slides.

Challenges: One of the challenges that Sunny Sherry came across was that the Gantt chart that was created was not compatible with Microsoft Project in its current layout. To correct this issue, Sunny researched how to configure the program to use five-hour work weeks instead of the standard forty hours, and this corrected the problem. Christopher Clark attempted to email someone within the University called Jerry High, as he is responsible for the University's supply of Raspberry Pis. However, Christopher was unable to find any contact details for him.

Following Actions: In the next meeting, Christopher Clark will continue looking into acquiring a Raspberry Pi.

Team Dynamic: After this meeting the team was very motivated. They accomplished a large amount of work and were making good progress towards the completion of the project proposal.

Next Meeting: 09/10/18, 9:00am, Hack lab, Abertay University.

Meeting 9:

Date and Venue: 09/10/18, 9:00am, Hack lab, Abertay University.

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Christopher Clark and Sunny Sherry acquired a Raspberry Pi by talking to Gerald High. Lewis Goor and Connor Duncan created a provisional state of project table. Included in this table was how many hours it will take to do any specific task throughout the course of the project. This table will become useful when the creation of the Economical Duck begins, as it will allow the team to keep track of how many hours have been put into each stage, and whether the team is on target with their deadlines.

Challenges: One of the challenges that occurred was that false information had been given to the team. This information was that a man by the name of Jerry Grant is responsible for the Universities supply of Raspberry Pis. There is a man who is responsible for the Universities supply of Raspberry Pis, however, his name is not Jerry Grant. Christopher Clark discovered that his name was Gerald High, hence why Christopher was previously unable to find him. Once this was found out Christopher Clark and Sunny Sherry got in contact with Gerald High and were able to successfully gain access to a Raspberry Pi.

Following Actions: With the deadline for the client pitch approaching, the team has decided to put emphasis on finalizing the pitch and rehearsing their speech. Therefore, the next meeting will be going over the pitch and expanding the notes for each slide.

Team Dynamic: In this meeting the team split off into two groups. Each group were very productive working with each other and accomplished all their given tasks.

Next Meeting: 11/10/18, 11:00am, Library, Abertay University.

Meeting 10:

Date and Venue: 11/10/18, 11:00am, Library, Abertay University.

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, the team went over the client pitch and consulted on what slides each member should talk about. It was decided that the slides Christopher Clark will undertake are the opening slide, overview, web server and the work done. Sunny Sherry will talk about the Mass storage of the Raspberry Pis data, the hardware components of the keypress injector, and any costs the project will incur. Lewis Goor will talk about the risks, the handshake component of the keypress injector and the benefits of the project. Finally, Connor Duncan will discuss the software component of the keypress injector, the reflection of the work done and any risks other than the ones Lewis has previously mentioned. Team 404 then practiced their slides, in order to make sure they had a clear understanding of how the presentation will flow, and to ensure they were confident talking about their given areas.

Challenges: One of the challenges that occurred was the wording of the presentation. Christopher Clark was unsure how to word the opening slide. To help Christopher, the team brainstormed several different ways to open the presentation. This challenge occurred with several other slides, and the team collectively helped each other find a solution.

Team Dynamic: The team felt pressured in this meeting as they knew the client pitch was fast approaching. However, together they combated their feelings so that they could still practice their slides effectively. Each member offered tips on how to talk on each slide, whether they think it flows well or not, and memory prompts to remember what they need to talk about. This created a strong team bond as they all understood that they needed to work together to allow the presentation to flow well.

Following Actions: In the next meeting, the team will continue going over the presentation and add the final touches. Christopher Clark and Sunny Sherry will acquire a Raspberry Pi and continue to try to make a demo.

Next Meeting: 16/10/18, 9:00am, Hack lab, Abertay University.

Meeting 11:

Date and Venue: 16/10/18, 9:00am, Hack lab, Abertay University.

Present: Christopher Clark, Sunny Sherry, Connor Duncan

Absences: Lewis Goor was unable to make this meeting, due to being on a personal trip down to London.

Discussed: In this meeting, Team 404 reviewed their client pitch and refined the details that they wanted to include. Christopher Clark and Connor Duncan added notes to the slides that they were talking on, and the three-team members decided exactly who would be talking on each slide. Christopher Clark and Sunny Sherry created a working demo with the Raspberry Pi; this demo showed a running bash script, which when plugged into the target pc, opened a terminal and displayed “Hello World”.

Challenges: One of the challenges that the team faced was the absence of Lewis Goor. This meant that the team needed to consult Lewis outside of the meeting hours, with an update of what was discussed, and what slides Lewis would be covering in the client pitch.

Following Actions: In the following meeting, Lewis Goor will create notes on his slides in the client pitch, and the team will begin practicing the presentation.

Team Dynamic: Despite not having one of their team members, the team remained positive. They completed all the work that they set out to achieve and were starting to feel much better about the client pitch.

Next Meeting: 18/10/2018, 4:00pm, Library, Abertay University

Meeting 12:

Date and Venue: 18/10/2018, 4:00pm, Library, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Lewis added notes onto each one of his slides for the client pitch, so that he had a firm understanding on what he would need to talk about. The team members then did a mock run through of their individual slides. The result of this was that the team knew exactly what they wanted to say and how they wanted to say it. At the end of the meeting, the first full mock run through was attempted, from start to finish.

Challenges: The main challenge that occurred for all participants was how each slide should be worded. The team wanted to make sure that their points were coming across

clearly and accurately, and together they helped each other with how to structure what they wanted to discuss.

Following Actions: In the next meeting, the team will continue perfecting their client pitch.

Team Dynamic: At the start of the meeting, each member felt pressured to practice their slides perfectly. Throughout the meeting each member slowly gained a better understanding of their slide and improved their overall presentation. By the end of the meeting the team felt confident about presenting to the client.

Next Meeting: 21/10/2018, 1:00pm, Library, Abertay University

Meeting 13:

Date and Venue: 21/10/2018, 1:00pm, Library, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, the team completed their first full mock run through. Christopher Clark and Connor Duncan then added a methodology slide. It was decided that Connor would talk about the methodology. The final decision for what members is talking on each slide is as follows:
Christopher Clark – Opening slide, Overview, Exfiltration (Web Server Upload), Work and Demo

Sunny Sherry – Keypress Injector (Hardware), Exfiltration (Mass Storage Device) and Costs

Lewis Goor – Handshake, Benefits and Reflection

Connor Duncan – Keypress Injector (Software), Methodology and Risks

Challenges: All members in the team struggled to remember their lines initially, and what needed to be discussed. To combat this, on the slides that a member was hesitant about, they would go over them four or five times, until they knew exactly what they needed to say.

Following Actions: Have one more meeting to go over the presentation before pitching to the client.

Team Dynamic: In this meeting the team was anxious, but overall positive. Every member was nervous during their slide, but after rehearsing it several times they became confident, and the nerves disappeared. This led to the team's confidence in the pitch continuing to grow.

Next Meeting: 22/10/2018, 1:00pm, Library, Abertay University

Meeting 14:

Date and Venue: 22/10/2018, 1:00pm, Library, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, the team went over the client pitch. They spent two hours practicing the pitch amongst themselves. Afterwards they tested the presentation on the projector screen, to make sure that all the changes that had be made since previous were still presentable.

Challenges: One of the challenges encountered by Connor Duncan, was that he struggled to remember all the information on the risks slide. Connor then rehearsed the risk slide consistently until it was well understood.

Following Actions: Present the client pitch to the client and continue working on the project proposal.

Team Dynamic: Connor Duncan was initially stressed due to struggling to remember the risk slide in full. The remainder of the team reassured him and gave him tips on how to remember what he needed to mention, and by the end he was feeling confident in his role.

Next Meeting: 23/10/2018, 12:00pm, Hack lab, Abertay University

Meeting 15:

Date and Venue: 23/10/2018, 12:00pm, Hack lab, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, the team present their client pitch to Dr. Xavier Bellekens and Dr. Andrea Szymkowiak. The presentation went well and all questions that were asked were anticipated and answered. After the meeting, the team went to Abertay Library to continue the completion of the Project Proposal. Connor Duncan updated the minutes, completed the assumptions section and edited the costs and benefits section. Sunny Sherry added in some costs and removed irrelevant details from the project proposal. Lewis Goor updated the Alternatives and Analysis section and added a summary section to it. Christopher Clark added notes to the Version control and Requirements section and finished creating the product breakdown structure. Christopher also added a description in to the breakdown structure.

Challenges: The team did not face any challenges during this meeting.

Following Actions: The team will continue to complete the project proposal.

Team Dynamic: The team was feeling very positive after this meeting, as they successfully delivered the client pitch.

Next Meeting: 30/10/2018, 10:00am, Hack lab, Abertay University

Meeting 16:

Date and Venue: 30/10/2018, 12:00pm, Hack lab, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Christopher Clark and Sunny Sherry started to create the executive summary. Both members worked on this to ensure that it was created to a high quality. Approximately half of the executive summary was completed. Lewis Goor and Connor Duncan begin reviewing the work that had been completed thus far. Together, they reviewed and edited the majority of section two, stopping at the stakeholder's section.

Challenges: The main challenge that was encountered was by Lewis and Connor. This challenge was how to reword and restructure section two. By consulting the other members, and using thesauruses, this only proved to be a minor challenge.

Following Actions: The team will continue to complete the project proposal.

Team Dynamic: The team felt positive after this meeting, as they felt like a large amount of work had been completed.

Next Meeting: 06/11/2018, 10:30am, Library, Abertay University

Meeting 17:

Date and Venue: 06/11/2018, 10:30am, Library, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting the team continued to go over the project proposal, adding in extra details and reviewing all the words previously written. Connor Duncan spent most of his time reviewing and reformatting the minutes section of the document and adding in the methodology section of the executive summary. Connor also reviewed his peers work completed so far and restructured it to be of a high quality. Lewis Goor began restructuring the document to look presentable and added to sections three and four. Christopher Clark and Sunny Sherry continued adding to the executive summary. Christopher edited the Team Rules and Roles, Activity Plan and the Preliminary Work Breakdown Structure. Sunny Sherry edited the Quality Assurance, Product Breakdown Structure and the Software Requirements sections.

Christopher Clark emailed the client explaining that the team will need him to review the document and sign it, if it is of a satisfactory standard, and that they will send him the project proposal in due course.

Challenges: In this meeting the team acknowledged that they were behind the word count. The proposal had approximately 7200 words, and it required 11,000 ± 10%. The team reviewed the document and adding in extra details into certain sections, as well as added more information into previously unfinished sections. By the end of the meeting, the word count was at 9,000. Another challenge faced by the team was between Christopher Clark and Connor Duncan. While reviewing the work Christopher had completed in the Team Rules and Roles section, Connor disagreed with the wording of two of the rules. The rules were as followed:
"Any disagreements within the team will be discussed amongst all members to weigh the advantages and disadvantages on each side. A diplomatic vote will then be cast, with Christopher Clark's vote acting as the deciding vote in the event of a tie. However,

an extended debate will continue for at least twenty minutes before the team consider the disagreement is at an impasse."

"Conflict within the team will be resolved by having those within the conflict discuss their reasoning in the presence of at least one neutral member of the team. A win-win solution will be the first goal to reach for, and if not, a compromise must take place. In the event of all four members being in conflict, then Dr. Andrea Szymkowiak will be consulted."

Connor argued that the rules were effectively the same as there was not a difference between a 'Conflict' and a 'Disagreement'. Christopher argued that there was a difference. The two discussed the logic behind each other's thoughts and then asked Lewis Goor for his opinion. Lewis agreed with Christopher that there was a difference, and so it was decided to keep the second rule in the document.

Following Actions: In the next meeting the team will look to add the final details into the project proposal, restructure it, and send it to the client to have reviewed. They will also hope to set a date to meet up with the client to sign the document.

Team Dynamic: The team worked for six and a half hours in this meeting, `and so by the end were understandably tired and exhausted. However, they felt motivated as they knew that they were close to completing the document and having it submitted.

Next Meeting: 07/11/2018, 10:30am, Library, Abertay University

Meeting 18:

Date and Venue: 07/11/2018, 10:30am, Library, Abertay University

Present: Christopher Clark, Sunny Sherry, Lewis Goor, Connor Duncan

Absences: N/A

Discussed: In this meeting, Connor Duncan continued reviewing the document and adding changes in where necessary. Connor also updated the minutes section. Lewis Goor continued adding in extra words to several different sections across the document, including the Risk Management Plan, Benefits, and Costs section. Christopher Clark and Sunny Sherry completed the Executive Summary section. Sunny reviewed and added in details for the Justification of Project Approval section. Christopher reviewed all the General Project Information Section and made amendments. Christopher also liaised with the client, to find a suitable date to meet up to sign the document. Dr. Bellekens informed him to send the PDF to him for review, and a date to meet up will be set soon. At the end of the meeting, the team reviewed the full document from start to finish, in order to ensure the document was up to a high quality.

Challenges: One of the challenges that Christopher Clark encountered was contacting the client. This proved difficult to get a response as Christopher was unable to speak to the client directly. Unfortunately, there was no workaround for this, and so the Team must simply wait for a response. Another challenge that was encountered were conflicts within the team when it came to wording within certain sections. Whenever there was a

dispute, the team would take a vote, and if this vote was a tie, then they would continue discussions until one of the members decision was swayed. Another challenge was meeting the word count. However, after the final meeting, the team finished with the word count for the document sitting at 10,034

Following Actions: The next step is for the team to get together with the client and sign the proposal.

Team Dynamic: The team remained positive throughout this meeting despite any conflicts. The team was motivated as they understood that they could complete the proposal within the meeting.

APPENDIX E: ARTEFACT OR PROTOTYPE MATERIAL

Boot Script to be treated as HID device

```
#!/bin/bash

# Create gadget
mkdir /sys/kernel/config/usb_gadget/mykeyboard
cd /sys/kernel/config/usb_gadget/mykeyboard

# Add basic information
echo 0x0100 > bcdDevice # Version 1.0.0
echo 0x0200 > bcdUSB # USB 2.0
echo 0x00 > bDeviceClass
echo 0x00 > bDeviceProtocol
echo 0x00 > bDeviceSubClass
echo 0x08 > bMaxPacketSize0
echo 0x0104 > idProduct # Multifunction Composite Gadget
echo 0x1d6b > idVendor # Linux Foundation

# Create English locale
mkdir strings/0x409

echo "Team 404" > strings/0x409/manufacturer
echo "Economical Duck" > strings/0x409/product
echo "1337696969" > strings/0x409/serialnumber

# Create HID function
mkdir functions/hid.usb0

echo 1 > functions/hid.usb0/protocol
echo 8 > functions/hid.usb0/report_length # 8-byte reports
echo 1 > functions/hid.usb0/subclass
xxd -r -ps /root/mydesc functions/hid.usb0/report_desc

# Create configuration
mkdir configs/c.1
mkdir configs/c.1/strings/0x409

echo 0x80 > configs/c.1/bmAttributes
echo 200 > configs/c.1/MaxPower # 200 mA
echo "Test config" > configs/c.1/strings/0x409/configuration

# Link HID function to configuration
ln -s functions/hid.usb0 configs/c.1
```

```
# Enable gadget
ls /sys/class/udc > UDC
```

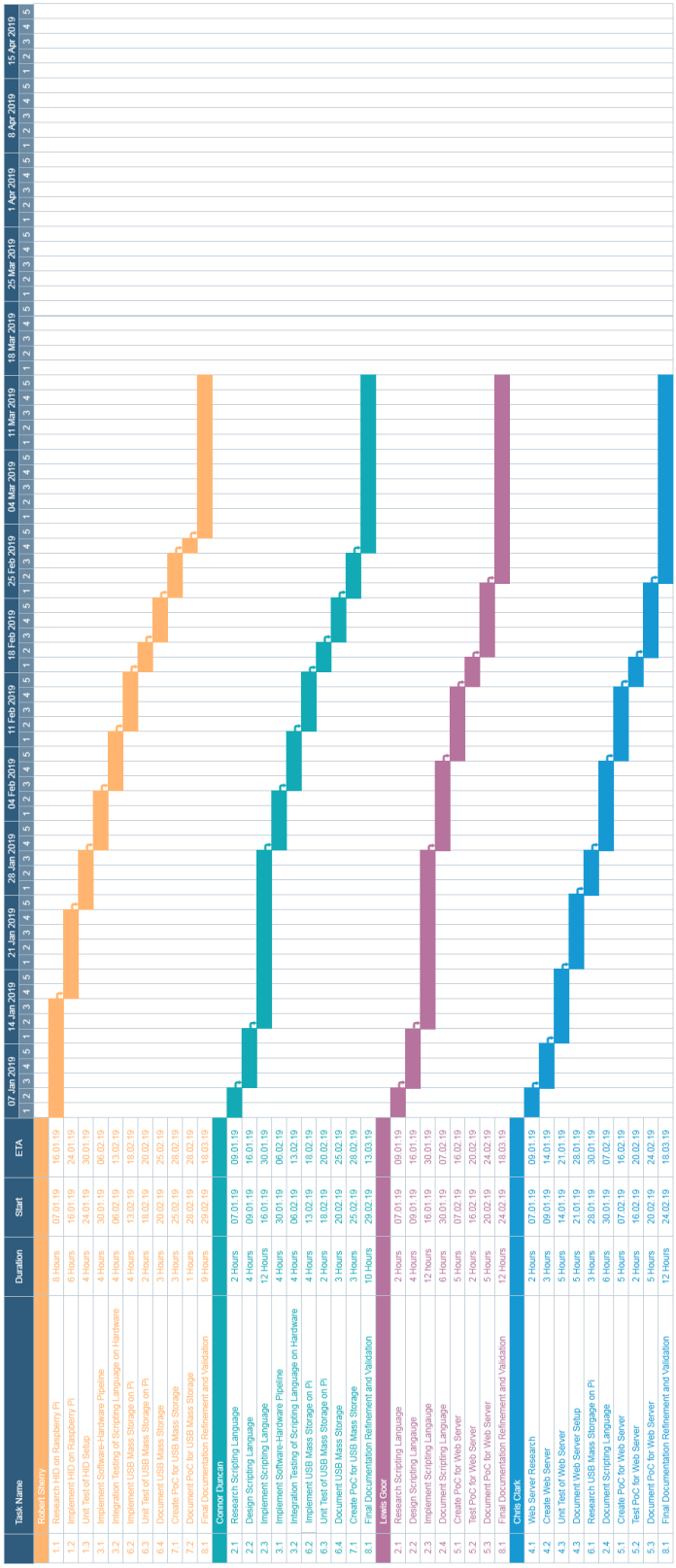
Listening script to wait until being plugged into target machine

```
#!/bin/bash

function write_report {
    echo -ne $1 > /dev/hidg1
}

cat /dev/hidg1 | echo

# Alphabetical numbers in HEX starting at x4


write_report "\x80\0\x15\0\0\0\0\0"
write_report "\0\0\0\0\0\0\0\0"
sleep 1
write_report "\0\0\x6\0\0\0\0\0"
write_report "\0\0\x10\0\0\0\0\0"
write_report "\0\0\x7\0\0\0\0\0"
write_report "\0\0\x28\0\0\0\0\0"
write_report "\0\0\0\0\0\0\0\0"
sleep 2
write_report "\0\0\x08\0\0\0\0\0"
write_report "\0\0\x06\0\0\0\0\0"
write_report "\0\0\x0b\0\0\0\0\0"
write_report "\0\0\x12\0\0\0\0\0"
write_report "\0\0\x2c\0\0\0\0\0"

write_report "\0\0\x34\0\0\0\0\0"
# H (press shift and H)

write_report "\x20\0\xb\0\0\0\0\0"

# e
write_report "\0\0\x8\0\0\0\0\0"

# ll
write_report "\0\0\xf\0\0\0\0\0"
write_report "\0\0\0\0\0\0\0\0"
write_report "\0\0\xf\0\0\0\0\0"
```

```
# o
write_report "\0\0\x12\0\0\0\0\0"

# SPACE
write_report "\0\0\x2c\0\0\0\0\0"

# W (press shift and W)
write_report "\x20\0\x1a\0\0\0\0\0"

# o
write_report "\0\0\x12\0\0\0\0\0"

# r
write_report "\0\0\x15\0\0\0\0\0"

# l
write_report "\0\0\xf\0\0\0\0\0"

# d
write_report "\0\0\x7\0\0\0\0\0"

# ! (press shift and 1)
write_report "\x20\0\x1e\0\0\0\0\0"

write_report "\0\0\x34\0\0\0\0\0"

write_report "\0\0\x28\0\0\0\0\0"

# Release al keys
write_report "\0\0\0\0\0\0\0\0"
```

APPENDIX F: FULL PAGE DIAGRAMS

Gantt Chart



Activity Network Diagram