

Instructions

Kia ora. The questions below are to help InternetNZ understand the triumphs and challenges you have faced to date in your mahi we have supported.

We want to celebrate your successes and understand the obstacles you have encountered so far. This will help us all to learn what we could do differently next time.

This form will be placed on our website for transparency.

Please complete and submit this form no later than the date stipulated in your funding agreement. Should you be unable to meet the deadline, contact us to arrange an alternative date, by emailing funding@internetnz.net.nz. You may not be eligible to apply for further grants from InternetNZ if this is not submitted. The completion of this form should be overseen by someone with an intimate knowledge of the funded mahi.

Mid-project report

*** indicates a required field**

For your convenience, you will find some information for this section has prepopulated from previous forms you have completed. Please amend any details as needed to ensure we have the most accurate information.

Project title *

UAV-aided Wireless Mesh Networking for Remote NZ Communities

Amount granted by InternetNZ? *

\$30,000.00

Must be a dollar amount.

Provide a short summary of the work that has been completed so far as part of this project/research. *

The PI has investigated the low-cost ground network architecture to optimally cover areas with changing terrains. The architecture is a two-tier hierarchical wireless mesh network in order to provide coverage to individual entities (e.g., a household, a farm) as well as efficiently bridge these entities via ground links, enabling a physically connected community. Practically, we design this architecture to carry several Gbps data rates in line-of-sight transmissions.

For non-line-of-sight transmissions, the PI and her RAs/student explore UAV-aided connections. We have studied aerial communication links via simulations and experiments. In addition, we designed algorithms to efficiently handle drone mobility and establish energy-efficient yet performance-guaranteed transition paths. These studies will help us to plan reliable and non-interrupted aerial-ground integrated communications.

Describe the 'who, what, where, when and why' of your initiative.

When do you anticipate that your mahi will be completed? *

07/08/2021

Must be a date.

Grants Round

2020 Grant Round Mid Year Report

Application GR000262019/20 From Dr WANQING TU

Form Submitted 7 Dec 2020, 9:57am NZDT

If you are uncertain, please provide an estimate.

What are the outcomes of this project so far? *

- Algorithms and theoretical analyses to complete the planned milestone 1 as well as the in-progress milestone 2.
 - Publications: A part of our results has been accepted by IEEE CCNC 2021. We are also refining our further results with IEEE TMC. Meanwhile, we are working on another paper for a potential submission in the near future.
 - Trained researchers: So far, two RAs and a research student have been involved in this project. They have progressed greatly in developing research methods, experimental skills, some practical network systems, etc.
- Describe major achievements of the project so far in terms of benefits for participants and/or others.

What have you learnt so far? *

- Two-tier hierarchical ground WMN architecture.

The architecture is formed by applying three algorithms designed by us. In general, these three algorithms employ multiple transmission rates, multiple channels, etc. to adaptively offer coverage with high transmission rates. In face of frequently changing terrains, we assign end user devices into different clusters so that any devices can be flexibly covered by a gateway no matter where they locate. The cluster formation algorithm analyses the threshold of cluster sizes that enable the largest possible cluster without incurring unacceptable performance. The cluster interconnection algorithm is implemented at the higher tier through high-performance WMN gateways. Channels at this tier are orthogonal with those employed in the lower tier. High-performance gateways at the higher tier and their connections together serve as the backbone of our ground architecture.

The efficient data routing through this two-tier architecture is the third algorithm that we proposed for optimal ground connections. The algorithm takes routing paths between gateways at the same tier as well as routing paths across the two tiers into account, when planning the best routes. The algorithm also includes a customised scheduling policy for routing data from multiple simultaneous sources without incurring interference between nearby nodes.

- UAV-aided connections.

To establish efficient aerial and ground connections, we first focus on high-performance data routing through aerial mesh and optimal trajectory planning for UAVs to implement quick transitions. We looked into two major routing strategies via experimental simulations. We find that they suit to connections to ground applications differently. Mainly, distance-vector routing protocols may process data routing quickly for applications with static ground devices, while link-state routing protocols can react to mobile applications on the ground better.

Furthermore, we investigated multicasting routing in aerial networks to support group applications. We studied a seamless and efficient transition algorithm for aerial group communications which can be used to support ground group communications. Our theoretical and experimental studies have reported that the proposed algorithm is able to maintain high-performance data multicasting while fast yet seamless transit any UAVs for their necessary movements. We are currently exploring how to efficiently integrate the above studies.

(For research) What findings have you made so far? (For projects) Describe areas for improvement, challenges or reasons for success.

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What (if anything) have you changed in your approach and practices? Why was this necessary?

Describe any changes from the original proposal and the reason the change was required. We may use this information to help others doing similar work.

Which population group/s were affected by this project or program? *

Living environment > Rural/regional dwellers

Please choose only the group/s that were at the very core of this mahi.

Financial report

*** indicates a required field**

Project income and expenditure

Please provide details of any project income (funds received) and project expenditure (funds spent) to date.

Use the 'Notes' column to provide any additional information you think we should be aware of.

Income description	Income type	Confirmed funding?	Income amount (\$)	Notes
			Must be a dollar amount.	
InternetNZ research grants	Other income	Confirmed *	\$30,000.00	

Expenditure

Expenditure description	Expenditure type	Expenditure amount (\$)	Notes
RA Wage.	Salaries and wages	\$8,000.00	For two RAs.
DJI MAVIC Air 2.	Infrastructure and/or hardware	\$3,398.00	For two.

Income and expenditure totals

Total income amount Total expenditure amount Income - expenditure

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\$30,000.00
This number/amount is
calculated.

\$11,398.00
This number/amount is
calculated.

\$18,602.00
This number/amount is
calculated.

Have you experienced any issues with your intended project budget to date? If so, please explain reasons for any major variances or for providing incomplete information:

Due to Covid-19, the PhD student cannot start his PhD onsite on time. He is doing research with the PI remotely. The expenditure scheduled for his scholarship has not been included in the above "Expenditure" table yet. It will be released to him once the travel ban is lifted.

Feedback

You are almost at the end of our mid-year reporting process. Before submitting your mid-year report, please take a few moments to provide some feedback.

Please indicate how you found the acquittal process:

Very easy Easy Neutral Difficult Very Difficult

How many minutes in total did it take you to complete this form?

600

Estimate in minutes (i.e. 1 hour = 60 minutes)

Please provide us with your suggestions about any improvements and/or additions to this form that you think we need to consider:

N/A. Very easy to use.

InternetNZ is a membership organisation. Would you be interested in hearing more about becoming a member?

Yes please No thanks I am already a member