



# **Status Report**

## **Network Performance Evaluation of Linux Based Operating Systems in a Physical Environment**

Date: 15/06/2025

Version: 1.4

**Client: Dr. Raymond Lutui**

**Prepared By:**

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## Version Control

Date	Version	Author	Note
25/05/2025	0.1	Win Phyto	Initial document creation.
26/05/2025	1.0	Larissa and Win	Inserted appropriate headers, tables, and formatting the document.
28/05/2025	1.1	All Team Members	Brief, Overview, Status, and Team Contributions filled out. Finalisation of draft.
09/06/2025	1.2	All Team Members	Improving status report from feedback.
14/06/2025	1.3	All Team Members	Finalising status report for submission.
15/06/2025	1.4	Thomas Robinson	Final proofread and corrections for submission.

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## Executive Summary

This project evaluates the IPv4 and IPv6 network performance of three Linux-based software routers using D-ITG. Performance evaluation, encompassing throughput, delay, jitter, and packet loss, will be conducted across 12 packet sizes on a network comprised of four computers.

The project, estimated at 300-360 hours, acknowledges potential risks such as Linux networking experience and hardware limitations, and includes a cost analysis for supervisor support and necessary equipment. Some of the risks and constraints to consider include lack of team experience with Linux networking, possible hardware failure, and potential budget restraints.

The total project cost is budgeted at NZD\$118,502.57, which covers the hardware, labour, and tools needed for the project.

The team is nearing the completion of the Test Execution phase for Ubuntu, having compiled and graphed the data for IPv4 and IPv6 across both TDP and UDP, with a client meeting already scheduled to close out this iteration.

## Project Brief

Our client, Dr. Raymond Lutui, has requested an evaluation of the network performance of three Linux-based operating systems (Fedora, Ubuntu, and Kali Linux) configured as software routers, to determine which has the best performance and to compare the data with its previous evaluations. Despite IPv4's acknowledged scalability constraints and IPv6's intended role as a replacement, the limitations of real-world performance data for both protocols hinder network professionals from confidently strategising and executing the transition. This project addresses the lack of real-world data by undertaking network performance evaluation using D-ITG across different packet sizes over IPv4 and IPv6, TCP and UDP protocol within a four PC network topology.

## Project Overview

The goal of this project is to evaluate the performance of three Linux-based Operating Systems – Ubuntu, Fedora, and Kali. These operating systems need to be configured as software routers on two of four computers in an isolated network. The tool D-ITG is to be employed to generate the evaluation traffic. The project follows the Software Testing Life Cycle (STLC) methodology, to evaluate network throughput, delay, jitters, and packet loss for TCP and UDP transmissions on IPv4 and IPv6 protocols within a 95% confidence interval over ten runs per packet size.

## Risk and Issues

The team have continued to update the Risk Register and Issue Log as needed. As expected, sickness and transport issues have been the most common, impacting both team and client meetings. We have managed these instances with catch-up sessions online. We have also identified new risks:

- Fatigue and burnout
- Inaccurate or invalid performance results
- Inconsistent formatting/presentation of results across operating systems

A full list of updated risks can be found in Risk Register v2.

## Proposal Feedback / Recommendations

The team has carefully considered and appropriately addressed the feedback and recommendations received during our proposal presentation. Team members were assigned in pairs to work on refining relevant sections of the original proposal, implementing changes for improvement. The completion work of assigned tasks was later peer-reviewed within the team to ensure the work meets the high standards of quality, accuracy and credibility outlined in the quality assurance plan. The following table shows the list of feedback and recommendations our team has received for the proposal, and how the proposal has been revised in response.

## Proposal Improvement

The following table below shows the changes implemented based on the feedback and recommendations for our proposal document.

Original Proposal	Revised Proposal	Reason for changes
<b><u>Scope Statement:</u></b> Functional Requirements <b>R7.</b> Generate network traffic using D-ITG or iPerf <b>R11.</b> Record throughput performance across all evaluation scenarios <b>R12.</b> All evaluations must be run 10 times each with all evaluations at 95% confidence <b>R13.</b> Measure network delays in all evaluation configurations <b>R14.</b> Calculate jitter values throughout evaluations <b>R15.</b> Track packet loss rates for all evaluation cases <b>R16.</b> Log all evaluations	<b>R7.</b> Generate network traffic using D-ITG <b>R11.</b> Record performance across all test scenarios for delay, jitter, throughput and packet loss <b>R12.</b> Log all evaluations in Excel spreadsheet <b>R13.</b> Generate visual graphs which show average performance metrics for all packet sizes	Improved functional requirements and removed repetitive functional requirements. Identified more relevant functional requirements and added them to scope statement.
<b><u>Non-Functional Requirements:</u></b> Missing some key requirements.	<b>R12.</b> Clock across all 4 computers must be synchronised <b>R13.</b> Finding the optimal value for packet rate <b>R14.</b> To keep each run 10 seconds	Added relevant non-functional requirements.
<b><u>Out of Scope:</u></b> <b>R3.</b> Comparison data must allow for direct analysis between operating systems <b>R15.</b> Addressing performance issues identified during evaluation <b>R17.</b> Troubleshooting underlying hardware issues	The 3 requirements shown on the left-hand side have been removed.	Removed irrelevant out of scope requirements.
<b><u>Project Scope:</u></b> Each configuration will undergo 10 evaluation runs to ensure statistical validity, with additional runs conducted for any results falling outside the 95% confidence interval.	The evaluation runs involve the sender initiating the sending of packets in the specified network topology to the receiver. Each evaluation run uses D-ITG to generate traffic for 10 seconds with different packet sizes, and logs will be decoded to export the average performance metrics.	Added more specific details on evaluation testing.
<b><u>Project Phases:</u></b> Requirement Analysis, Evaluation Planning, Evaluation Case Development, Evaluation Environment Setup, Evaluation Execution, Evaluation Closure.	Requirement Analysis, Test Planning, Test Case Development, Test Environment Setup, Test Execution, Test Closure.	All project phase names have been reverted to their original terminology from the STLC framework for clarity and consistency.
<b><u>Quality Assurance:</u></b> QA/QC plan can be clearer on how it integrates with the methodology	QA/QC Walkthrough Procedures by Project Phase table has been modified to relate back to project management methodology along with the project phases link to the QA as well.	Comments based on proposal review indicated the QA plan didn't link strongly to STLC.
<b><u>WBS:</u></b> High-level Work Breakdown Structure (WBS) shows the 6 phases along with the milestones.	The initial WBS was modified to show more technical aspects of the project as well as to show iterations between the Test Environment Setup and Test Execution phases for each of the operating systems.	The WBS diagram needed to show iteration and milestones.
<b><u>Gantt Chart:</u></b> Reworked based on revised WBS and project proposal feedback.	We updated the project schedule based on our current project status. A high-level project schedule from Gantt Chart is provided in <b>Appendix A.</b>	Work in progress (to be finished for final submission of mid-term review).
<b><u>Project Feasibility:</u></b> Original project feasibility section did not have references to quality assurance.	To ensure the project remains feasible throughout its lifecycle, we apply structured quality assurance measures. For full details, please refer to the Quality Assurance Plan in Appendix T. This includes: <ul style="list-style-type: none"> <li>• Tool validation to confirm D-ITG work across all Linux systems.</li> <li>• Structured upskilling to ensure team is prepared.</li> <li>• Peer-reviewed configurations to reduce errors and ensure consistency.</li> <li>• Requiring all results to meet the 95% confidence interval with re-tests for all outliers.</li> </ul>	Feedback from proposal emphasised the need for quality assurance of the project feasibility.

<b>QA Plan:</b> Section 6.0 evaluation case template, router configuration checklist, evaluation log template, bug report form, peer review checklist	Router configuration checklist, evaluation log template, peer review checklist.	Evaluation Case template and Bug Report form were removed from the QA Plan to avoid duplication. Evaluation procedures are detailed in the Requirement Traceability Matrix and project phases, while all issues will be logged into the Issue Log.
<b>Estimated Costs:</b> Original estimate assumed four monitors, four keyboards/mice, and 6 NICs. Total was NZD\$118,774.71.	Costs reduced: 6 NICs → 2 NICs 4 monitors → 3 monitors 4 keyboards/mice → 3 keyboards/mice Now down to NZD\$118,502.57.	PC motherboards have NICs on-board so only 2 extras needed. SSH or swapping peripherals can be used for setting up either or both routers since they don't need independent operation during evaluations. Whilst it's possible to reduce costs further using only SSH, having one set of peripherals for the routers is preferable for troubleshooting.

## Project Status

Phases	Planned Completion	Actual Status	Explanation
Requirement Analysis	11/04/2025	11/04/2025 Completed	Proposal was successfully submitted by scheduled date. The project's objectives, deliverables, methodology and scope were clearly outlined. Functional requirements were identified.
Test Planning - Ubuntu	02/05/2025	26/04/2025 Completed	Team members assigned roles and responsibilities (IPv4 and IPv6 teams). Testing objectives, environment setup prerequisites, and test plan documents were created. All members undergone 2 weeks of upskilling.
Test Case Development - Ubuntu	06/06/2025	26/04/2025 Completed	Detailed test cases were defined and aligned with the requirements. Instructions for executing each test cases were identified and documents. Bash scripts were created for automation on running evaluations.
Test Environment Setup - Ubuntu	04/07/2025	03/05/2025 Completed	Our team started environment setup earlier than planned, since we were able to get in touch with IT senior technician for our required hardware.
Test Execution - Ubuntu	31/07/2025	<b>Current Phase</b> Scheduled to finish on 22/07/2025	We have conducted all the runs for IPv4 and IPv6 on both TCP and UDP. We are currently working on finding the confidence interval for each test cases, which is part of our functional requirement.
Test Planning - Fedora	<b>Next Phase (Scheduled to start on 23/07/2025)</b>		

The evaluation of Ubuntu started two months ahead of schedule but was delayed due to the team's misunderstandings of how the evaluations should be conducted to gather accurate results. However, the team was able to diagnose and resolve this problem as it was caught early in the process, thus hopefully preventing similar problems for the rest of the project. Therefore, the entirety of the project schedule has been slightly shortened, despite the Ubuntu evaluation taking longer overall.

Documentation of the processes during the Ubuntu evaluation was lacking due to workload imbalance between team members and subpar delegation.

This is a difficult, non-stop balancing act in team projects, but the team is actively working on improving these issues, as shown in the *Recommendation on Team Performance Improvement* section.

## Team Contribution & Skills Learnt

Team Members	Tasks Completed	Skills Learnt
Thomas Robinson	<ul style="list-style-type: none"> <li>Executive Summary</li> <li>Terms of Reference</li> <li>Project Scope</li> <li>Project Feasibility</li> <li>Network Diagram</li> <li>Estimated Costs</li> <li>Upskilling Plan Schedule</li> <li>Requirement Traceability Matrix</li> <li>Work Breakdown Structure</li> <li>Referencing</li> <li>Meeting Agendas (Part 1)</li> <li>Initial scripting for all evaluations</li> <li>OS installations</li> <li>Network configuration</li> <li>Project Overview</li> <li>Project Status</li> </ul>	<ul style="list-style-type: none"> <li>Netplan</li> <li>Linux router configuration</li> <li>Chrony configuration</li> <li>How to use D-ITG</li> <li>IPv6 local addresses</li> </ul>
Win Phyto	<ul style="list-style-type: none"> <li>Team Contract</li> <li>Scope Statement</li> <li>Work Breakdown Structure</li> <li>Meeting Minutes</li> <li>Project Proposal</li> <li>Proposal Presentation Slides</li> <li>Scripting</li> <li>Data Analysis on DITG</li> <li>IPv4 TCP Ubuntu Running Evaluations</li> <li>Project Status Report</li> </ul>	<ul style="list-style-type: none"> <li>BASH scripting</li> <li>Chrony Configuration</li> <li>D-ITG</li> <li>Linux Network Configuration</li> <li>Project Planning and Management</li> <li>Data logging and analysis</li> <li>Communication Skills</li> </ul>
Nathan Quai Hoi	<ul style="list-style-type: none"> <li>Stakeholder Register</li> <li>Stakeholder Management Plan</li> <li>Network Diagram</li> <li>Gantt Chart</li> <li>Multiple contributions to proposal document</li> <li>Configuration of Pcs/Routers</li> <li>Data Analysis of the D-ITG Data (on Excel)</li> <li>Work Breakdown Structure</li> </ul>	<ul style="list-style-type: none"> <li>Hardware / Configuration Ubuntu Router</li> <li>BASH scripting to automate runs</li> <li>Initial Project Management Skills</li> <li>Excel formula knowledge to help automate calculations</li> <li>Some Python to automate D-ITG DAT files into Excel files</li> <li>D-ITG</li> </ul>
Zafar Azad	<ul style="list-style-type: none"> <li>Issue Log V1</li> <li>Risk Register V1</li> <li>Methodology Comparison</li> <li>Methodology Breakdown</li> <li>Project Phases</li> <li>Octave Graphing</li> <li>IPv6 D-ITG Script</li> </ul>	<ul style="list-style-type: none"> <li>IPv6 D-ITG scripting</li> <li>Ubuntu hardware setup</li> <li>Octave</li> </ul>
Larissa Goh	<ul style="list-style-type: none"> <li>Risk Register V1 &amp; V2</li> <li>Issue Log V1 &amp; V2</li> <li>Quality Assurance Plan V1 &amp; V2</li> <li>Milestone Report V1</li> <li>Labour Breakdown</li> <li>Meeting Minutes</li> </ul>	<ul style="list-style-type: none"> <li>BASH scripting</li> <li>MATLAB basics &amp; scripting</li> <li>Linux Familiarity</li> <li>Adaptability, giving and receiving feedback, time management, collaboration</li> </ul>
Charmi Patel	<ul style="list-style-type: none"> <li>Communication Plan V1</li> <li>Estimated Costs</li> <li>Proposal Presentation Slides</li> <li>Conflict Resolution Plan</li> <li>Project Status</li> </ul>	<ul style="list-style-type: none"> <li>Linux familiarity</li> <li>BASH scripting</li> <li>MATLAB basics</li> </ul>
Kylie Afable	<ul style="list-style-type: none"> <li>Tools comparison</li> <li>Proposal presentation slides</li> <li>Meeting Minutes</li> <li>Terms of Reference</li> <li>IPv4 Assessing runs</li> </ul>	<ul style="list-style-type: none"> <li>BASH scripting</li> <li>Linux familiarity</li> <li>Networking basics</li> </ul>

The table shows the contribution of all team members on the tasks, along with the new skills (technical and non-technical) learnt.

## Recommendation on Team Performance Improvement

The following list shows the recommendations for improving our team performance and maintaining consistent collaboration with open and respectful communication.

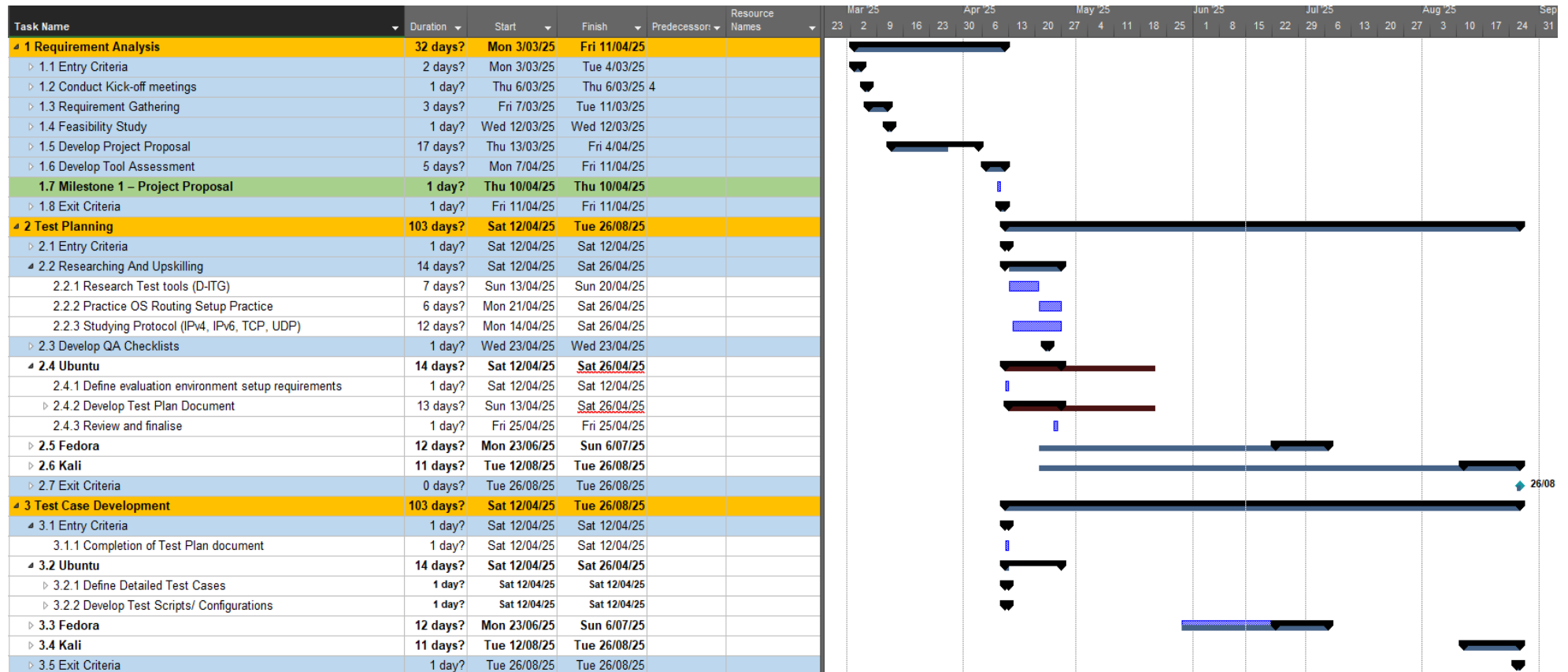
- Encourage team members to be more active and engaging in our online Discord server to enhance communication and improve collaboration.
- Improved work allocation to allow equal sharing of workload.
- Encourage team members to take initiative in doing tasks or ask what needs to be done.
- Encourage team members to provide updates on tasks they have been assigned so that everyone knows what is being done and can assist if needed.

## Summary of Client and Mentor Meetings

During our first phase, our team planned to have regular weekly meetings with the client and mentor. We transitioned to fortnightly meetings from the second phase onwards. In total, we conducted 6 meetings with the client and mentor with a total duration of 6 hours. This is only slightly less than expected, as our kick-off meeting in week 2 was pushed to week 3 because the time scheduled conflicted with our first workshop. As we move into Part 2 of our project, we aim to schedule client further in advance, rather than just a few days out. Our team meeting schedules remain the same and is shown in the following table.

Weekly Schedule Week 1 to Week 5 (21 July 2025 - 08 Sep 2025)	Time	Monday			Tuesday			Wednesday			Thursday			Friday		
	11am															
	12pm										Team Meeting					
	1pm							All Members Available Time			Weekly Meeting with Mentor + Client					
	2pm										R&D Workshop			All Members Available Time		
	3pm															
	4pm	Team Meeting (if needed)														
	5pm															
	6pm															
	7pm				Team Meeting											
	8pm															
Week 6 - Week 12 (19 Sep 2025 - 14 Nov 2025)	Time	Monday			Tuesday			Wednesday			Thursday			Friday		
	11am															
	12pm										Team Meeting					
	1pm							All Members Available Time			Client/Mentor Meeting (Fortnightly)					
	2pm										R&D Workshop			All Members Available Time		
	3pm															
	4pm	Team Meeting (if needed)														
	5pm															
	6pm															
	7pm				Team Meeting											
	8pm															

## Appendix A – New Project Schedule





4 Test Environment Setup	103 days?	Sat 12/04/25	Tue 26/08/25	
4.1 Entry Criteria	1 day?	Sat 12/04/25	Sat 12/04/25	
4.2 Ubuntu	20 days?	Sat 12/04/25	Sat 3/05/25	
4.2.1 Setting up OS and Network Topology	20 days	Sat 12/04/25	Sat 3/05/25	
4.2.2 Installing Linux OS distros (Ubuntu, Fedora, Kali) on routers	20 days?	Sat 12/04/25	Sat 3/05/25	
4.2.3 Installing required software	20 days?	Sat 12/04/25	Sat 3/05/25	
4.2.4 Deactivating/ Deleting unused software/package (to avoid interference)	1 day?	Fri 2/05/25	Sat 3/05/25	
4.2.5 Validate Environment Setup	1 day?	Fri 2/05/25	Sat 3/05/25	
4.3 Fedora	12 days?	Mon 23/06/25	Sun 6/07/25	
4.4 Kali	11 days?	Tue 12/08/25	Tue 26/08/25	
4.5 Exit Criteria	1 day?	Tue 26/08/25	Tue 26/08/25	
4.5.1 Fully functional evaluation environment	1 day?	Tue 26/08/25	Tue 26/08/25	
5 Test Execution	111 days?	Sun 4/05/25	Wed 1/10/25	
5.1 Entry Criteria	1 day?	Sun 4/05/25	Sun 4/05/25	
5.2 Status Report	19 days?	Mon 26/05/25	Wed 18/06/25	
5.3 Team Portfolio	13 days?	Tue 3/06/25	Wed 18/06/25	
5.4 Progress Presentation	8 days?	Mon 9/06/25	Wed 18/06/25	
5.5 Milestone 2 – Mid-term progress Review	1 day	Wed 18/06/25	Wed 18/06/25	
5.6 Ubuntu	38 days?	Sun 4/05/25	Sun 22/06/25	
5.6.1 Execute Test Cases	38 days?	Sun 4/05/25	Sun 22/06/25	
5.6.2 Validate Test Results	47 days?	Tue 22/04/25	Sun 22/06/25	
5.6.3 Re-evaluating (if needed)	37 days?	Mon 5/05/25	Sun 22/06/25	
5.7 Fedora	26 days?	Mon 7/07/25	Mon 11/08/25	
5.8 Kali	26 days?	Wed 27/08/25	Wed 1/10/25	
5.9 Exit Criteria	1 day?	Wed 1/10/25	Wed 1/10/25	
6 Test Closure	22 days?	Thu 2/10/25	Fri 31/10/25	

