



CIRA's Internet Performance Test

Presented by: Yachen Shen & Don Slaunwhite



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BUILDING A BETTER
ONLINE CANADA

.CA

2.7 million .CA domains
with 100% uptime.

Cybersecurity Services

100,000 new cybersecurity threats
blocked daily by D-Zone Firewall.

Registry Services

Robust top-level domain
products and services.

We support initiatives that enhance Canadians' internet experience:



Global Internet Leadership

- Support internet governance and standards through global organizations such as ICANN and CENTR



Canadian Initiatives

- **11** Internet Exchange Points nation-wide
- **280,000+** internet performance tests conducted last year



Community Initiatives

- More than **\$4.2 million** in grants to **102** projects through our Community Investment Program





The Internet in Canada



CRTC

The Canadian Radio-television and Telecommunications Commission (CRTC) is an administrative tribunal that regulates and supervises broadcasting and telecommunications in the public interest. They establish definitions of Broadband within Canada.

CRTC – Broadband Definition

- 1999 - The basic service objective was set out:
 - individual line local touch-tone service;
 - the capability to connect to the Internet via low-speed data transmission at local rates;
 - access to the long distance network, operator/directory assistance services, enhanced calling features and privacy protection features, emergency services, as well as voice message relay service; and
 - a printed copy of the current local telephone directory upon request.
- 2011 - It set an aspirational target of universal access to:
 - Download speeds of 5 Mbps
 - Upload speeds of 1 Mbps
 - But did not include high-speed Internet in the basic service definition.



CRTC – Broadband Redefined

- 2016 – Defined that all Canadians should be able to access speeds of:
 - Download speeds of 50 Mbps
 - Upload speeds of 10 Mbps
 - Access to a service offering with an unlimited data allowance
- 2018 – Defines high-quality fixed broadband requirements:
 - Round-trip latency threshold of 50 milliseconds,
 - Packet loss threshold of 0.25%, both based on measurement during peak times.
 - Starting a separate proceeding to establish an appropriate QoS metric for jitter.



Internet Performance Test (IPT)

- As a not-for-profit organization, one of our primary goals is to see the Internet thrive in Canada and around the world.
- In order to develop the Internet you first need to understand the State of the Internet.
- We found there was no active mechanism to measure true broadband speeds in Canada.
- After examining a number of alternatives, CIRA chose to work with the Measurement Lab Consortium (M-Lab) back in 2011.



IPT Original Goals – Open Data

- Improve the availability of neutral and open data about the state of the Internet in Canada.
- Provide consumers with a public broadband testing solution that is open and transparent.
- Implement a research platform that is adaptable to a changing Internet and that is completely open to developers and researchers.
- Encourage and support public participation in research, development, and analysis.



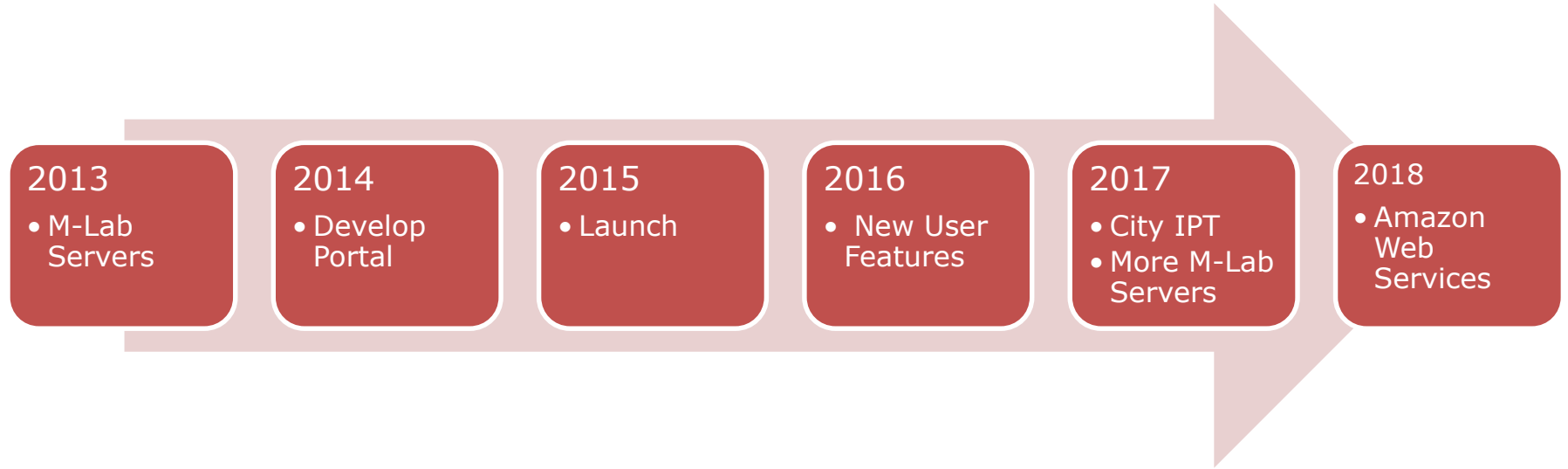
IPT Original Goals – Measurements

- Measure broadband connection performance and transparency by location
- Measure mobile connection performance and transparency by location
- Measure IPv6 adoption rate (% of clients support native IPv6, trending)
- Measure DNSSEC adoption rate (% client support native DNSSEC, trending)
- Measure trans-Canadian traffic routes (% of traffic flowing outside Canada, trending)

IPT Original Goals – Reporting

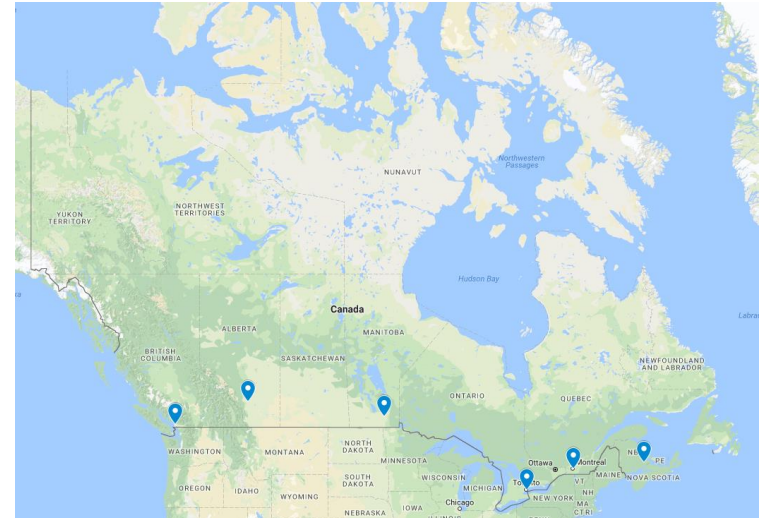
- Report on broadband and mobile performance by ISP, ISP subscription services and costs.
- Provide mobile heat maps by performance, transparency, ISPs, ISP subscription services by GPS location
- Provide broadband heat maps by performance, transparency, ISPs, ISP subscription services by province, city, postal code, etc.

IPT – What did we do.



Adding new M-Lab sites

- In 2013 CIRA worked with M-Labs to create 3 new sites in Canada:
 - Toronto
 - Montreal
 - Calgary
- In 2017 CIRA worked with M-Labs to upgrade existing sites and add another 3 sites:
 - Moncton
 - Winnipeg
 - Vancouver



IPT – Features

- Uses the NDT (Network Diagnostic Test)
- Presents Download, Upload and advanced details
- Separate test to present DNSSEC & IPV6 support
- Choropleth Mapping to provide easy-to-view results
- Visual Traceroute

IPT – Take a look

cira BUILDING A BETTER ONLINE CANADA

MLAB
Sign In | Français

My Internet Performance Test

Your IP is 66.46.91.188. Verify the information below, edit if needed, and click **Start** to begin.
If you wish to inform us of a location without internet access, [click here](#).

My Postal Code K1S5K5	My ISP Allstream Corp.	How often? Once	For how long? N/A	Test Server Toronto
---------------------------------	----------------------------------	---------------------------	-----------------------------	-------------------------------

Upload Speed | My Device | ISP Network | The Internet | Download Speed

Map | Help

Statistic: Download Search: Postal Code

418,078 Tests Run in Canada

* This performance test collects information including Postal Codes, IP addresses and survey question responses (where applicable) which will be made available for research purposes only.

Terms & Conditions



IPT – The Test

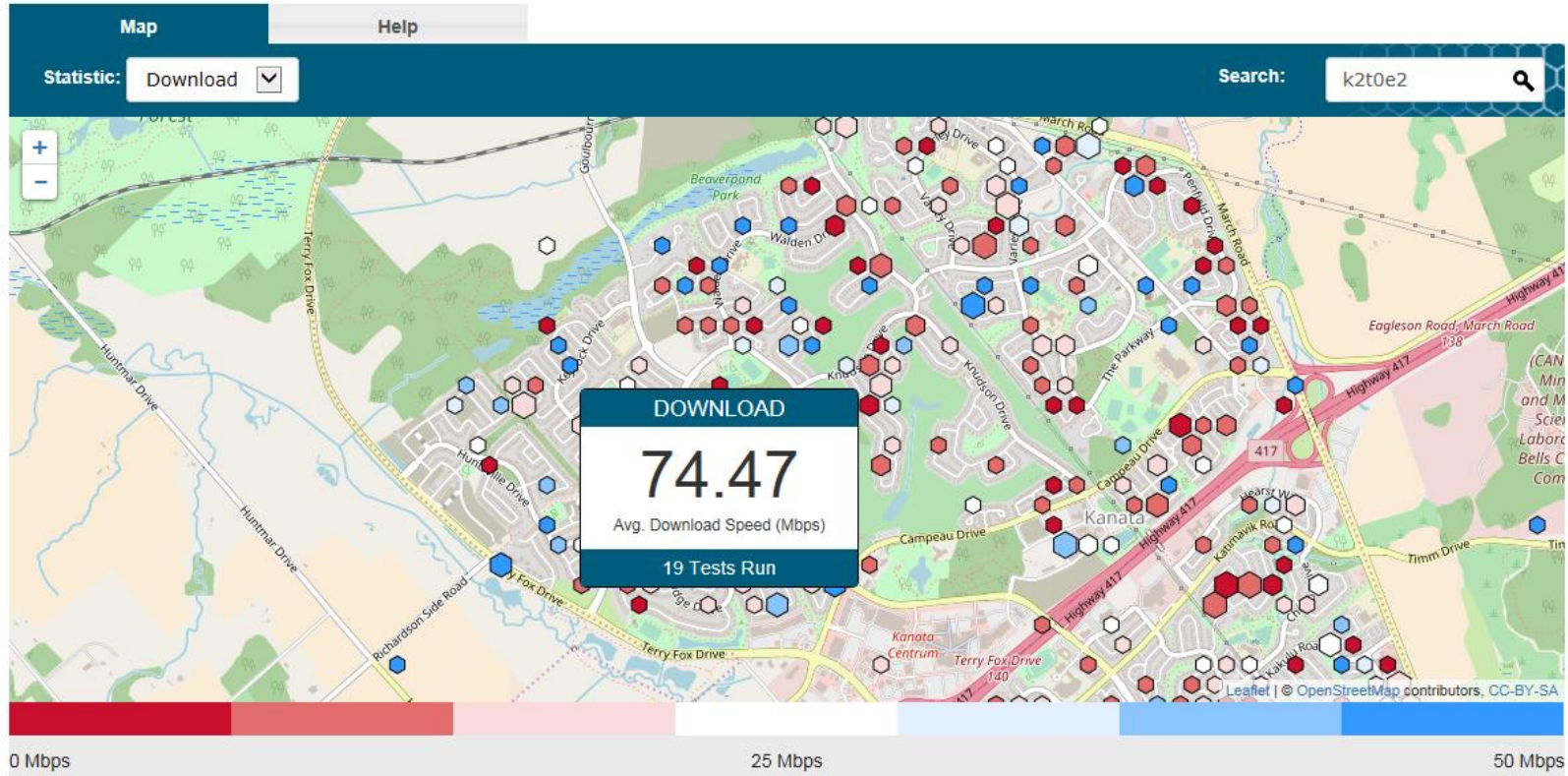
My Internet Performance Test

Your IP is **66.46.91.186**. Verify the information below, edit if needed, and click **Start** to begin.
If you wish to inform us of a location without internet access, [click here](#).

Start

My Postal Code	My ISP	How often?	For how long?	Test Server
<input type="text" value="K1S5K5"/>	<input type="text" value="Allstream Corp."/>	<input type="text" value="Once"/>	<input type="text" value="N/A"/>	<input type="text" value="Toronto"/>
Avg: 5.3 Mbps (Max: 7.4 Mbps)	33 ms			Avg: 48 Mbps (Max: 49 Mbps)
Upload Speed	Ping	IPv6	DNSSEC	Download Speed


IPT – The Map



IPT – Where am I?

Please confirm your location

The marker is positioned where we think you are located. If not correct, simply use your mouse and drag the marker to the correct location.



Tell us about yourself

Type of internet service
 Business Home

Package download speed
0 Mbps

Monthly cost of service
0 CAD

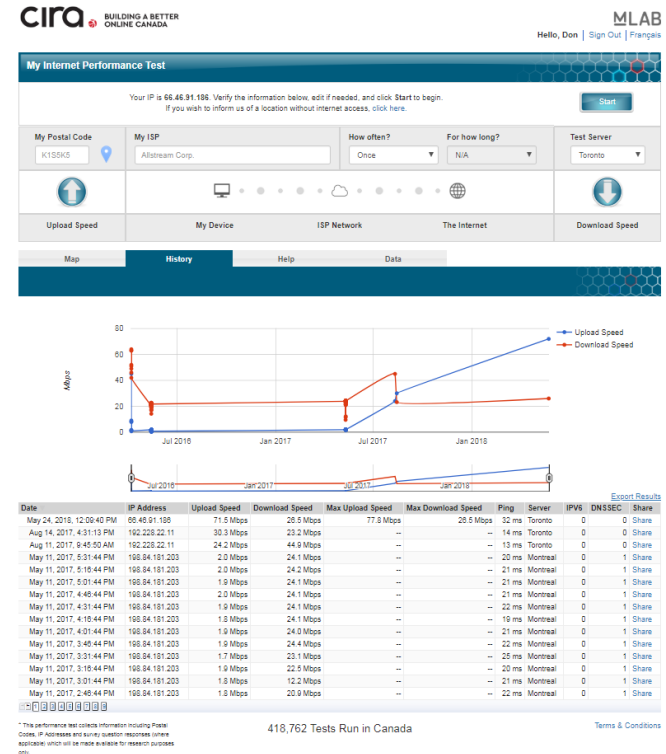
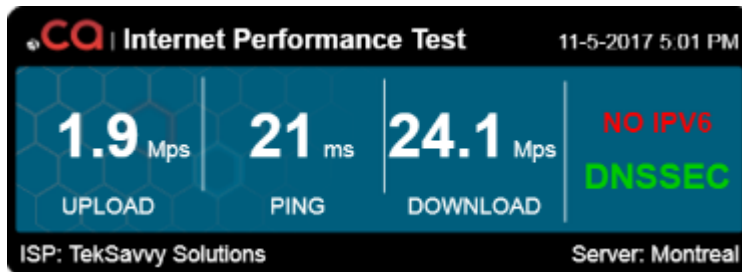
Satisfaction with internet package
Select a rating

Comments
Maximum 140 characters

I'm happy with my information, don't ask me again

IPT Users



- Added the ability to log into IPT.
- Keep History of your tests run.
- Allow Auto-Run of IPT tests.
- Share results via social media friendly image



Launching the IPT

- How to launch a successful Internet Performance Test.
 - Press Releases
 - Newspaper Articles
 - Radio spots
 - Contests
 - Search Engines
- Difficult to maintain momentum and keep people engaged.

Search – Above the fold

Google  

[All](#) [News](#) [Videos](#) [Images](#) [Shopping](#) [More](#) [Settings](#) [Tools](#)

About 610,000,000 results (0.71 seconds)

Speedtest by Ookla - The Global Broadband Speed Test

www.speedtest.net/

Test your Internet connection bandwidth to locations around the world with this interactive broadband speed test from Ookla.

[Android](#) [Windows](#) [Apps](#) [Mac](#)

You've visited this page 3 times. Last visit: 07/06/18

Fast.com: Internet Speed Test

<https://fast.com/en/>

How fast is your download speed? In seconds, FAST.com's simple Internet speed test will estimate your ISP speed.

Xfinity Speed Test

speedtest.xfinity.com/

Xfinity Speed Test tests your Internet connection speed.

Internet speed test | Support | TELUS.com

<https://www.telus.com/en/support/article/speed-test>

Measure the speed of your TELUS Internet connection. ... Use this speed test to estimate both the download and upload speed of your Internet connection.

Internet Speed Test | Rogers Support - Rogers

<https://www.rogers.com/customer/support/article/internet-speedtest>

Jun 25, 2018 - Test the current speed of your Rogers Internet connection.

CIRA Internet Performance Test

<https://performance.cira.ca/>



A quick and easy Canadian Internet speed test. Providing unbiased results with advanced diagnostic information which can help solve your Internet ...

Internet Speed Test | CenturyLink

<https://www.centurylink.com/home/help/internet/internet-speed-test.html>

A slow Internet connection can be very frustrating. Here's a test you can run to check your Internet speeds and some tips to help improve your experience.

Measure the speed of your Internet connection - Bell support

Google  

[All](#) [News](#) [Images](#) [Shopping](#) [Videos](#) [More](#) [Settings](#) [Tools](#)

About 526,000,000 results (0.52 seconds)

The CIRA Internet Performance Test (IPT) is a quick and easy test of the speed and quality of your Internet connection on Canada's Internet Infrastructure. ... Download speed (how fast you can transfer data from the Internet to your computer) Upload speed (how fast you can transfer data from your computer to the Internet)

CIRA Internet Performance Test

<https://performance.cira.ca/>



[About this result](#) [Feedback](#)

People also ask

What is a good speed for internet?

What is the average download speed in Canada?

What is considered to be high speed internet?

What should be my Internet speed?

[Feedback](#)

CIRA Internet Performance Test

<https://cira.ca/cira-internet-performance-test/0>

CIRA Internet Performance Test. CIRA's Internet Performance Test is one of the most advanced tests of Internet speed and quality available. ... This allows CIRA to measure the actual performance of an Internet connection in real network conditions, closely representing the Internet experience of Canadian users.

CIRA Internet Performance Test

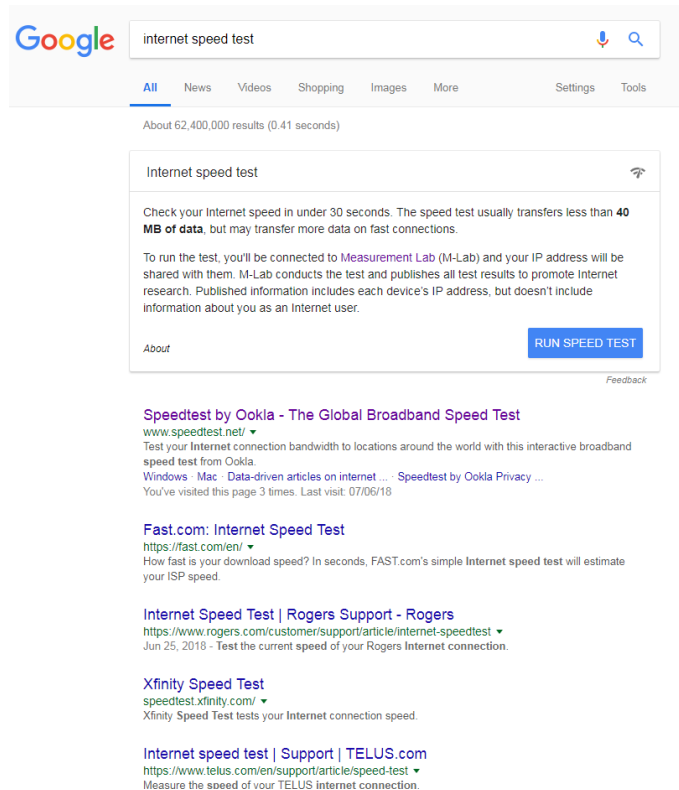
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The CIRA Internet Performance Test (IPT) is a quick and easy test of the speed and quality of your Internet connection on Canada's Internet Infrastructure. ... Download speed (how fast you can transfer data from the Internet to your computer) Upload speed (how fast you can transfer data from your computer to the Internet)

[Speedtest by Ookla - The Global Broadband Speed Test](#)



The world can quickly change...



Google internet speed test

All News Videos Shopping Images More Settings Tools

About 62,400,000 results (0.41 seconds)

Internet speed test

Check your Internet speed in under 30 seconds. The speed test usually transfers less than **40 MB of data**, but may transfer more data on fast connections.

To run the test, you'll be connected to Measurement Lab (M-Lab) and your IP address will be shared with them. M-Lab conducts the test and publishes all test results to promote Internet research. Published information includes each device's IP address, but doesn't include information about you as an Internet user.

About [RUN SPEED TEST](#)

Feedback

Speedtest by Ookla - The Global Broadband Speed Test
www.speedtest.net/
Test your Internet connection bandwidth to locations around the world with this interactive broadband speed test from Ookla.
Windows · Mac · Data-driven articles on internet ... · Speedtest by Ookla Privacy ...
You've visited this page 3 times. Last visit: 07/06/18

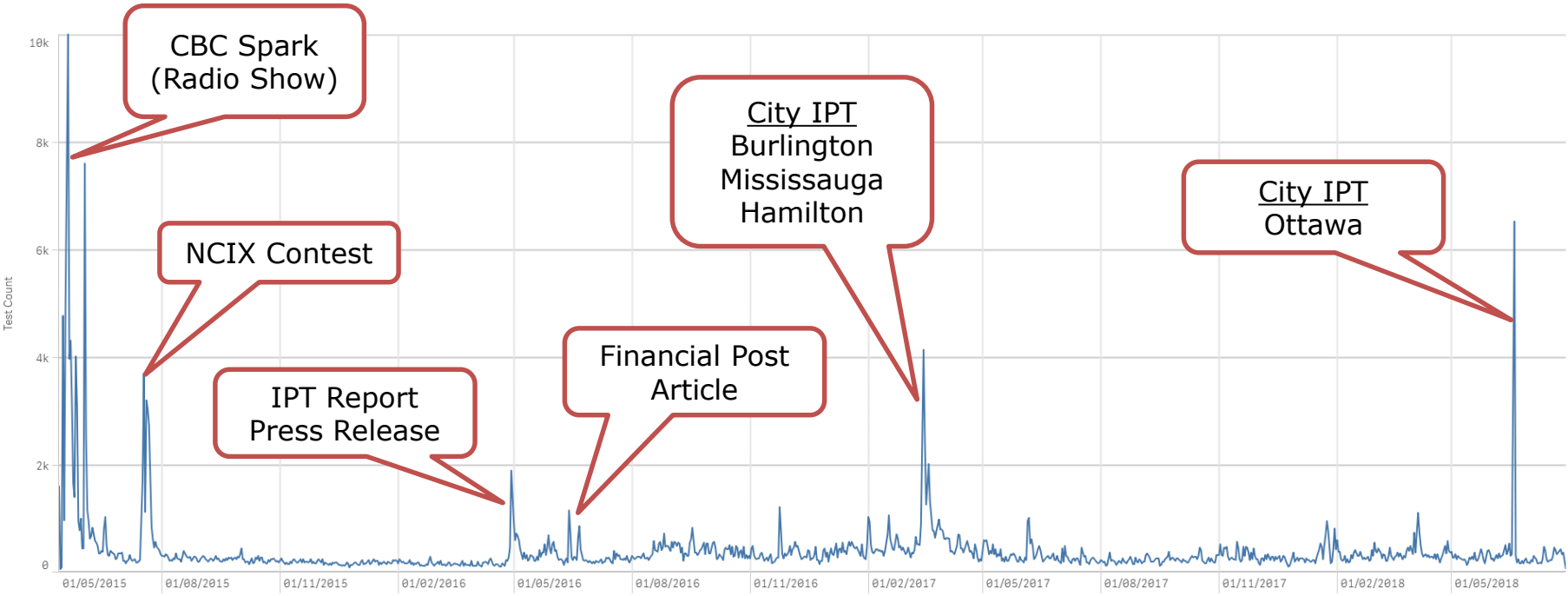
Fast.com: Internet Speed Test
<https://fast.com/en/>
How fast is your download speed? In seconds, FAST.com's simple Internet speed test will estimate your ISP speed.

Internet Speed Test | Rogers Support - Rogers
<https://www.rogers.com/customer/support/article/internet-speedtest>
Jun 25, 2018 - Test the current speed of your Rogers Internet connection.

Xfinity Speed Test
speedtest.xfinity.com/
Xfinity Speed Test tests your Internet connection speed.

Internet speed test | Support | TELUS.com
<https://www.telus.com/en/support/article/speed-test>
Measure the speed of your TELUS internet connection.

IPT Marketing – Tests per Day





Technology

CIRA's IPT is essentially built on three different tests.
Network Diagnostic Test, DNSSEC test, IPV6 test

Network Diagnostic Test – NDT

- Network Diagnostic Tool (NDT) is a client/server program that provides network configuration and performance testing. It forms the base test for the IPT.
 - Provides speed information
 - Provides Web100 detailed information
 - Originally run as a command-line client.
 - As the times changed moved from Java, Flash to Websocket as the technology of choice for the web client.

IPT - DNSSEC

- The test connects and retrieves data from two DNSSEC protected websites where one site is configured incorrectly and should not have access to retrieve the data.
- If the test is able to retrieve the data from the incorrect website then that means you are not protected with DNSSEC benefits.
- Your computer, your home network and **Internet Service Provider (ISP)** connection all must support the newest DNS features to enable DNSSEC validation in order to pass the test.
- 19% IPT test users are DNSSEC capable

IPT – IPV6

- The IPv6 test is designed to connect and retrieve an image from an IPv6 only web site. Your computer, your home network and your Internet Service Provider (ISP) all must support IPv6 in order to pass the test.
- 13.5% IPT Test users are IPV6 capable



NDT is Great!!

But it does have a few areas that could be improved.

- Websocket
- Heuristics
- High Speed
- Satellite
- Jitter



NDT Client - Websockets

- Websockets is a great technology that works with in most major browsers.
- We did run into a few difficulties along the way.
- Certain browsers had poor websocket performance.
 - This manifested in slower or incorrect test speeds.
- Over time browsers improved their websocket performance, while good, this also created a variance in the test results.
- As a result the IPT always recommended users use Google Chrome which constantly produced solid results.
- The vast majority of our tests were using Chrome or Firefox.

NDT Client – Heuristics

- NDT test provides heuristics to assist the users in their evaluation. Unfortunately not all are applicable or correct in our current environments. For example:
 - Bottleneck Link Detection
 - Duplex Mismatch Detection
 - Link Type Detection
 - Faulty Hardware Link Detection



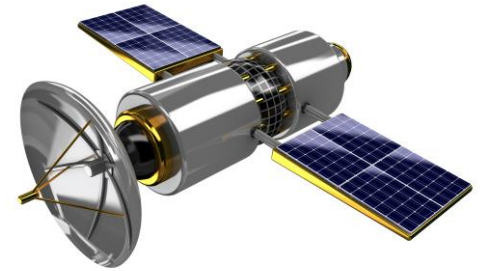
NDT Client – High Speed Tests

- NDT Client using Websockets can test reliably to the 700Mbps range under ideal conditions. Which for the vast majority of people is more than enough.
- However with Fibre becoming more and more popular we are finding that the NDT test (in the IPT context) is sometimes struggling to test accurately.
 - Users with 1Gbps connections have trouble.
 - The Canadian M-Lab sites only have 1Gbps transit to them.
 - Overloading when 10 people try and run a NDT test with 150 - 200Mbps bandwidth?



NDT Client – Satellite

- Canada is huge. Although the majority of people live in urban areas we still have almost 20% of Canadians in rural conditions.
- Many of those rural areas, and also small isolated urban areas, rely on Satellite for their Internet access.
- We have been unable to determine exactly why but the NDT test has a difficult time with Satellite connections.
- It may be the high-latency, it could be the method that the satellite base stations operate or something else.
- Many cases we have entire towns unable to complete a test. While in other areas they have no problem. (But it is slow..)



NDT Client – Jitter... ..

- There is no single agreed upon definition of Jitter.
- It can be better described as “Packet Delay Variation”
- There are RFCs that try and do that:
 - RFC 3393 and 5481 and 4689
- The NDT test returns a value for Jitter and sometimes refers to Average RTT as Jitter.
 - **Jitter** = $\text{MaxRTT} - \text{MinRTT}$
 - **avgrrt** = $\text{sumRTT}/\text{countRTT}$;

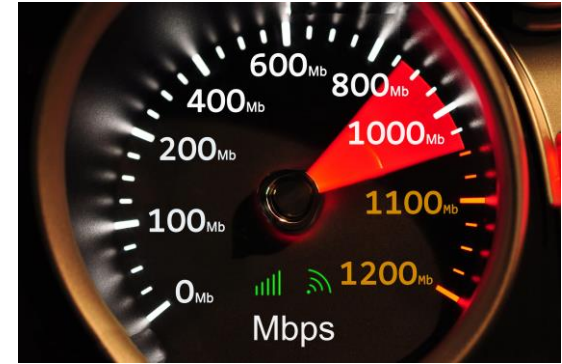
NDT Client – Jitter Revisited

- Calculating Jitter via $\text{MaxRTT} - \text{MinRTT}$ is statistically problematic for us in that outliers will have a tremendous affect on the result.
- We have had numerous discussions with interested parties as to why our Jitter numbers are wrong.
- We have started a project to go back through all our IPT tests and try and find the snaplogs associated to those tests. From there we are analyzing the NDT data and recalculating Jitter.

NDT Client – The Ookla Issue

I have spent many a day explaining the differences between testing for speed and quality. This is best exemplified by the difference users see between a test run with

- Ookla
 - multi-stream
 - ignoring errors
 - usually on-net
- and IPT (NDT)
 - single stream
 - looking at quality of connection
 - off-net



NDT – Can we get there?

- Can we work together to produce the next-generation of Network Diagnostic Test.
- One that combines testing Quality with:
 - Modern Heuristics
 - Agreed upon Definitions
 - Easier debugging
 - More Wireless Friendly (Mobile & Satellite)
 - Better access to Data
- And the ability to test pure SPEED. (Which it seems some days, is what everyone wants...)



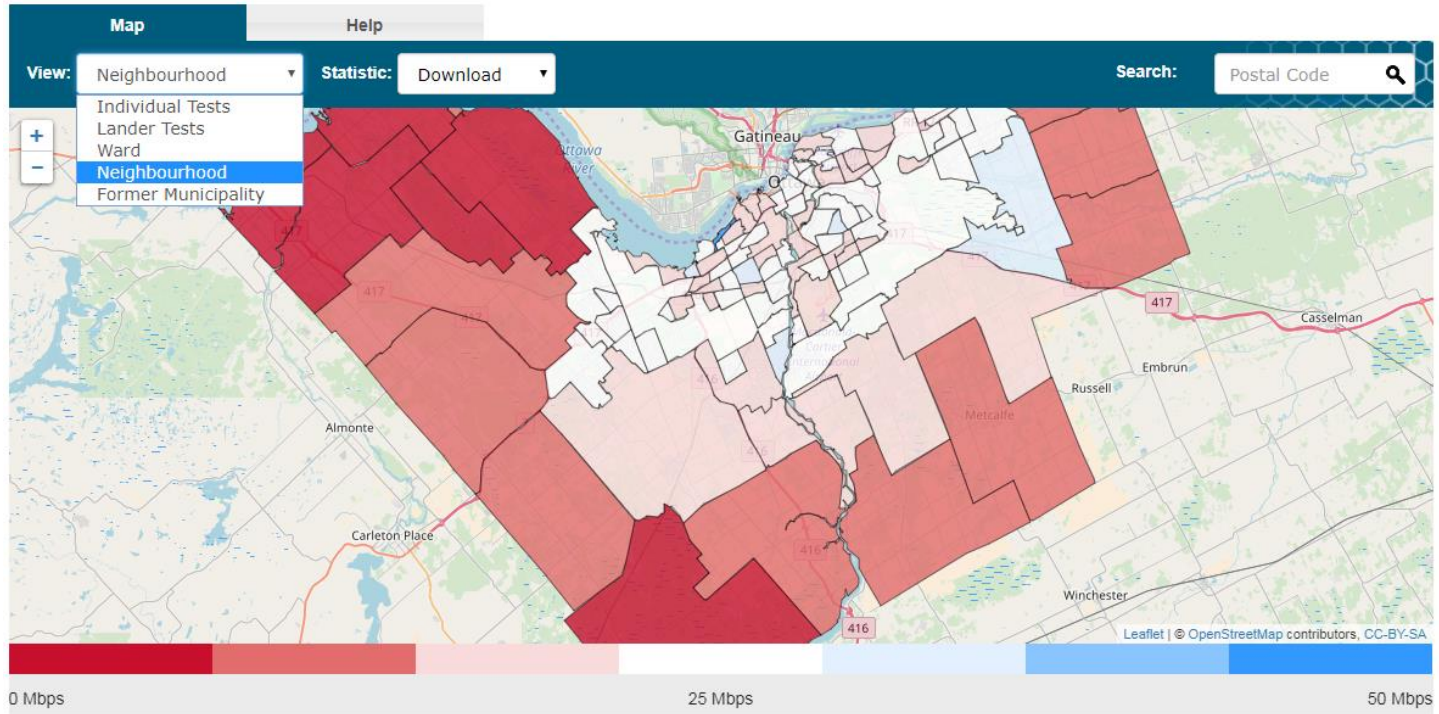
City IPT

Internet Performance Test for Communities

City IPT

- In 2016 we created a prototype of a City IPT. This page builds on the IPT by adding in heat maps for different applications as defined by the customer.
- In most cases cities are interested in:
 - Ridings or Wards
 - Neighbourhoods
 - Old City Boundaries

City of Ottawa IPT



* This performance test collects information including Postal Codes, IP Addresses and survey question responses (where applicable) which will be made available for research purposes only.

47,918 Tests Run in Ottawa

[Terms & Conditions](#)
Built by CIRA



City IPT

- In the last two years we have engaged 16 organizations to license a City IPT Lander.
- Most are Municipalities such as the City of Ottawa.
- A few are representing entire regions such as Annapolis Valley and Southwestern Ontario.
- And even an ISP.
- First Nations supporters are examining the use of IPT to better understand the infrastructure available to their communities.

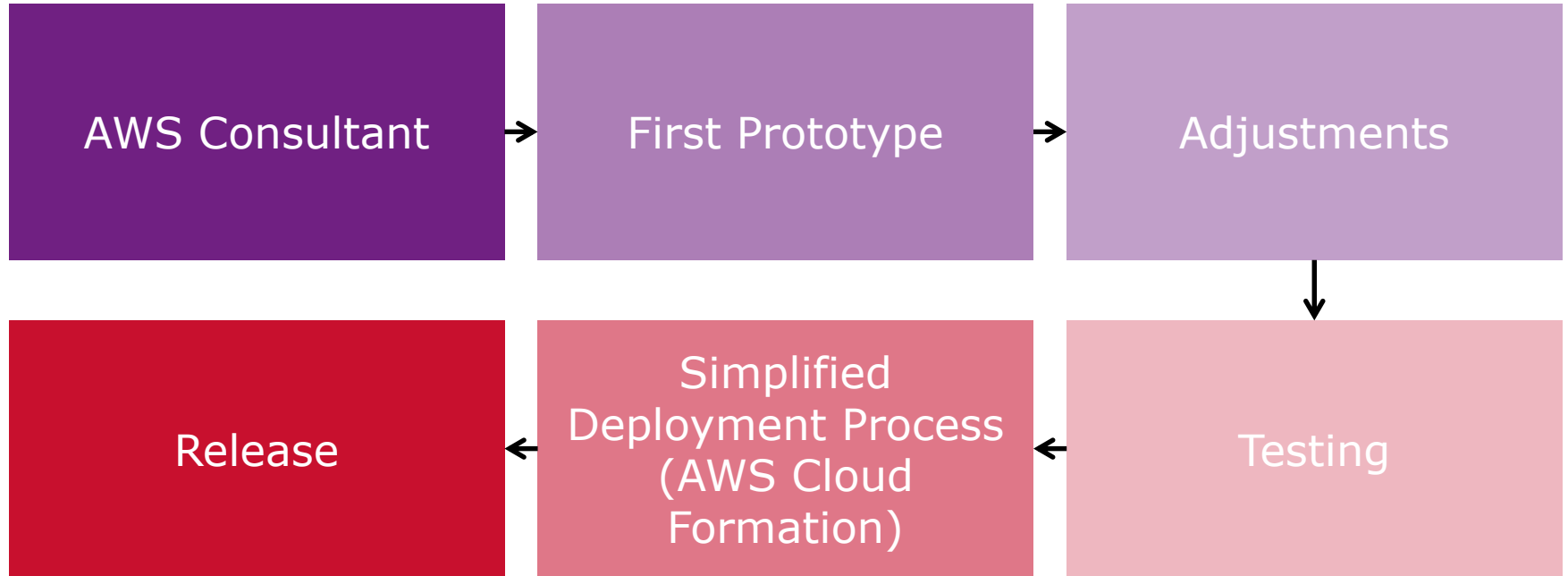


IPT's Complete Migration to the Cloud using Amazon Web Services

The Setup

Previously	Currently
2 web servers on site	1 Load Balancer which directs traffic to 2 to 4 web servers (AWS Elastic Compute Cloud)
Files stored directly on web servers	Files stored in the cloud in 'buckets' (AWS Simple Storage Service)
1 PostgreSQL database on site	1 PostgreSQL database (AWS Relational Database Service)
1 Cassandra database on site	No longer use Cassandra after moving all data to PostgreSQL
Nagios for monitoring services	AWS monitoring services (AWS CloudWatch)

The Migration Process



Why We Migrated

- Decreased server management costs
 - AWS handles all patching and upgrades
 - Reduced risk of hardware failures
- Easier deployment and release process
 - Launch new IPT environments with a few configuration files
 - Releases are done by uploading a new .zip file of IPT to AWS

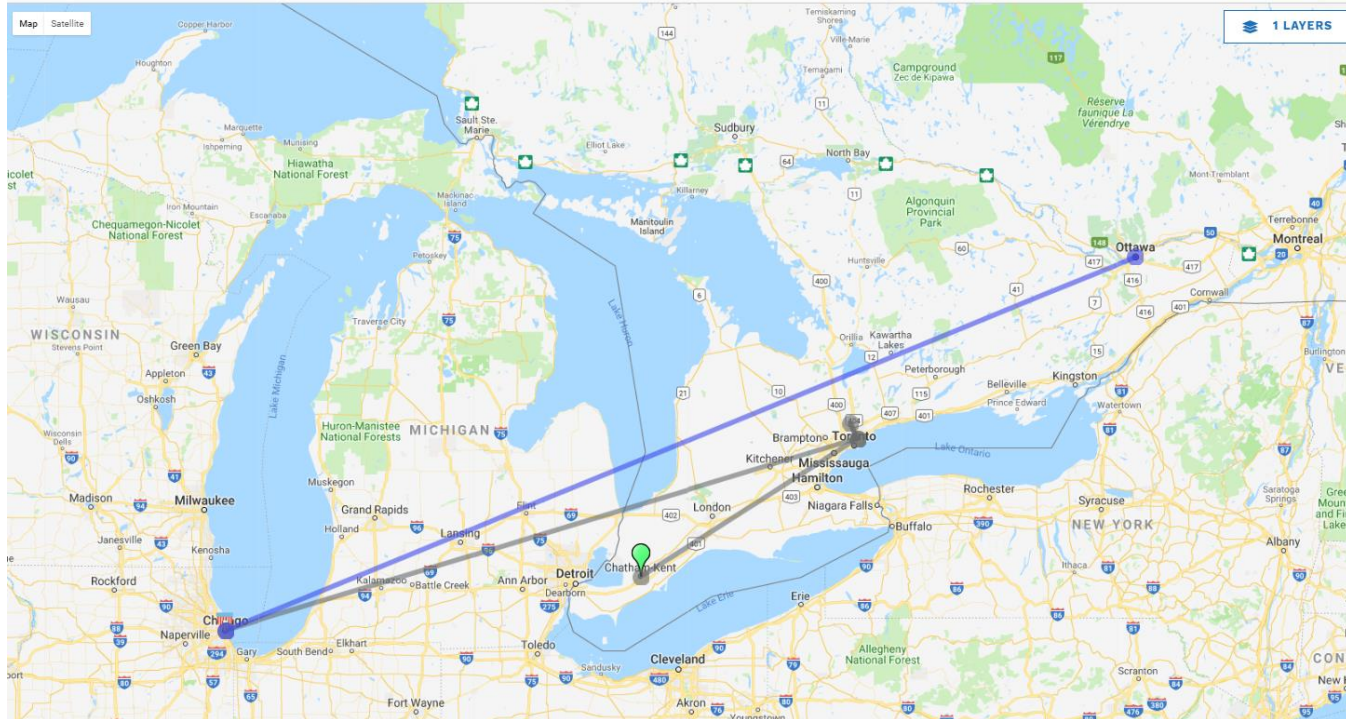
Future of IPT

- Hopefully new NDT test
- New User Friendly UI
- Improved and expanded City Landers
 - National, Provincial, Municipal, Communities
- New Features
 - Embeddable Customized Interfaces (API)
 - Mobile Support
 - Visual Traceroute

Visual Traceroute

- With assistance from the CIRA Community Investment Program (CIP) a research project at the University of Toronto called IXmaps was launched.
- The IXmaps research project is developing an interactive mapping tool aimed at helping internet users and researchers learn about internet routing, focussing particularly on surveillance and privacy issues.
- CIRA is working with IXmaps to:
 - Integrate their visualizations into the IPT
 - Improve geo-location information of various ASNs.

IXMaps - Visual Traceroute



18857 Traceroutes Found

Displaying 1 of a sample of 20 search results

Search results details...

	HIDE ALL	MAP ALL
CA Brandon	210.00.39.81	605144
CA Stoney Creek	www.ck-ca.com	528756
CA	viff.org	390048
CA Ottawa	caphc.org	367024
CA Mayne	opportunitiespel.ca	321592
CA Vancouver	court.nl.ca	280720
CA London	www.lspel.pe.ca	254418
CA Halifax	eservice.ag.gov.bc.ca	219180
CA Chatham	pbcc-clcc.gc.ca	199234
CA Montreal	bchousing.org	144924
CA Kamloops	Ebay.ca	95308
CA Montreal	www.bcl.org	63630

Carriers

Carrier	Nat.	Rts.	Transparency
TekSavvy	CA	3	★★★★★
Bell	US	2	★★★
Hurricane Elect...	CA	2	★





Canadian Internet Exchange Points

CIRA's IXP Program

Canadian IXPs

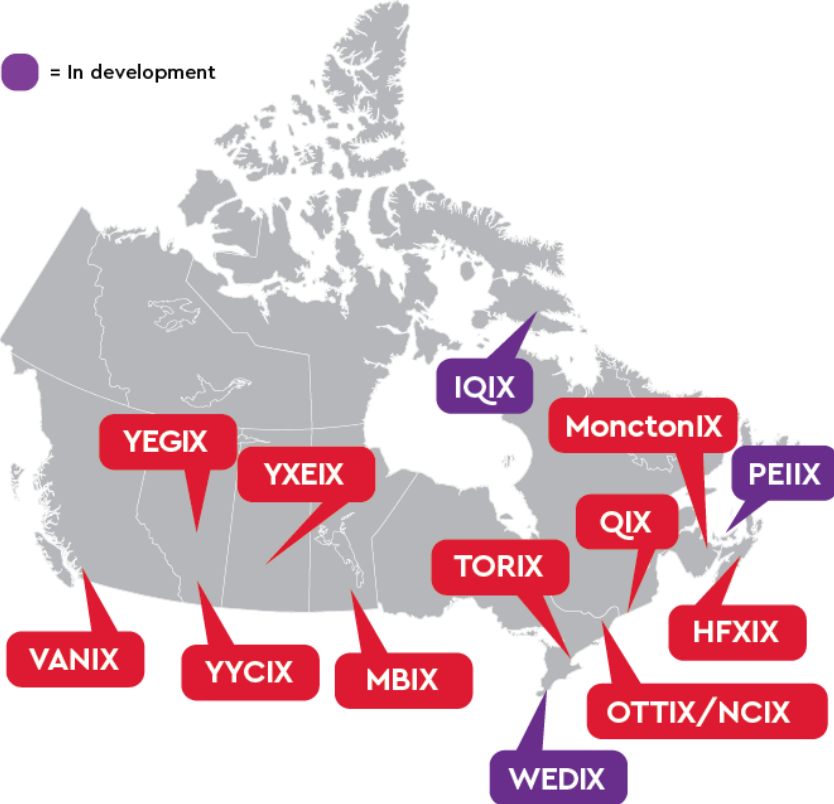
- Canadian Internet access is heavily and unnecessarily dependent upon the United States infrastructure.
- By establishing Internet Exchange Points (IXPs) within Canada we can:
 - Reduce reliance on costly international data transit
 - Increase the amount of bandwidth available to Canadian users
 - Reduce network latency, improving the performance of new services including video and cloud-based applications.
 - Reduce the risk of Canadian data becoming subject to U.S. and other foreign laws and practices.
 - Increase the reliability and resilience of Internet access in Canada.

CIRA – IXP Program

- To raise awareness of CIRA's work to develop a robust network of Internet exchange points in Canada.
- To engage community-based groups in Canada in a discussion surrounding the development of Internet exchange points.
- We are trying to build IXPs that are:
 - Community based
 - Vendor neutral
 - Non profit organizations
 - Member driven
 - Open peering policy
 - Accepts content providers, ISPs, transit providers, government, R&E and any other participant that can gain in exchanging traffic



Canadian IXPs





Canadian Internet Data

What's a presentation
on the Internet
Performance without
some numbers!!

Fastest Province In Canada

Province	Download	Upload	Number of Tests
Alberta	21.04	6.79	27990
British Columbia	18.05	6.01	40523
Manitoba	13.41	4.66	9599
New Brunswick	38.38	12.28	5817
Newfoundland	19.92	6.67	2924
Nova Scotia	17.25	6.7	17602
Northwest Territories	12.03	3.55	774
Nunavut	1.44	1.84	266
Ontario	19.84	7.58	169050
Prince Edward Island	15.06	7.86	2510
Quebec	17.72	8.24	49161
Saskatchewan	20.98	6.43	4835
Yukon	7.49	1.59	1597



All speeds are listed as Megabits per second (Mbps)



Major Cities in Canada



Province	Download	Upload	Number of Tests
Moncton	50.45	12.94	1404
Saskatoon	42.05	11.44	1667
Calgary	27.87	7.28	10977
Halifax	26.5	12.46	4091
Québec	22.78	14.54	2528
Ottawa	22.7	8.79	25690
Vancouver	22.39	8.68	7052
Edmonton	21	7.99	7451
Toronto	20.54	10.03	29423
Montreal	16.15	8.37	15487
Victoria	16.02	4.81	6090
Winnipeg	16	5.23	6676

All speeds are listed as Megabits per second (Mbps)



Some Unhappy Cities in Canada

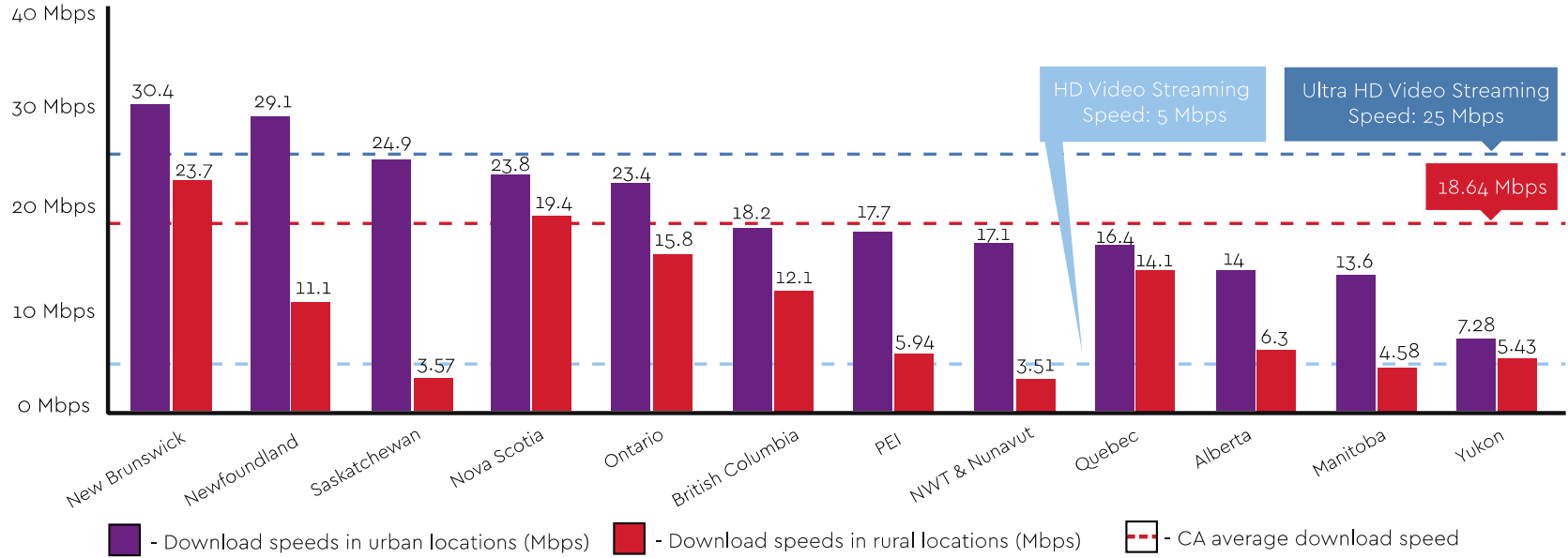


Province	Download	Upload	Number of Tests
Iqaluit	1.27	0.45	175
Sointula	1.56	0.27	1551
Porters Lake	2.26	0.64	748
Fort St. James	2.5	0.73	775
Belleville	2.52	0.95	5450
Etobicoke	3.88	1.2	893
Montague	4.04	1.05	513
Washago	4.36	0.37	822
Midland	4.92	0.53	2454
Carleton Place	5.35	1.73	541
Sooke	7.85	2.73	557
Whitehorse	8.01	1.74	1437

All speeds are listed as Megabits per second (Mbps)



Urban vs Rural Speeds



Let's Help.

As I've worked on the IPT over the years, there were generally 3 types of support calls.

- I have the best speeds and your test isn't showing that. Why?
- I have normal speeds and your test is bang on. Thanks!
- I have poor speeds. Dear CIRA. Please help.

We can't always help. But at least we can give them the data to be heard.





Questions?

IPT Team

The IPT Team is represented by seven red hexagons arranged in a circular pattern. Each hexagon contains a name and a small photograph of the corresponding team member in an office environment. The names and their positions are: Gowtham (top-left), Yachen (bottom-left), Bill (center), Richard (top-right), Don (top-right), Mason (bottom-right), and an unnamed member (bottom-right, partially overlapping Mason's hexagon).

- Gowtham
- Yachen
- Bill
- Richard
- Don
- Mason