Bandwidth Monitoring Parameters for Capacity Management

Dennis Cleary
High Speed Access Corp.

ABSTRACT

Operators need to effectively plan and manage capacity when designing and building a broadband network. These networks need to be capable of handling services available today. They must have the flexibility to grow and meet future demands. The success rate of a cable operator's system, from a service and an economic stand point can be directly effected by circuit capacity management. An excess of bandwidth can be economically inefficient when on the other hand, not enough bandwidth will cause delays resulting in possible lost revenue. We will discuss bandwidth monitoring parameters to assist the cable operator with a general understanding of Bandwidth issues for their systems. The basic parameters follow the 70/30 rule. The following is the equivalent of a brief white paper with some of the issues that impact the 70/30 rule.

DEFINITIONS

The 70/30 Rule: This means that at 70% and above, contention occurs, and multiple users are vying for access. This 70 % and higher would generally be considered peak periods. When peak utilization spikes routinely exceed 70%, additional bandwidth is required to avoid contention-based delays. Conversely, when capacity is in excess of 30% for average utilization (that is, during normal use, and continuous utilization runs 30% or more), bandwidth allocation needs reviewing.

Additional bandwidth is required to avoid contention-based delays, where average utilization exceeds 30%, and peak utilization hits 70% or more, consistently. The degree of accuracy with respect to these capacity percentages is directly related to the timeframe of the monitor (i.e., it is more accurate to monitor every 15 seconds than to monitor every hour). The monitor process, itself, uses the network. Thus, it is important to consider this when establishing these monitoring timeframes. The more frequent the monitor, the more the network is utilized.

Capacity: For the purposes of this discussion the definition of "capacity" is the information carrying ability of a telecommunications circuit.

Bandwidth: Bandwidth, in a broad sense is directly proportional to the amount of data transmitted or received, per unit of time. In a qualitative sense, bandwidth is proportional to the complexity of the data for a given level of performance. Obviously, it requires more bandwidth to download a graph or picture than to download a page of text in the same unit of time. Computer programs, audio files, and animated videos require the use of more bandwidth in the same unit

of time. The consumer is still pushing hard for the delivery, of streaming media, today. Oh, by the way, let's not forget gaming with its utilization requirements.

All this looks good on paper, but how do we apply these theories, manage them, and survive the high cost of bandwidth today? A good place to start, is the 70/30 rule, combined with many other elements that make up the capacity management formula. We will touch on other supporting tools such as:

Capacity Management Tools
Caching Technologies
Capacity Planning Model
Circuit Monitoring Software
Organization Issues

With respect to bandwidth, it is important to understand that the traditional mode of operation for many companies has been less than "managerial". Basically, when contingency occurred, a circuit was ordered. This put the fire out, but did it solve the problem? More often than not, this solution did nothing more than create more billing, and an over abundance of circuits.

The idea with this discussion is to increase management's awareness in order to utilize bandwidth in a network more efficiently and economically. By doing so, companies will order circuits less often and more effectively utilize the existing bandwidth for a longer period of time Done correctly, this will result in improved customer service and additional savings.

The point is, the cost of circuits may make or break the core business plan and may, quite possibly, exceed any other company expense.

CAPACITY MANAGEMENT TOOLS

Some of the software tools available today that will enhance capacity management capabilities include (but are not be limited to) products such as:

Transcend
Optivity
Centillion
Spectrum
Cascade View
Cisco Works
HP Open View
Net View
NetManager

And let's not exclude the ability today for companies to completely outsource their network monitoring and bandwidth management needs to companies owning very sophisticated Network Operations Centers ("NOCs").

A recent article in the Telephony Magazine[1] states "About 95% of the U.S. population has cable TV, proving that providers have built confidence and found a place in the homes of consumers".

For successful capacity management, a close relationship must be in place with the Marketing Department. One marketing campaign could easily affect the network. When sales increase at a particular location, in a short period of time, the network can be drastically affected. Tight coordination with Marketing allows the Capacity Management Department to ensure that there will be enough

bandwidth to accommodate the projected customer acquisition rates.

With that in mind, demographics should certainly be one element to consider in a capacity management formula. Other elements to consider include:

Is the system a 2 Way System or a 1 Way Cable Modem System?

Does the system support Dial-Up customers?

What are the total subscriber counts, both for the commercial and residential markets.

How many homes passed?

What marketing campaigns are on the horizon.

A review of the sales forecasts.

Planning for the long time lines for installation of the LEC and back bone provider circuits (i.e., DS-1s or DS-3s).

Is varied bandwidth being offered (ranging from 128 kbps to 512kbps).

Is VSAT an option in suburban areas?

The cable operator might consider several philosophies and theories, when applying capacity forecast tools. Some individuals view the process as a science and others view this process as an art. In either case I am not convinced that a complicated and detailed formula for bandwidth capacity is the answer.

Generally speaking, historical records of bandwidth utilization also deserve some study. This research could produce ratios of circuits vs. subscribers. Certainly not fool proof, ratios are commonly used to help keep networks in check.

For example, history might show that in a dial-up network, a ratio of 3:1 would exist, providing services to 72 customers per DS-1 on the local side. On the back bone side, the ratio might be 200:1 or 300:1, which would support 200 or 300 customers per DS-1.

CACHING TECHNOLOGIES

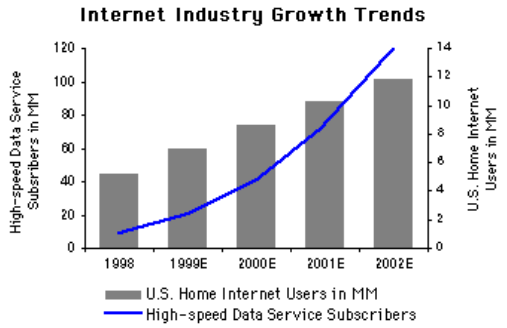
Should local caching be considered as a bandwidth capacity management tool. As mentioned earlier, streaming media files are very large and bandwidth intensive. The distance between the provider and the customer is usually substantial. As more users request streaming content, it requires additional bandwidth. Multiple users viewing the same program, in the same system without caching will consume the bandwidth required on an individual basis. For instance, if twenty different users in the same system want to view the same movie, then multiply the bandwidth required by twenty.

By using caching technologies the Cable Operator can provide high quality streaming video, and increase revenue, without wasting bandwidth. The bandwidth saving will not only effect the customers viewing the streaming video but deliver a higher

quality service to other subscribers on line.

Streaming video is only one example and one should consider the effects of caching for their entire system. We estimate an across the board 20 to 30 percent savings in bandwidth utilization with caching technologies.

Bandwidth management is, without a doubt, a very important issue with Cable Operators delivering Internet services. The Futurist Magazine estimates that "more than 70 percent of U.S. adults will have Internet access by the fall of this year."[2]



Broadband Access Management www.dyband.net

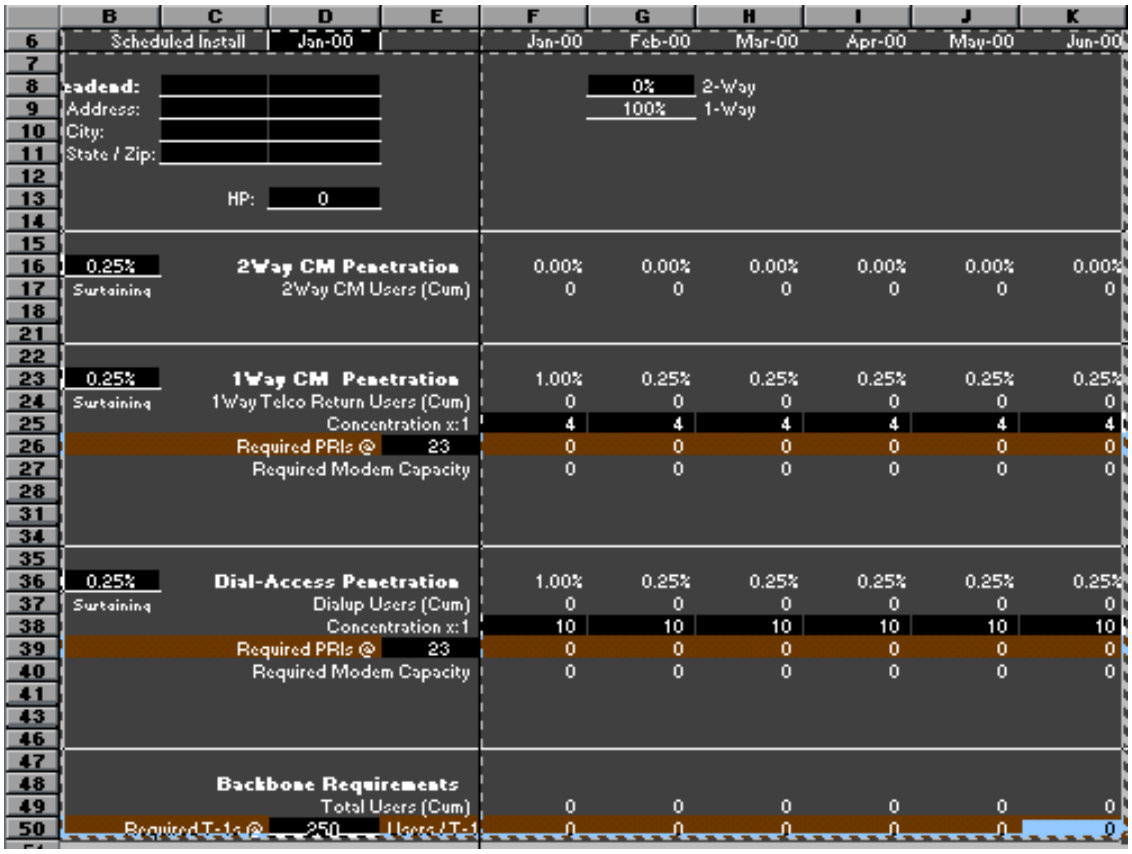
CAPACITY PLANNING MODEL

We, at High Speed Access Corporation, are continuously evaluating all processes and procedures involved in capacity management, from the onset of receiving an Authorization To Proceed (ATP), to the Site Survey through the Alpha test, into the Beta test, and finally to the ongoing monitoring of a site (once in full service).

Today, when our Sr. Project Managers receives the Authorization to Proceed (ATP) from a system, a very detailed Site Survey is completed.

Based on our capacity planning model, circuits are ordered. The formula for the circuits is written into the capacity planning model. In a cable modem application, the policy has been to apply a suitable ratio dictated by the capacity planning model. In a system where dial-up is also present, a different ratio might be used than in a system where 2-way is the only service. Although the model for a 2-way system shows that in the month that the headend is installed, we are at a 1% of homes passed. And each month thereafter, we increase the penetration by .5, we actually order whatever the model calls for in the first month that the headend is scheduled for installation and, then, in three months, we schedule for the remainder of what the model calls for (by the fourth month). For example: if the model calls for 1 DS-1 to be installed in January for the headend installation, we order one DS-1 at installation. Then, the model shows an additional DS-1 each month (Feb, Mar, and Apr) for a total of 4 DS-1s by the April date for revenue launch.

In this scenario, We would typically order 2 of the DS-1s for installation in January and an additional 2 DS-1s to be installed March 31, for the April total of 4, which the model calls for.



	B	C	D	E	F	G	H	I	J	K
6	Scheduled Install		Jan-00		Jan-00	Feb-00	Mar-00	Apr-00	May-00	Jun-00
7										
8	Leadend:					0%	2-Way			
9	Address:					100%	1-Way			
10	City:									
11	State / Zip:									
12										
13			HP:	0						
14										
15										
16	0.25%	2Way CM Penetration			0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
17	Sustaining	2Way CM Users (Cum)			0	0	0	0	0	0
18										
21										
22										
23	0.25%	1Way CM Penetration			1.00%	0.25%	0.25%	0.25%	0.25%	0.25%
24	Sustaining	1Way Telco Return Users (Cum)			0	0	0	0	0	0
25		Concentration x:1			4	4	4	4	4	4
26		Required PRIs @	23		0	0	0	0	0	0
27		Required Modem Capacity			0	0	0	0	0	0
28										
31										
34										
35										
36	0.25%	Dial-Access Penetration			1.00%	0.25%	0.25%	0.25%	0.25%	0.25%
37	Sustaining	Dialup Users (Cum)			0	0	0	0	0	0
38		Concentration x:1			10	10	10	10	10	10
39		Required PRIs @	23		0	0	0	0	0	0
40		Required Modem Capacity			0	0	0	0	0	0
41										
43										
46										
47										
48		Backbone Requirements								
49		Total Users (Cum)			0	0	0	0	0	0
50		Required T-1s @	250	Users / T-1	0	0	0	0	0	0

Sample Capacity Planning Model View

This practice seems to vary, depending on the number of prospects in the Operator's prospect database. If Project Managers see that there are 2000 potential customers ready to sign-up; they would escalate that order to accommodate for a more robust market. If there were only 200 potential customers, they would not order as many DS-1s as with the first example.

BROADBAND ACCESS SERVICES

According to Broadband Access Services, data traffic has been doubling approximately every 100 days, or at an average rate of 1000% for the last three years. With this kind of growth, monitoring your network is an absolute. The future of broadband access services depends on the ability to manage the distribution of bandwidth, dynamically. Without Bandwidth monitoring, heavy users can monopolize bandwidth at the expense of other users, resulting with dissatisfied customers. Here again, monitoring your network is essential. Bandwidth management is important for another reason, as well. Security. Unusual traffic patterns could easily point to a suspect and the problem stopped before damage is caused. An example of this, are people who spam using your network, or set up a DNS server—selling their own services—with your IP address.

One of the most important aspects to achieve is to educate your personnel. They need to know how to analyze bandwidth needs before ordering circuits. In many cases, the individuals who ordered circuits were simply placing the orders with little or no analysis or thought. This is the first change towards bandwidth management.

CIRCUIT MONITORING SOFTWARE

Generally speaking, circuit monitoring software may offer a built-in feature for notification. This type of feature can notify specified individuals when circuit capacities exceed pre-determined thresholds. The active circuit inventory monitored by the circuit monitoring software is usually loaded manually. Periodically, an audit of the circuit inventory is necessary to ensure accuracy. It's important to have circuit monitoring software that has the ability to access each site, and accomplish an automatic inventory of circuits and equipment. This will accommodate for changes in the field, as time goes on.

Our circuit monitoring software currently executes every 5 minutes. The results are stored and accumulated in several time frames for historical value, per site. These time intervals are adjustable. The information is blocked. First, for every 5 minutes then every 4 hours, 6 times per day, weekly, monthly and yearly.

These time intervals are set based on our preference. Your preferences may differ. It is important to note, that while monitoring is taking place, you are utilizing your network.

When new locations are added to the system, your procedures should reflect the addition of that location to your monitoring software.

ORGANIZATIONAL ISSUES

A pro-active effort must be taken at all levels within the company. This means from the President, at corporate level, to field personnel. Extremely close attention to the billing by the CFO, with a clear focus on circuit costs, generating questions and commanding answers from subordinates, can begin the process. In addition, more than one department may take part.

For instance, if several departments have access to the capacity management tools and are reviewing this data, this will create an effective check and balance process.

This awareness and focus on capacity management will, no doubt, improve the customer experience and allow you to utilize your networks in a more economically sound manner.

Accurate database accounting for each and every circuit—both carrier, and LEC providers—that indicates every cost per circuit, will help heighten awareness within the organization.

It is important to mention here that, personally, I am unimpressed with the accuracy of the billing from the circuit providers. A word of caution that an internal checks and balance process be implemented to confirm pricing, prior to payment. It's amazing that so many companies today pay the bill they receive without the means to verify bill.

I would go as far as to say that an internal billing audit might be appropriate. (Many third-party companies will audit these bills on a contingency basis. (Often times, with no cash outlay from your organization).

CONCLUSION

Throwing money at a problem such as capacity issues, without proper management, prior to the purchase of any circuits is not a recommended practice.

Under utilized networks are equally as important as over utilized networks. Good bandwidth management will adjust for both seniors.

The future will bring high-speed data, voice and video to our homes and offices. Cable Operators are in an advantageous situation. With even more exciting opportunities on the horizon.

An aggressive approach to provide the services and technologies the consumer wants through high speed access is the key to success.

---

[1] Telephony Magazine, February 21, 2000 Solution For Success: author Chrissy Moch

[2] What's Hot for the 21st Century, February 25, 2000: author Barbara Reinhold