

Instructions for Grantees

This form is designed to help us understand the challenges, triumphs and insights you experienced and gained while running your funded project/program. Please be frank - while we absolutely want to know about and celebrate your successes, it's just important to us that we understand what did not work so well. This will help us to learn what we and others could do differently next time.

You must complete and submit this form no later than the date stipulated in your funding agreement. However, should you not be able to meet the deadline please contact Gertrud to arrange an alternative date. If you fail to do so you may not be eligible to apply for further grants from **InternetNZ**.

The completion of this form should be overseen by someone with an intimate knowledge of the funded project/program.

Mid-project Report

Research Title

Accurate synchronization for coherent joint transmission to provide better mobile Internet service

This question is read only.

Amount of funding granted from InternetNZ?

\$25,000.00

Must be a dollar amount.

Please provide a short summary of the work that has been completed as part of this project/research

A comprehensive literature review has been undertaken. Existing solutions for centralized radio access network, coherent joint transmission, and time synchronization have been investigated and analyzed. A simulation platform has been developed. An algorithm for estimating delay and phase of an incoming signal has been designed and evaluated in simulations.

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

When do you anticipate that your project will be completed?

30/04/2019

Must be a date.

Milestones

What have been the major achievements/steps (i.e. milestones) involved in delivering your project to date?

Milestone

Description

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 Internet Research mid-year report
 Application IR170040 From Dr Haibo Zhang

Literature review	Existing solutions for centralized radio access network, coherent joint transmission, and time synchronization have been investigated and analyzed.
Develop the simulation platform for the distributed APs	A comprehensive simulation platform has been developed in Matlab to model: (a) a complex multipath propagation environment with realistic characteristics of a given area; (b) physics-based realistic work of an antenna in order to simulate proper reception and transmission of signals; (c) simultaneous work of a number of distributed APs with MIMO antennas; (d) a realistic movement of a human's body in order to examine the most common mobility scenarios for synchronization; (e) a proper dynamics of a smartphone to model realistic movement effects on signal propagation such as Doppler effect and consistent position change of antennas.
Develop the algorithms for the two-stage synchronization, coherent joint transmission, and parallel processing, and evaluate them in simulations.	An algorithm has been designed to estimate time delays and phases of incoming signals based on training signals. This is one of the vital steps in our two-stage algorithm. As it was expected, the algorithm estimates the time delays through estimating the phases, which are estimated through measuring correlation spikes of the training signals. Preliminary simulation results show that the estimation of time delays can be significantly refined after the phases measurement. Currently, we are developing a scheduler that will allow coherent joint transmission of multiple APs.
e.g. planning; major activities; evaluation	

What findings have you made so far?

- (1) Preliminary simulation results show that the estimation of time delays can be significantly refined after the phases measurement. With a slight change of the algorithm, the location of a mobile user can be found, which will potentially be helpful for tight synchronization.
- (2) We found that the 3D orientation of a mobile user's antenna may play a crucial role in the tracking of the user's channel, which can be taken into account during coherent transmission. This is actually an interesting research question on how to estimate the

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orientation of user's antenna and infer channels for coherent transmission for a number of APs.

What (if anything) did you change in your approach and practices as your project/program/initiative proceeded, and why?

N/A

We may use this information to help inform others undertaking similar work

Financial Report

* indicates a required field

Project Income & 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
InternetNZ research fund	Other Income *	Confirmed *	\$25,000.00 *	research grant received from InternetNZ *

Expenditure Description	Expenditure Type	Expenditure Amount (\$)	Notes
Salary for research assistant *	Salaries and Wages *	\$2,581.00 *	
hardware for experiments	Infrastructure and/or Hardware	\$3,461.00	
Overheads	Overheads	\$2,508.00	

Income and Expenditure Totals

Total Income Amount	Total Expenditure Amount	Income - Expenditure
\$25,000.00	\$8,550.00	\$16,450.00

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This number/amount is calculated.

This number/amount is calculated.

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:

No

Certification and Feedback

Feedback

You are almost at the end of our application process. Before **Submitting** your application, 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?

60

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: