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We are submitting these comments on behalf of Tucows Inc. Tucows is a Canadian company that has been around since the dawn of the Internet. We were part of the early days of Internet access when Canada had a position of leadership. We have watched with sadness as Canada has gone from an Internet access leader to an Internet access laggard according to objective observers (http://cyber.law.harvard.edu/newsroom/broadband_review_final , http://noss.org/weare33). As governments at all levels across Canada agonize over our lack of innovation and productivity gains, it is clear that fantastic Internet access - fast, symmetrical, affordable - is perhaps the greatest platform for innovation that any government can provide.

We appreciate the opportunity to share our thoughts on spectrum allocation in particular. We feel that spectrum allocation policies provide one of the best opportunities to rectify the poor Internet access situation that currently exists in Canada. We also note that spectrum policy is based on artificial notions of scarcity. Much like current Intellectual property policy, notions of scarcity were important ideas in the industrial age.

The Internet has truly changed things. The Internet allows us to think in terms of abundance, not scarcity.

The notion of Spectrum as a scarce resource is based on very old science. This is understandable, but changeable. We also recognize that spectrum allocation has become an important source of revenue for governments and that any serious changes to allocation policy need to encompass this point. In this submission we do not propose to address the issue of government revenue, but

we do plan to as the dialogue progresses. Our goal here is to introduce the idea of spectrum as a plentiful resource. Specifically:

- Spectrum is plentiful, not scarce;
- Interference is a function of the receivers, not an inherent property of wireless transmission; and
- With smart radios and well-defined equipment specifications we could take much greater advantage of the Spectrum we have.

Following the above would allow Canada to take significant strides in addressing its Internet access issues AND to establish itself as a world leader in telecommunications policy.

As with our submissions to the copyright consultation process in the summer of 2009, we have employed the pen of David Weinberger in an effort to create a submission that is readable and hopefully accessible by an audience wider than most policy submissions are able to reach.

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Spectrum as Plentiful as We Let it Be.

When I was a lad, our family doctor was a young man named Dr. Murtceps. He took good care of us, and I have stuck with him for over fifty years. The last time I saw him, he shocked me by telling me that he was leaving his practice in order to pursue an important discovery he'd made in physics: over the decades he's noticed that his loyal patients who have grown old with him are increasingly having trouble with their vision. He leaned in and said with a firm voice that seemed a hedge against the alarm he felt, "I am very much afraid the evidence points in only one direction. There is simply no other explanation." I waited. "Photons are failing."

I have to admit I laughed at first. "Doc, you're joking, right?" I said. "There's no problem with light. The problem is with our eyes." He looked at me uncomprehendingly. I struggled for an analogy, but the one I found apparently just made matters worse: "Next thing you'll be telling me that radio interference is a property of spectrum, and not just a problem with bad receivers."

Dr. Murtceps wasn't joking. Neither was I. (And I, unlike Dr. Murtceps, am not entirely made up.)

Unfortunately, our misdiagnosis of the situation with spectrum is analogous to Dr. Murtceps' taking the weakness of our eyes as evidence of a limitation of photons. The price for being wrong about spectrum, however, is not even slightly laughable. By continuing to treat interference as a physical limitation of the medium itself, we will drastically restrict the usability of spectrum at what could be the highest opportunity cost in history.

Here's a simple experiment. Plug in an expensive radio next to a cheap one. Play with the radio dial of the cheap one until you find a station with a signal made cruddy by interference. Now tune the expensive radio to the same station. It is likely to have a much clearer signal than the cheap one. Where did the interference go? Nowhere, because interference is not a thing or a property of radio waves. Interference is receiver failure. As far as I can gather - I am not a physicist - radio waves don't really bounce off one another and knock each other out of shape.  They may degrade over distance, and physical objects in their path may diminish their strength, but when one radio wave meets another radio wave, they pass right through each other.

The static and fuzz we hear when we talk about interference is caused by the inability of the receiver to distinguish one signal from another. The system we've designed solves that problem by assigning broad continuous swaths of spectrum to designated broadcasters. Fine, but that solves the "interference" problem by

*limiting* the amount of available spectrum: We take the continuum of frequencies and divide them into a relative handful of ranges of frequencies (= "bands").

At one point, that was a reasonable approach. Unfortunately, that point was in the 1930s. Eighty years ago it made sense to regulate who could broadcast at particular frequencies, and to make the assigned swath of frequencies quite broad: if all you have is a blunderbuss, then you do best if you make your target the size of the broad side of a barn.

There are two important good consequences of our current practice of auctioning off slices of spectrum: First, the government raises lots of money from businesses that then make yet more money from the transaction. Win-win is a good thing. Second, we get a system that works.

The problem is that we've defined "works" disastrously narrowly. The current system works in that it enables a handful of large corporations to provide quite reliable one-way broadcasts. We are now, however, witnessing a worldwide redefining of "works," so that a system that does *not* allow maximum multi-way communication and maximum innovation is broken.

The first half of that criterion— maximum multi-way communication— addresses the cultural, social, and political benefits. Call it free speech, call it open culture, call it open group formation, call it a renaissance, we all nevertheless know it's just waiting to happen.

The second half— maximum innovation— addresses the economic reasons why we should care so deeply about getting the Internet's broadband infrastructure right. It's where growth is going to come from, and it has the potential to be the greatest market-based generator of wealth since we invented open marketplaces.

So, how do we make this new definition of "works" real? Fortunately, what has been keeping us from opening vast new quantities of bandwidth is primarily our

old habit of assuming that we have to divvy up the continuum of usable frequencies into thick, scarce bands. Notice that the fundamental verb that gets applied to "spectrum" under the old assumptions is "divide." Dividing is a verb of scarcity.

We could instead assume abundance. Today's receivers and transmitters are smarter than they were when you had to turn a dial to tune in a station. They can do what we do when we drive a car on a highway: change lanes to avoid over-crowding and thereby maximize throughput. In this case, the lanes are frequencies. If the frequency the receiver and transmitter are using is getting crowded, they can send a signal and hop over to a different one. This type of intelligent, dynamic spectrum management wrings far more capacity out of the airwaves than doing the equivalent of assigning each car its own fixed lane.

Assuming abundance can create abundance because information is not like a car. Over the years we have figured out ways to compress information, to combine multiple signals into a single "lane," and even to create what David P. Reed (one of the architects of the Internet) calls "cooperation gain": an improvement in information capacity as *more* nodes join, say, a multi-hop mesh network.

It's vital that we drop our assumption that information needs a dedicated, unvarying channel. When broadcasters need to get assigned a "lane" by a centralized authority, it's expensive and slow to become a broadcaster. Where frequencies have been opened up to all comers in a free market, enormous innovation has occurred already. Imagine if the public airwaves were in fact open to the entire public, with their management handled in real time by the technology itself, rather than by a government office. It would be like the Internet, and we know the result: There are currently 200 million registered domains, and we have just run through 4.3 billion Internet addresses. That happened for two reasons. First, the Internet enables anyone to jump in, without first having to apply for permission, pay a fee, or hope to be assigned a route; the Net gives participating

computers addresses, and negotiates the routes between them dynamically. Second, we are a damn innovative species just waiting for the chance.

But, we are being held back by an old way of managing a resource that works by turning it into something scarce. Spectrum is bounteous if we want it to be. It will be a tragedy for which we will not be soon forgiven if we continue to slice this shared abundance to ribbons that we then sell off for short-term gain.

Open up the spectrum and we will figure out what to do with it. Trust us. We've just spent the past fifteen years proving that we're more innovative than even the craziest of us imagined.

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Thank You.

Elliot Noss
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Tucows Inc.