# Memo

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| **To:** | Erin Reinders, City Manager |
| **From:** | Jacob Whitaker |
| **cc:** | Jim Sharpe, Acting Finance Director |
| **Date:** | 12/02/2020 |
| **Re:** | Internet Quality Metrics Inquiry |

**Service Overview**

This a summary of the internet service we currently have with TelAlaska as our primary internet connection, and how we monitor and test the service quality.

They currently provide a **20**Mbps/**10**Mbps dedicated internet service to the City of Unalaska. This service is *not* shared with other TelAlaska customers and is therefore considered a *dedicated* service. We're currently nearing the end a 3-year contract that expires at the end of FY21, so we'll be going out for bids soon as part of the RFP process.

**Bandwidth Monitoring**

We monitor this internet service in real-time using various methods and systems. Internet traffic is visually monitored by live and historical graphs that illustrate traffic loads in both directions (send/receive). The graph shown below is an example from November 25th, during the morning, with the green line representing download (receive) consumption and the blue line representing upload (send) consumption. The two red lines represent the approximate bandwidth maximums (download/upload) of our service with TelAlaska as indicated earlier.
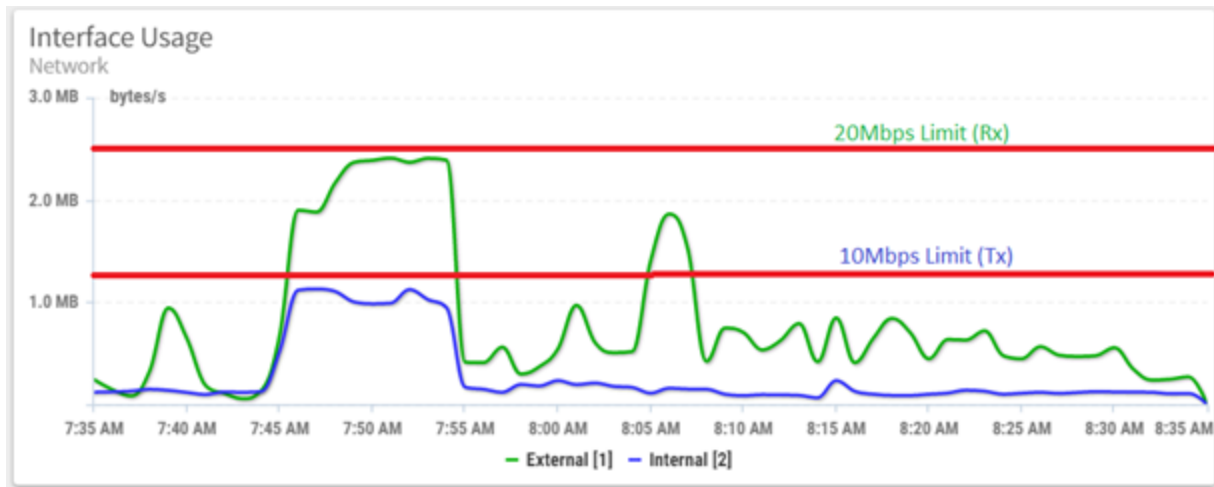
As you can see we were able to achieve those maximums for approximately 10 minutes while I ran a bandwidth stress test.

**Bandwidth Testing**

The metrics *most often* used when testing bandwidth capacity and link quality are the following:

1) **Download / Upload Bandwidth** – How much traffic can pass per second (e.g. 20 Mbps can theoretically transmit a 2.5 megabyte MP3 file (e.g. song) every second)
2) **Latency** – How long it takes traffic to travel from A to B, usually measured in milliseconds (1ms = 0.001sec), for example, the *roundtrip* time for traffic over a satellite link is usually 550-630ms
3) **Packet Loss** – How much traffic (%) is lost in transit, a certain amount of packet loss is expected on satellite links due to traffic shaping and the nature of wireless transmission, however, if packet loss begins to exceed 5-10% it can have an adverse effect on service quality.

The nature of bandwidth testing is simply to see how much data can be stuffed down the pipe, so to speak, at once. This means that during a bandwidth or capacity test real data is being sent and received to simulate maximum traffic load in order to observe the integrity and performance of the service. The graph above records the result of such a test.

It's not a difficult or complex task to test the capacity and quality of an internet service. I'm not aware of any 3rd party consultants who specialize in this task simply because it's assumed to be a basic skill that IT professionals already possess. However, that isn't to say that a 3rd party wouldn't gladly get paid to do it. Most tools automate this process and are free, so it seems strange to me that we would hire a third party do this (it literally takes *minutes* to perform a test by simply clicking a couple of buttons).

When we were having service quality issues with TelAlaska about a month ago (July-October) I purchased a more advanced tool (that gave me greater visibility of the metrics mentioned above for our service. I was able to observe, at times, high levels of packet loss and then forward that information over to TelAlaska to help them troubleshoot the issue. I've included an example of those tests below. You can see that each column represents one of the testing metrics mentioned above (plus others), as well as the associated results at that particular *second*, indicated by a timestamp on the far left. In this example you can see that the **Rx**

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(receive/download) path is experiencing severe packet loss, illustrated by the color red, while the **Tx** (send/upload) path is experiencing no packet loss, illustrated by the color green.

| Home | Measurements (compressed) (6206) | | Measurements (raw) (85752) | | Uptime 100.00%(2) | | Advanced | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | State | Download (Rx) | Upload (Tx) | Rx packet loss | Tx packet loss | RTT (ping) | Rx loss burst length | Tx loss burst length | Rx instant jitter | Tx insta |
| 2020-10-06 08:05:24 | up | 120.18kbps/204.80kbps | 179.50kbps/204.80kbps | 23.49% | 0.00% | 621.0ms | 1.57 packet(s) | 1.00 packet(s) | 55.4ms | 3.3ms |
| 2020-10-06 08:05:23 | up | 176.86kbps/204.80kbps | 177.04kbps/204.80kbps | 15.38% | 0.00% | 580.0ms | 1.29 packet(s) | 1.00 packet(s) | 36.0ms | 2.8ms |
| 2020-10-06 08:05:22 | up | 183.38kbps/204.80kbps | 177.04kbps/204.80kbps | 15.22% | 0.00% | 580.0ms | 1.25 packet(s) | 1.00 packet(s) | 50.5ms | 2.2ms |
| 2020-10-06 08:05:21 | up | 182.71kbps/204.80kbps | 127.89kbps/204.80kbps | 16.72% | 0.00% | 580.0ms | 1.29 packet(s) | 1.00 packet(s) | 41.1ms | 2.8ms |
| 2020-10-06 08:05:20 | up | 187.64kbps/204.80kbps | 204.70kbps/204.80kbps | 16.23% | 0.00% | 580.0ms | 1.27 packet(s) | 1.00 packet(s) | 37.4ms | 4.3ms |
| 2020-10-06 08:05:19 | up | 185.97kbps/204.80kbps | 204.80kbps/204.80kbps | 16.90% | 0.00% | 580.0ms | 1.24 packet(s) | 1.00 packet(s) | 51.0ms | 4.3ms |
| 2020-10-06 08:05:18 | up | 183.83kbps/204.80kbps | 204.54kbps/204.80kbps | 19.06% | 0.00% | 621.0ms | 1.27 packet(s) | 1.00 packet(s) | 22.2ms | 3.1ms |
| 2020-10-06 08:05:17 | up | 180.86kbps/204.80kbps | 204.80kbps/204.80kbps | 21.67% | 0.00% | 625.7ms | 1.31 packet(s) | 1.00 packet(s) | 58.7ms | 6.0ms |
| 2020-10-06 08:05:16 | up | 175.56kbps/204.80kbps | 204.61kbps/204.80kbps | 23.74% | 0.00% | 625.7ms | 1.37 packet(s) | 1.00 packet(s) | 46.4ms | 6.0ms |
| 2020-10-06 08:05:15 | up | 145.36kbps/204.80kbps | 204.80kbps/204.80kbps | 23.92% | 0.00% | 621.0ms | 1.40 packet(s) | 1.00 packet(s) | 32.2ms | 4.7ms |
| 2020-10-06 08:05:14 | up | 162.71kbps/204.80kbps | 204.80kbps/204.80kbps | 24.28% | 0.00% | 599.0ms | 1.44 packet(s) | 1.00 packet(s) | 52.8ms | 4.0ms |
| 2020-10-06 08:05:13 | up | 141.63kbps/204.80kbps | 204.77kbps/204.80kbps | 22.66% | 0.00% | 599.0ms | 1.64 packet(s) | 1.00 packet(s) | 43.6ms | 4.0ms |
| 2020-10-06 08:05:12 | up | 146.75kbps/204.80kbps | 179.59kbps/204.80kbps | 15.79% | 0.00% | 605.0ms | 1.56 packet(s) | 1.00 packet(s) | 41.4ms | 4.7ms |
| 2020-10-06 08:05:11 | up | 181.69kbps/204.80kbps | 204.80kbps/204.80kbps | 9.87% | 0.00% | 589.0ms | 1.16 packet(s) | 1.00 packet(s) | 33.0ms | 4.7ms |
| 2020-10-06 08:05:10 | up | 184.81kbps/204.80kbps | 204.80kbps/204.80kbps | 12.23% | 0.00% | 579.0ms | 1.16 packet(s) | 1.00 packet(s) | 26.4ms | 4.7ms |
| 2020-10-06 08:05:09 | up | 184.57kbps/204.80kbps | 204.80kbps/204.80kbps | 14.14% | 0.00% | 579.0ms | 1.18 packet(s) | 1.00 packet(s) | 25.8ms | 5.5ms |
| 2020-10-06 08:05:08 | up | 181.12kbps/204.80kbps | 153.51kbps/204.80kbps | 16.80% | 0.00% | 612.8ms | 1.19 packet(s) | 1.00 packet(s) | 32.0ms | 7.8ms |
| 2020-10-06 08:05:07 | up | 181.79kbps/204.80kbps | 204.80kbps/204.80kbps | 15.34% | 0.00% | 594.0ms | 1.27 packet(s) | 1.00 packet(s) | 27.3ms | 7.6ms |
| 2020-10-06 08:05:06 | up | 182.20kbps/204.80kbps | 204.80kbps/204.80kbps | 19.18% | 0.00% | 586.0ms | 2.09 packet(s) | 1.00 packet(s) | 40.5ms | 4.0ms |

## Historical Analysis

Unfortunately, I can't go back and see what our real-time bandwidth capacity was at a particular time in the past *unless* I've kept the results of a test that I performed at that particular time (like the screenshot above). However, we do currently keep historical data of our bandwidth *consumption* for at least two weeks, which can give us a limited insight into whether we were achieving those theoretical bandwidth maximums or not by observing the consumption at that time. For example, those graphs will show peaks and valleys representing consumption, and we can then observe *how high* those peaks were to get an idea of whether we were achieving our theoretical maximums or not.

## Testing Considerations

It's also important to emphasis that in order to test the capacity of our internet service we have to *consume* real bandwidth, which means if I perform such a test during normal business hours it'll have a significant impact on users who are currently utilizing the connection. The test will compete for bandwidth alongside employees who are on a Zoom call or performing typical online business transactions. This will adversely affect their internet performance and will skew my bandwidth testing results. Therefore, we typically only conduct tests if we're experiencing a known issue during non-business hours.

Let me know if you have any questions, need additional information, or require further explanations. I'd be happy to discuss this over the phone or even give you the opportunity to observe a bandwidth test in real-time if you like.