To assess the functionality of my program I will test it against the initial set of objectives.

Each test will be displayed in the table lower down. The *Video Time* column is used as a reference for where each test is on the testing video.

The testing video can be found here:

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| --- | --- | --- | --- | --- | --- |
| **Purpose of test** | **Test data** | **Expected Outcome** | **Actual Outcome** | **Pass/ Fail** | **Video**  **Time** |
| Checking that the initial appearance is correct. | Running the program. | All nodes, cable tool and server icon should be displayed on left hand side of screen, inside sidebar.  Slider, save and open button should be displayed in top right corner. | All images and icons displayed in correct position. Cable tool and server icon displaying default image. | Pass | 00:00 |
| Checking that the user can drag-and-drop nodes onto screen. | Dragging and dropping nodes onto canvas. | User should be able to drag and drop nodes onto canvas. | User can easily drag and drop nodes onto canvas. | Pass | 00:03 – 00:10 |
| Checking that the nodes are not added to canvas if not dragged out of sidebar. | Dropping nodes inside sidebar. | If the user does not drag the node completely out of the box, node should not be placed on canvas. | If the user does not drag the node outside of sidebar, the node is not drawn onto canvas and returns to original position. | Pass | 00:11 – 00:18 |
| Check that user can add RAID server to screen. | Clicking server then clicking where on canvas to add it. | Should be able to click server icon then click on the canvas to draw RAID there. | The user can select server icon and then click on screen to add it to that position on screen. | Pass | 01:25 – 01:29 |
| Checking checkboxes work correctly. | Selecting checkboxes to select which drives to add. | User should be able to select server’s corresponding checkbox and a ‘tick’ should be displayed inside it. | The user can select the checkboxes and a ‘tick’ icon is displayed in the ones they click. They can select multiple drives. | Pass | 01:30 – 01:34 |
| Checking correct drives appear in RAID. | Clicking off of selection box once selecting drives. | Once drive checkbox selected, it should appear in the RAID once selection box exited. | Once the user clicks onto an empty part of the canvas, the selection box disappears. The drives which the user selected are then displayed in the correct position. | Pass | 01:39 – 01:40 |
| Checking user can use RAID fill bar to move RAID and to add/ remove drives. | Dragging and dropping the RAID through the fill bar as well as clicking the fill bar. | Should be able to change server’s position by drag and dropping fill bar.  Should be able to add/remove servers by clicking fill bar. | The user can drag and drop the RAID to a new position by using the fill bar at the top of the RAID. If they simply click the bar, the original selection box appears with the same checkboxes selected. | Pass | 01:35 – 01:40 |
| Selecting a PC’s running applications. | Clicking on a PC icon on the canvas. | Selection box should appear with checkboxes corresponding to the four different applications. Multiple applications should be able to be selected at once. | A similar selection box appears with checkboxes corresponding to the four different applications. Multiple applications can be selected at once. | Pass | 00:24 – 00:26 |
| Viewing the name of a device.  Checking device cannot be selected if it has not been dragged onto canvas. | By clicking on a node’s icon or the fill bar on the RAID.  Clicking none-activated device. | Server drive names (i.e. *File server*) should be displayed within the RAID.  See objective 7a,b. Clicking none-activated node. | When clicking on a node or the server fill bar a box appears displaying the name and icon of the device.  The user cannot select a node if it has not been dragged onto canvas. | Pass | 01:53 |
| Ensuring the cable tool and server icon indicate that they have been selected. | By selecting the cable tool and server icon. | When selecting cable tool, a red border should show around the icon. When selecting server icon, yellow border should be shown.  When deselecting either tool, the border should disappear. | Correct borders are shown around both tools upon selection.  When deselected, the border disappears. | Pass | 00:22 and 01:25 |
| Checking that a device can be removed. | By dragging all of the devices into the sidebar box, with and without cables connected. | Once released inside the sidebar box, the node should be removed from canvas and return to default position.  Any cables connected to the node should also be removed. | Node removed from canvas, returned to original position inside sidebar box and any cables connected are removed. | Pass | 01:20 – 01:22 |
| Checking the user can only connect a node to its corresponding connectable nodes, defined in objective 6a. | Trying to connect every node to every other node. | If trying to connect to connectable node, should draw a blue line between the two nodes and stop following the cursor.  If trying for none-connectable node, blue line should not be drawn between two nodes and should stay following cursor. | When trying for connectable node, the program rightly draws a blue line (the cable) between the two nodes.  When trying for none-connectable node, the blue line does not display between the two nodes and remains following the cursor, waiting for connectable connection. | Pass | 04:40 – 05:30 |
| Checking that multiple nodes can be connected to devices. | Trying to add 5 PC’s to the same switch and hub. | 5 cables should be added between the PC’s and bridging device. | The connections are successfully made and cables drawn. | Pass | 01:08 – 01:11 |
| Checking that packets flow when suitable network is made. | Creating network:  PC 🡪 Hub 🡪 Printer.  Selecting *word processing* in PC’s applications. | One packet should flow from PC 🡪 Hub 🡪 Printer.  Once reached printer, should flow again from PC. | One packet flows from PC down correct route. When it reaches the printer, it restarts it route from the PC. | Pass | 00:25 – 00:40 |
| Check that packets appear correctly. | Same as above^ | Packet should be a small circle, have a fill colour, and flow down the centre of the cable to the next node. | Packet is small circle, has a blue fill colour, and does flow down the centre of the cable without deviation. | Pass | 01:45 – 2:00 |
| Checking that packets take correct route when server is added (other than print server). | Creating network:  PC 🡪 Hub 🡪 Switch 🡪 E-mail server.  Selecting *e-mailing* in PC’s applications. | One packet should flow from PC 🡪 Hub 🡪 Switch 🡪 E-mail server.  Once reached server, packet should flow back down route, as so:  E-mail server 🡪 Switch 🡪 Hub 🡪 PC.  Once reached PC, should restart. | One packet flows down correct route. When it reaches the server it backtracks and flow back down same route to the root PC.  It then starts the cycle again. | Pass | 03:05 – 03:40 |
| Checking packets take correct route when print server is added. | Network:  PC 🡪 Hub 🡪 Printer/ Switch  Switch 🡪 Print server.  Selecting *word processing* in PC’s applications. | One packet should flow down network ignoring the printer on the way out.  (PC 🡪 Hub 🡪 Switch 🡪 Print server.)  Once reached print server, should flow back to PC.  Once reached PC, should flow out to printer (PC 🡪 Hub 🡪 Printer.)  Once reached printer, should restart cycle. | One packet flows down correct route from PC to print server. Once reached, then flows back down route to PC.  Once PC reached, flows from PC 🡪 Hub 🡪 Printer.  Then restarts cycle. | Pass | 01:55 – 02:10 |
| Checking print queue works correctly and each packet is different colour.  Also checking packets take correct route when multiple devices connected to single device. | Network:  4 x PC 🡪 Hub 🡪 Printer/ Print Server.  *Word processing* selected on all PC’s. | One packet should flow from each PC, each with different colours.  Should all flow to print server ignoring printer on way out.  Should then flow back down same route to PC.  Only one packet should be sent from PC 🡪 Hub 🡪 Printer at one time.  Once all 4 packets have been sent to printer, cycle should restart. | A single packet flows from each PC. Each packet has a different colour.  All flow from PC to print server ignoring printer on way out.  Once at server, they all return to their root PC’s.  Here, each packet waits until the printer is free before travelling from PC 🡪 Hub 🡪 Printer.  Once all 4 packets have been sent to printer, cycle restarts. | Pass | 01:55 – 02:10 |
| Checking packets do not continue flowing after cable removed.  Also checking cables are removed. | Network:  2 x PC 🡪 Hub 🡪 Router.  *Internet browsing* selected on PC’s.  Removing hub from network. | After removing the hub, the two cables from the PC’s, as well as cable from hub to router, should be removed.  All packets should stop flowing and be removed from screen. | Cables from PC’s to hub and from hub to printer are removed.  All packets are removed from screen. | Pass | 01:21 – 01:24 |
| Checking that packets flow down multiple routes when more than one PC application is selected. | Network:  PC 🡪 Hub 🡪 Printer/ Router.  *Word processing* and *internet browsing* selected on PC. | One packet should flow from PC 🡪 Hub 🡪 Printer.  One packet should also flow from the Hub 🡪 Router. | One packet flows to the printer.  One flows from the hub to the router. | Pass | 01:10 – 01:15 |
| Checking that packets flow to all devices connected to a hub. | Network:  3 x PC 🡪 Hub 🡪 E-mail server.  *E-mailing selected on one of PC’s/* | Packets should flow from the hub to all of the PC’s, not just the specific one. | Packets flow from the hub (on return route) to all of the PC’s. | Pass | 05:35 – 06:14 |
| Checking that the speed slider works. | Moving the slider button to the leftmost and rightmost position. | When moved to leftmost position, the speed of the packets should dramatically slow down.  Vice versa when moved to right, with packets moving much faster. | When moved to leftmost position, the speed of every packet drastically decreases.  When moved to rightmost position, speed of every packet drastically increases. | Pass | 02:12 – 02:25 |
| Checking that the save and open buttons are clickable. | Mouse-clicking save and open button. | When save and open button clicked, should display box for user input. | When buttons clicked, text box opens where user can input text. | Pass | 03:39 and 03:51 |
| Checking that the save button works correctly. | Mouse-clicking save button and entering “Network 1”.  Pressing return key. | Should display text box for user input when clicked.  When “Network 1” entered and return key pressed, should display message saying “Network 1 saved”. | Displays text box.  When the text is entered and the return key is pressed, “Network 1 saved” is displayed. | Pass | 03:40 – 03:48 |
| Checking that the open button works correctly. | Mouse-clicking open button and entering “Network 1”.  Pressing return key. | Should display text box for user input when clicked.  When “Network 1” entered and return key pressed, should display message saying “Network 1 opened”. | Displays text box.  When the text is entered and the return key is pressed, “Network 1 opened” is displayed. |  | 03:50 – 04:05 |
| Checking that a network is imported correctly. | After entering “Network 1” into ‘open network’ text box. | Should update canvas with imported network. Each node and cable should be in the same position.  Packets should immediately start flowing down same route as before. | All nodes and cables are displayed on screen in the same position as they were before they were saved (and the program exited).  Packets immediately started flowing down same route. | Pass | 04:05 – 04:14 |
| Checking the user can delete a network. | Entering “delete Network 1” into ‘open button’ text box.  Then entering “all” into text box.  Then entering “open Network 1” into text box. | Should display a message saying “Network 1 deleted”.  When entering “all”, the network should not appear in the list of networks.  When the user tries to open “Network 1”, network should not be imported; instead message “Network 1 does not exist” should be displayed. | “Network 1 deleted” is displayed.  When entering “all”, ‘Network 1’ now does not appear in the list of networks.  When trying to open “Network 1”, network is not imported. Message: “Network 1 does not exist” is displayed. | Pass | 04:15 – 04:38 |

Evaluation

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| Objective | Objective Analysis |
| **Initial appearance**   * All of the devices should be displayed as roughly 2cm x 2cm icons within a column on the left-hand side of the screen. The remainder of the screen (around three quarters of it) is what I will refer to as the *canvas* and this is where the devices will be placed. The canvas will be a slightly off-white colour. * The network devices should be enclosed within a black rectangular box on the left-hand side of the screen. * There should be *save* and *open* icons at the top right of the screen, similar in size to the networking device icons. * Next to the *save* and *open* icons there should be an orange slider with a black button on top, used to change the speed of the packet flow. | All the network devices specified in my analysis are displayed on the left-hand side of the screen behind a box that encloses them.  They are around the right size as specified in the objective. The canvas is around three quarters empty, allowing for many connections to be made without filling the canvas. It appears a slightly-off white colour.  There are *save* and *open* buttons in the top right-hand side of the screen, making them clearly distinguishable. Next to these buttons is an orange slider with a black button on top, exactly as said in the objective. |
| **Adding devices to the canvas**   * The user should be able to left mouse-click on the nodes and keeping the mouse pressed down, drag them on to the blank canvas. Once they are in the desired position the user can release the mouse and drop them in that location. * If the user does not drag the node completely out of the box, the node will not be placed on the canvas and it will return to its original position. * To add a server to the canvas, the user should be able to left-mouse click on its icon then click again on the canvas in the position that they want it to be placed. | To add nodes to the screen, the user can easily drag-and-drop them to the desired position.  If they do not wish to add the node to the canvas, they can simply release the node back inside the box they came from and the node will return to its default position.  To add a server, the user can simply click once on the server icon and then again in the position on canvas they wish to add it. The server drive selection box then appears. |
| **Adding server drives**   * The user should be able to add server drives to the canvas by selecting them from a checkbox. * Once the user has selected the servers they wish to add to the canvas, they should be displayed on the canvas all together inside a black box. | Once the user has added a RAID to the canvas using the server tool, they can then select which drives they wish to add to it by selecting the checkboxes corresponding to each drive.  Once the user clicks of the selection box, the drives all appear in the correct positions within a black box representing the RAID. |
| **Selecting a PC’s running applications**  The user should be able to select certain applications to run on each PC using checkboxes. These applications will determine which nodes the packets flow to.  They should be able to select:   * Word processing * Internet browsing * Multimedia * E-mailing | By selecting or deselecting a PC’s checkboxes (after clicking on the PC), the user can change its running applications. The packets route change according to the selected applications.  The user can select all of the applications listed in the objective. |
| **Moving a device to a new position**   * To move the RAID server, the user will be able to left-click the filled rectangle at the top of the server and drag-and-drop it to a new location. * To move any other node the user should be able to simply left-click anywhere on the device’s icon and drag-and-drop it to a new location. | The user can easily use the fill bar at the top of the RAID to move the servers to a new position (as shown in the testing video).  Moving any other node is just like adding it to the screen: they can simply be dragged to a new position on canvas. |
| **Adding cables between nodes**   * To add a cable between nodes the user will left-click the cable icon, stored with the other network devices on the left-hand column of the screen. Once selected, the cable icon will change, showing a red border around the icon, indicating the selection of the tool. Once selected, the user can then left-click on the nodes they wish to connect from and to. * A blue line (representing a cable) should be drawn between the nodes. | The user can use the cable tool to add connections. They simply select the two nodes they wish to connect together while having selected the tool. A blue line (the ‘cable’) will be drawn between the two nodes indicating that they are connected.  A red border is shown around the cable icon when the cable tool is selected, showing that it is selected. |
| **Viewing the name of a device**   * The user should be able to left-click on the device’s icon (or the filled rectangle on the RAID) to bring up the selection box which will display the name and icon of the node at the top, as well as its properties if the device is a PC or the RAID server. * The user should not be able to select a node if it has not been dragged onto the canvas. | If the node has been added to the canvas, the user can click on it to view its name and icon.  They can click the RAID’s fill bar to view its name and icon. |
| **Showing packet flow**   * The program should display ‘packets’ flowing over the cables once a valid network has been created. Each packet will be a small circle with a fill colour. They should flow down the centre of the cables. * The fill colour of each packet should change for each route from different PC’s. | Once a valid network has been created (as defined in my design section), packets will start to flow over the centre of the cables.  The packets appear as small circles with a fill colour.  When a new route is created from a different PC, the fill colour of the packet changes. |
| **Changing packet flow speed**   * The black button on top of the orange slider should be able to be clicked and drag-and-dropped in the x-axis. The speed that the packets travel at will be determined by the position of the button: the fastest speed being at the rightmost position and the slowest speed being at the leftmost position. * The button should only move as far as the orange slider box is wide (a relatively small distance). It should not move in the y-axis. | When the slider is dragged left, the speed of the packets decreases. If dragged right, the speed increases.  The slider button only moves in the x-axis and stops at each side of the box. |
| **Saving, opening and deleting a network**   1. A network should be able to be saved by left-clicking the *save* button in the top-right corner of the screen and entering the name they wish to call the network. Clicking the return key (on the keyboard) should save the network. 2. A network should be able to be opened in the same way as saving a network, however by left-clicking the *open* button instead. They should then be able to enter the name of the network they wish to open before pressing the return key to open it. 3. The user should also be able to view all existing networks by entering ‘all’ instead of the network name into the ‘open button’ text box. | Users can save and open networks easily. To save a network they can select the save button, enter the network name and click the return key.  To open a saved network, the user selects the open button, enters the network name and clicks the return click (exactly the same to saving a network).  There are also two keywords that can be entered after pressing the open button.  The user can delete a network by entering ‘delete <network name>’ and display all networks by entering ‘all’.  Confirmation and error messages are displayed after every text input (i.e. ‘Network 1 saved). |

**Third-party feedback and possible improvements**

*“The layout of the program is good. The GUI is smooth and easy to use.”*

Most people that I questioned felt that the program was easy to use and was aesthetically pleasing. This is due to the clear icons used to represent the nodes and the time I put into ensuring the program runs as it should.

*“A very interesting and educational program demonstrating data transfer over a network.”*

I was pleased to read this comment as my program is intended to be used primarily as an educational tool and this comment backs this up. I think that most people found creating networks and selecting different PC applications interesting.

*“The images of the devices could do with their white background being removed to make the GUI more professional.”*

This is definitely a valid point, not only with the white background behind images but also in general. Some of the animations, such as the uneven border around the cable tool, could be edited to make the program appear more professional, however I do not feel that this is an urgent improvement as the program still functions correctly without the need to improve the look of the program.

*“Some of the colours of the packets are very similar making it hard to distinguish between them.”*

This is another issue with the display that could be improved upon. I did not have time to ensure that similar colours are not used after all of the standard colours in the list are used. The program has to randomly create RGB colours after the list has been used up and therefore similar colours are bound to be generated once in a while. Once again, this is an issue with the animations that could be improved upon given more time.

*“I found it really easy to select PC applications and to add servers to the screen through the checkboxes.”*

This was a commonly held feeling amongst people I questioned. They felt that the use of checkboxes to select the different servers to add to the canvas, as well as to select which applications to run, was a very easy way of doing so.

*“The interface to save and open networks is really intuitive and easy to use. The confirmation messages help to tell if the text command has been successful.”*

Most people felt that using the text box to save and open networks was easy and ‘intuitive’. The keywords used to delete networks and display all of them was useful.

After showing the program to my end user, my brother who studies computer science at GCSE, he suggested the following improvement:

“I would have liked to be able to see where the packets go after they reach the router.”

I think that the additional simulation of a Wide Area Network would have been a definite improvement, however given the time frame it was simply not possible to simulate LAN’s and WAN’s.

He agreed with the majority of people that the program is easy to use and that it is interesting to make different network layouts and trace the routes packets take.

Conclusion

Overall, I think that all of the initial objectives have been fulfilled to the standard I set out for. The third-party feedback offered some definite improvements that could be made to the program, none of which, however, would have added to the complexity and fundamental purpose of the program.