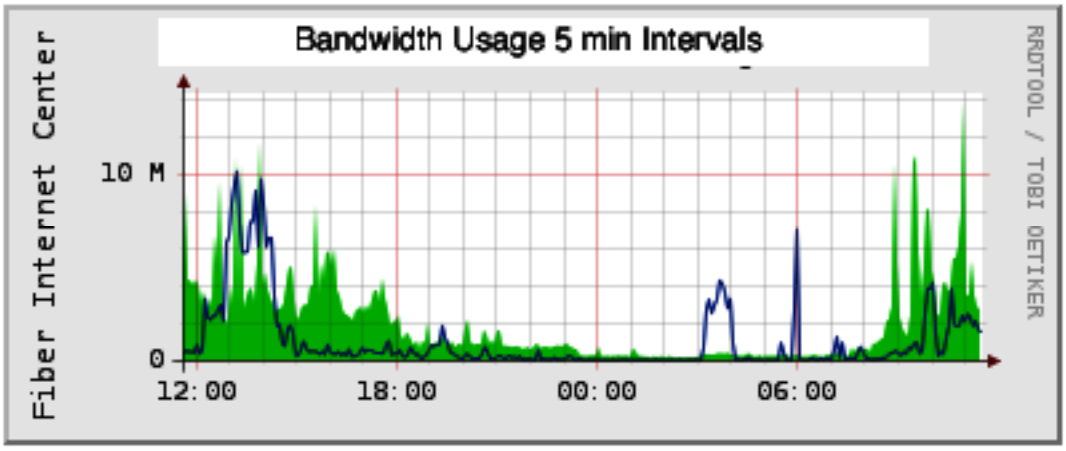
Understanding
Fiber Ethernet Bandwidth
vs.
End User Experience



This white paper will help you understand your bandwidth utilization and how your ends users see your network as it relates to your fiber internet pipe.

About the Pipe:
Fiber Ethernet is sold by the pipe size. Normally, a Fiber Ethernet Pipe is sold symmetrical at a single fixed rate of speed, upload and download. Since this is a Fiber Internet Center pipe, we let this customer's Inbound burst a full 100 megabits/second. So let's say this customer's pipe is, Outbound at 10 megabits per second to the world & Inbound from the world is 100 megabits per second.

About the Graph:
The blue line represents the "outbound", traffic from the office LAN to the world. The green shaded area represent the "inbound", traffic to the office LAN from the world.

Each peak point on this graph is a single 5 minute interval. The 24 hour time-line at the bottom is full of 5 minute durations. Exactly what does that mean?

The graphing computer asks the router for the value of the inbound and outbound traffic of each port. The values it gathered are the exact number of bits in and out of each port. Each port register is then reset to zero and the count begins again. The graph machine begins calculating and plotting. The router continues to count until the graph machine reappears in 5 minutes. The values represent the bit totals including the VLAN tagging , TCP/IP addressing, etc … "all bits total" within all the packets moved through the port.

The graphing system plots the two values on the graph. In this case blue=outbound, and green=inbound.

It's a 5 minute interval that established the dots along the time-line. We need to realize what it would take to make a dot appear. Looking at the above graph you can see that at exactly 1PM there is a 8 megabit/second outbound blue dot. At 5 minutes after 1PM there is a 9 megabit/second blue dot. And about 15 minutes after 1PM there is a 10 megabit/second blue dot.

At this point in time, it sounds simple enough. There is a graph machine that asks a router for two numbers, a value for the bits that went into the port and a value for the bits that went out of the port. The graph machine comes and goes every 5 minutes asking the router for these values. It then places some color on a graph relative to the values.

Now, let's take that first 5 minute interval, blue dot (outbound in this example) and chunk it into 1 minute segments.

During the first minute period. How fast was the first minute? We have no idea! So lets guess that the number of bits per second equaled 5 million bits/second. Remember, we are guessing. We have nothing to tell us what it was during that exact minute of the five minute interval. You see the graph system only asks the router for the cumulative count in an Ethernet port's register every five minutes.

For the second minute lets guess the number of bits per second was 10 megabits.
The Third minute it was 10 megabits. The Fourth minute it was 8 megabits per second.
The last Fifth minute it was 6 megabits per second.

Adding them all up, 5+10+10+8+6= 39 divide it by 5 minutes and we are back to a total "average" speed rate of 8 megabits per second that gave us the single blue outbound dot representation on the graph at the 5 minute interval. Or, maybe the by-the-minute pattern was really 10+10+5+6+8 or maybe it was 8+8+8+8+7 or 10+10+10+9+0 as any combination that equals 39 would provide us the same blue dot 5 minute averaging upon the graph.

Let's use the 5+10+10+8+6 pattern for the 8 megabits per second dot. By applying this by-the-minute speed, we know that the blue dot does NOT mean there was always 2 megabits per second of space in the pipe available for outbound packets during the 5 minute interval. If this 5+10+10+8+6 was the pattern, only the first, fourth and last minute had available space outbound in the pipe. Aha, congestion for 2 minutes!

About your End User Experience:
Now, how does looking at this graph tell us anything about my end user experience?
To grasp the human experience. We need to ask ourselves, how long does a minute feel? Does it feel like 60 seconds? Don't worry I won't start you on a path to guessing speed by-the-second. To understand the human experience, all we need to remember is that the graph machine gathers one number value in and one value out of the port for the entire

duration of 5 minutes. However, by mentioning seconds, it's easy to see that the possible by-the-second pattern could look much different than the by-the-minute patterns we project. We all know that how the end user "feels" is directly related to how much coffee one drank, how fast their computer responds, how fast the user needs to procure some bit of information before the next meeting, etc. One minute can feel like forever. That one minute can mean the difference between comments like, "the Internet feels slow" or "the Internet is broken".

For any given minute that one computer on your LAN uploaded a file and maintained 10 megabits per second there were probably 2 others that felt the internet was broken as their mouse clicked packets never made it to the distant end or had to be repeated by the computers TCP/IP driver, because the driver never received an acknowledgement from the distant end.

Now, it's easy to understand that a 5 minute interval at an "average" of 8 megabits per second does not mean there was always 2 megabits per second of space available outbound in the pipe. Maybe there was space during the first minute and the last two minutes. During the second and third minutes in the middle – everyone shouted the Internet was broken or at best it was slow. Knowing a little about the how humans experience things – 2 minutes can easily provide 20 minutes worth of irritation and a days worth of never ending comments.

Summary:
From this knowledge, it is easy to see that when you begin to accumulate bunches of 5 minute interval dots at a level of 50% or more of your pipe size, you will find your users are making claims that things are slow. Or you will notice the VOIP & Video conferencing is more choppy than usual. So when you reach 50% of your pipe, it's time to get more pipe.

Are you still using Copper Telco services – a T1 or worse bonded T1s? Do you realize what video can do…YouTube videos, Video Conferencing & Slingboxes that connect people at work to their cable or satellite service at home? Did you know they auto config to match the office pipe size? That they typically run at 1/2 or more than 1/2 of a T1? So how does anyone in your office get any work done? You need fiber from Fiber Internet Center.

I am sure that many of you found this information is useful. And I already know your next question, Nemo… "How do I stop that Matrix Internet YouTube traffic from clogging my VOIP?"

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