

# Technical Research Report

## Introduction

This is the April 2016 Technical Research Report, setting out the research projects being undertaken by NZRS. This is the second version of the report, updating on the progress of projects and adding two new activities. An updated version of this document will be provided at each Council meeting.

## Scope and output of technical research

Technical research aims to expand the frontiers of our knowledge about the Internet within NZ and make that new knowledge openly available to all. Projects are drawn from the wide range of topics within this broad ambit.

One of the earliest considerations is what data is available as data analysis is the cornerstone of research activity. This explains the inevitable heavy emphasis on .nz research in the projects listed below as the data is readily available after a number of years building a data collection and analysis infrastructure for .nz.

Research projects are initiated with an idea of what might be achieved, how that might be used and in what forms the output might be delivered. The identification of potential uses looks beyond research team to consider how other researchers might build on that knowledge and how that knowledge might be commercialised, both within and without NZRS, to aid the growth of the NZ economy.

As with all true research though, there is no guarantee that this is what will be achieved or that the project will not change radically over time and it is not uncommon for a project to change focus or even name during its lifetime.

Wherever possible the outputs of technical research projects will be open knowledge, open code published on our GitHub repository and open data published on our Internet Data Portal (IDP), all under a Creative Commons license. The limitations on this are a) to respect the privacy inherent in any data used; b) to preserve the security of the Internet; and c) to comply with .nz policies and procedures.

## Projects

Title	NZ IP Topology Map		Status	In Progress
<b>Description</b>	Mapping the internal structure of the Internet in New Zealand. This project uses the RIPE Atlas probes to do active measurement and discovery of Internet Topology.			
<b>Potential uses</b>	There are a number of outstanding questions about the structure of the NZ Internet whose answers can drive useful policy debate. For example, are their routes where traffic between one NZ site and another NZ site is forced to sub-optimally 'trombone' out of the country and back again because of the way that some providers interconnect?			
	<i>Form</i>	<i>Done</i>	<i>Details</i>	

<b>Planned outputs</b>	Web site	<input checked="" type="checkbox"/>	Website at <a href="http://ip.topology.net.nz">http://ip.topology.net.nz</a> updated with new version.
	Open data	<input checked="" type="checkbox"/>	Resulting network representation made available via the project's website.
	Open code	<input checked="" type="checkbox"/>	Code available in NZRS GitHub account.
<b>Presented</b>	Proof of Concept presented at First NZIRF. Working version presented at Second NZIRF. Submission made to RIPE 72.		
<b>Collaborators</b>	Active collaboration with RIPE Labs. RIPE has a tool that operates under the same principle of active measurements using the same measurement platform. RIPE has asked to use our visualization code to include it in their tool. There is interest in merging both projects and turn them into a framework to be available for other researchers and the community in general.		
<b>Progress</b>	Code is no longer NZ-centric, but a generic framework to generate the same visualization for any country. Certain interesting analytics are available, like path anomaly detection (traffic destined to the country leaving the country). The new version of the frontend has been deployed.		

Title	ANZSIC classification of the register		Status	On hold
<b>Description</b>	Using web content from each domain web page, and a set of hand curated domain names mapped to an economic activity code (ANZSIC), train a machine learning model and be able to classify every domain in the register. This allow us to augment our understanding of the register			
<b>Potential uses</b>	The data could be provided to registrars for their Domains under management (DUMs) in the registrar portal and so help them understand their customers better. The same data could also be made available to registrants through a new product or service.			
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>	
	Open data	<input type="checkbox"/>	Will be published openly on IDP but in aggregated form to preserve the privacy expectations of registrars and registrants	
	Open code	<input type="checkbox"/>	Will publish code on GitHub	
<b>Presented</b>	Concept presented at 2015 Registrar conference.			
<b>Collaborators</b>	Initial data used for the training was bought from two companies one of which, whoiswhere, participated in the first round of analysis of the results.			
<b>Progress</b>	Using a strict mapping from domain to activity code, 50% (+/- 1%) of the testing data was mapped correctly. If using fuzzy matching (any of the top 3 most probable categories), this value increases up to 78% +/- 1% accuracy. Future steps include a better text collection from the webpages to support JavaScript, and better input data clean-up.			

Title	Domain Retention Prediction	Status	In Progress
<b>Description</b>	Project to generate a probabilistic model that will tell us: <ul style="list-style-type: none"> <li>• Which elements of a registration are best predictors of their likelihood to be stay in the register</li> <li>• Probability of a domain to be stay in the register in the future, and by extension, determine the forward value of a domain in the register</li> </ul>		
<b>Potential uses</b>	Can be provided to registrars for their DUMs to enable them to understand their customers better. This work may also allow NZRS to produce a better income forecasting model.		
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>
	Open code	<input type="checkbox"/>	Will publish code on GitHub.
<b>Presented</b>	Concept presented at Registrar Conferences in 2014 and 2015.		
<b>Collaborators</b>	Some of the insights obtained in this work has been shared and discussed with staff at .CA		
<b>Progress</b>	An approach using Machine Learning algorithms has been tested. Waiting for a suitable data dump from the SRS Operations Team to test if methodology produces meaningful results. Currently exploring elements of a domain that can affect the prediction.		

Title	Registrant Classification	Status	On Hold
<b>Description</b>	Machine Learning classifier to determine if a registrant is a person or an organization based on the registrant name.		
<b>Potential uses</b>	Augment our understanding of the register, as this information is not available at registration. Likely this will feed into other research projects rather than have much utility on its own.		
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>
	Open data	<input type="checkbox"/>	Will consider aggregated and anonymised data on IDP.
	Open code	<input type="checkbox"/>	Will be published on GitHub.
<b>Presented</b>	None.		
<b>Collaborators</b>	None.		
<b>Progress</b>	A Proof of Concept is available as a web service, achieving a 95% percent accuracy. Requires discussion with the Operations Team to run the algorithm in a continuous basis.		

Title	Domain Popularity Algorithm	Status	In Progress
<b>Description</b>	Algorithm using DNS data to determine if a domain name is more popular than others.		

<b>Potential uses</b>	Can be shared with registrars to help them understand their customers better. Can be used for interesting information about the .nz namespace for the general public in press releases and the like. Can be used to develop new products/services that allow registrants to see how their actions affect their domain name popularity.		
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>
	Report	<input type="checkbox"/>	
	Web site	<input checked="" type="checkbox"/>	Some selected data sets are publicly visualized at <a href="http://domain-rank.nzrs.net.nz/popular.html">http://domain-rank.nzrs.net.nz/popular.html</a> and <a href="http://domain-rank.nzrs.net.nz/bank.html">http://domain-rank.nzrs.net.nz/bank.html</a>
	Open data	<input type="checkbox"/>	Will be published openly on IDP but in aggregated form to preserve the privacy expectations of registrars and registrants
	Open code	<input type="checkbox"/>	Will be published on GitHub.
<b>Presented</b>	Presented as Proof of Concept at DNS-OARC 22 in Amsterdam. Accepted presentation for CENTR Jamboree in Brussels in May 2016.		
<b>Collaborators</b>	Seeking collaboration within the CENTR group, as suggested by the CENTR R&D Chair.		
<b>Progress</b>	A review of the algorithm has been done and we are now working with a different approach that produces better results. A sample of DNS traffic from one of your offshore providers will be used to test for bias. Working in identifying well known sources of traffic to treat that traffic in a different way. Google Analytics figures from 4 different domain names to be used to test correctness.		

Title	DGA detection algorithm		Status	On Hold
<b>Description</b>	We gave our summer intern relatively free rein to explore our DNS data set and what he came up with is the bones of an algorithm to automatically detect traffic generated by botnets using DGAs (Domain Generation Algorithms) using DNS traffic.			
<b>Potential uses</b>	Can be used for early detection of infected hosts. Can be used to assess the overall health of .nz. Can be used to assess the likelihood that a new registration is nefarious in intent.			
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>	
	Report	<input type="checkbox"/>		
	Open code	<input type="checkbox"/>	Will be published on GitHub.	
<b>Presented</b>	The concept was presented at the New Zealand Internet Research Forum 2015.			
<b>Collaborators</b>	Details have been exchanged with SIDN Labs as they are working in similar ideas.			

<b>Progress</b>	The proof of concept needs to be tested at a larger scale, possibly using a different language.
-----------------	---

<b>Title</b>	Register word decomposition	<b>Status</b>	On Hold
<b>Description</b>	Decompose every domain in the register into their word components (aucklandaccountants.org.nz into “Auckland accountants”).		
<b>Potential uses</b>	Largely as a building block for other potential projects, such as identifying prevalence of geographic terms (and thereby understanding potential for a new geographic TLD), detecting trending words in registrations and identifying use of Te Reo.		
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>
	Report	<input type="checkbox"/>	
	Open data	<input type="checkbox"/>	Will be published openly on IDP but in aggregated form to preserve the privacy expectations of registrars and registrants
	Open code	<input type="checkbox"/>	Will be published on GitHub.
<b>Presented</b>	None.		
<b>Collaborators</b>	None.		
<b>Progress</b>	There is a Proof of Concept available that needs to be tested for accuracy. One that’s completed, identify how to put it into production.		

<b>Title</b>	Full web scan of .nz	<b>Status</b>	On Hold
<b>Description</b>	Capture web content published under .nz domains to feed the ANZSIC classification project. Investigate tools to do a deeper gathering of content.		
<b>Potential uses</b>	Multiple possible uses including a general report on the state of the .nz web space; information for registrars on their DUMs; information for registrants as part of a new product or service; and as an input into a other research projects.		
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>
	Report	<input type="checkbox"/>	
	Open data	<input type="checkbox"/>	Will be published openly on IDP but in aggregated form to preserve the privacy expectations of registrars and registrants
	Open code	<input type="checkbox"/>	Will be published on GitHub.
<b>Presented</b>	None		
<b>Collaborators</b>	We have discussed this project with the National Library who have a contract for a web scan using similar technology and are looking at techniques to mine that data once gathered.		

<b>Progress</b>	A first working version is available and being used for ad-hoc shallow web scans. A second version is available to identify the cases where sites require Javascript to render content, to fetch them using a different tool. A Proof of Concept for the deep scan is available using Hadoop, Heritrix and HBase.
-----------------	---

<b>Title</b>	Zone Scan V2		<b>Status</b>	Not started
<b>Description</b>	The regular zone scan is using code that is no longer maintained. The replacement version allows faster scanning, and easier ways to run custom collections. This work aims to investigate, test and eventually replace the engine used by the zone scan.			
<b>Potential uses</b>	NZRS development team already working on building outputs from v1 into the registrar portal to provide registrars with information on their domains with a view to improving quality. Data could also be provided to registrants in a new product or service.			
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>	
	Open data	<input type="checkbox"/>	Will publish aggregated and anonymised data on IDP.	
	Open code	<input type="checkbox"/>	Will be published on GitHub.	
<b>Presented</b>	None			
<b>Collaborators</b>	IIS, the .SE register are collaborators as authors of the engine currently in use, and developers of the replacement.			
<b>Progress</b>	Not Started			

<b>Title</b>	DNS statistics publication using IDP		<b>Status</b>	Not started
<b>Description</b>	Make data from the DNS traffic for .nz available using the Internet Data Portal			
<b>Potential uses</b>	Researchers and Policy makers are always interested in data. DNS data is rich and vast, and can be useful to observe the uptake of new technologies. Making data from the DNS traffic for our ccTLD available in an open format can help the community to answer some questions, like the uptake of IPv6 or DNSSEC. We aim to make some of that data available on a regular basis.			
<b>Planned outputs</b>	<i>Form</i>	<i>Done</i>	<i>Details</i>	
	Report	<input type="checkbox"/>		
	Open data	<input type="checkbox"/>	Will publish aggregated and anonymised data on IDP.	
	Open code	<input type="checkbox"/>	Will be published on GitHub.	
<b>Presented</b>	None.			

<b>Collaborators</b>	SIDN is publishing some interesting counters from their DNS data, using a platform powered by Hadoop, inspired by the work we did with Hadoop
<b>Progress</b>	Not started

## Glossary

Botnet	A network of compromised PCs that are remotely controlled, generally for criminal purposes.
DGA	Domain Generation Algorithm. A technique used by botnets to automatically generate domains names that they can register and use for their command and control servers.
DNS-OARC	The main membership organisation focused on DNS research.
GitHub	The main web site used in our industry for sharing code.
IDP	Our Internet Data Portal at <a href="https://idp.nz">https://idp.nz</a>
NZIRF	New Zealand Internet Research Forum. Organised by InternetNZ.
Hadoop	Big Data Platform

INTENTIONAL BLANK PAGE