Comms satellites and

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Faster, faster, faster! That seems to be the story of the Internet and the requirements of the small office/home office (or the SOHO) for connection speeds. What are the possible roles of satellites in this rapidly developing requirement over the next 10 years?

A SOHO worker may be a telecommuter (or teleworker) of an agency of a large corporation. Perhaps an insurance agent or a telemarketer working from home or a local (even a mobile) office – the mobile aspects are beyond the remit of this article, except that they add more traffic and flexibility but tend to be narrow, and not broadband – at least for now.

Basically, the workers in a SOHO want telecommunications facilities equal to their big city, big corporate counterparts. For teleworkers, their virtual presence in the (corporate offices/staff meetings/conference calls) may be vital, and to accomplish these goals, the remote worker needs access to the same facilities – eg, the main office file server, the video and telephone conference facilities, the Internet and intranet.

For medical and insurance workers, the needs extend to medical records including access to quality images from X-rays, CAT scans, etc. When a telephone call comes into the remote office from a patient or another professional, the person answering the call needs quick access to the patient's file and the necessary date to efficiently process the inquiry. Even a short wait of 30 seconds for each piece of simple information is unacceptable.

In all cases, security to protect corporate and third party files is vital.

Teleworkers and small offices need the same (if not higher) access speeds as a regular office – and this imposes a need for broadband telecommunications.

Many teleworkers are located in areas far from cities (and this of course may be the reason they are teleworkers). This also implies they probably are some distance from a telephone office, thus xDSL and other terrestrial broadband services may not be available.

Table 1 summarizes key characteristics of a SOHO for text/Internet services.The assumption in Table 1 is that only one person is using the telecommunications facility at a time (non-LAN). The telecomms speed as a function of the tolerable wait time to download a file can be determined. For example, assuming a 1.0 Mbyte file, speeds of 267 and 66.7 kbps are needed for transmission times of 30 seconds and two minutes. These rates exceed the capabilities of local loops if xDSL is not available. An alternative means of delivery both basic and broadband service is needed. See Table 2.

DELIVERY MEANS

All the delivery means are subject to service saturation – just like cellular phones, especially at peak busy hours and under certain conditions. Later we will look at how one service behaves as a function of time of day. The goal, therefore, is to find a delivery means that can provide the needed range of services on a reliable, repetitive and economical basis. So what SOHO requirements may drive broadband services?

In a regular office, the workers are surrounded by all types of resources – paper and magnetic/optical. An isolated teleworker generally does not have these physical resources but can get access via a communications link. Many of our clients are now requesting electronic copies of our work. These can be made available to their remote workers. Access to this content is critical to the success of any SOHO.

Some face-to-face contact is needed between offices. In place of travel an inter-office teleconferencing link at 100 kbps may be used, but this is beyond the reach of a regular phone line unless ISDN or xDSL is available.

Ignoring games and recreational Internet surfing, the drivers are listed in Table 3.

Next, location of content: there are several places where content (information) can be located: (a) On the source's server which may be tens to thousands of kilometers away from the requestor; (b) At the local ISP. Only the most frequently requested pages can be stored in a local cache. Typically, this is about 90 percent of the requested material. The rest must come from the source (a). Everytime there is an update, the ISP cache must be refreshed, perhaps by a satellite; (c) At the satellite uplink – this is like case (b); (d) On the user's hard drive. Again, this is limited to the most frequently requested sites. The speed is limited only by the time to access the internal (or external) hard drive. The total capacity is limited by the size of the hard driver or its allocation to Internet caching.

In cases (b), (c), or (d), the content is current to the last download time which may be tens of minutes to many hours ago. If the material is not in the internal cache, a technique selected from (a) to (c) must be used. By moving the data closer and closer (and ultimately into) the user, the Internet congestion is relieved and the time to retrieve data is cut in each step.

A SOHO will be receiving data from its mother office(s) into its cache which will be updated as needed. Some information will be too specialized to be stored on every SOHO cache. It will need to be retrieved the old-fashioned way. A separate (non-cache) channel will be used. Like a highway, the new satellites will have both high-speed and lower-speed lanes, each for different types of traffic.

SIZE OF CACHE?

We have seen DirecPC webcasts at 1.2 Mbps into our equipment. Other future push systems expect to run at 30 Mbps. The cache size requirements to capture about 90 percent of the most

frequently requested web sites are expected to fall into the 17 to 100 GB range with 30 GB being common in late 2000. To an extent, these caches are like TiVo video hard disks which are being mass marketed to the general public with storage capabilities of four to 30 hours of TV. Retail prices start at US$400.

Both the cache size and the download speed are expected to grow as the Internet expands.

The next generation Internet service (Internet2, the 'grid', etc) expect to run much faster (perhaps several hundred times faster by 2003). Any satellite being designed to last for 10 to 20 years will need to consider its role as a provider of these faster, faster and still faster speeds during its lifetime.

And what about the speed of the downlink? Residential speeds may be dependent on the availability of material in the cache. It would be logical to assume that a large cache will substantially reduce the need for a high-speed downlink. In a large percentage of the cases, the requested material will be waiting on the disk and thus available very quickly and in full privacy. However, this may set a new time standard (much shorter than at present) which will make users much less tolerant of a delay when they must search the Web or a distant corporate database. As time goes on, this reduced tolerance to these speeds may drive the user expectations to the speed range of cable modems

Table 1: Text and Internet Volumes

Type of Office	Approximate No of people	Daily rate, MBaud	On-line hours/day	Peak Baud Rate (MB/hr)
Home business	1 to 3	6 to 15	2 to 4	12
Small office				
– Teleworker	1 to 3	5 to 25	4 to 7	20
– Small Business	3 to 10	5 to 20	5	25
Medical office	1 to 8	50	8	80

Note: 1 Baud/second = 8 bits/second (bps or b/s)

Table 2: Delivery Means

	Phone	CATV	Wireless	Satellite	High altitude drones/ blimps
Basic Phone Service	✓	✓	✓		✓
Service to 56 kbps	POTS				
Service to 400 kbps				✓	
Service to 2 Mbps	xDSL		✓	✓	✓
Service to 10 Mbps	xDSL	✓		✓	✓
Over 10 Mbps				✓	✓
Mobile Phone			✓	✓	✓

Table 3: Drivers

Application	SOHO Direction	Units/day	Real Time	Bit Rate	Bytes/day
In-basket	In	30 pages	*	*	
Out-basket	Out	50 pages	*	*	
E-mail	Both	20 messages	Near	*	
Video conferencing	Both	1 hour	Yes	0.1 Mbps	45MB
Corporate database access	Both	6 hours**	Yes	100 kbps	108MB
Internet***					
- B2B	Both	TBD	Yes	>100 kbps	TBD
- B2C	Both	TBD	Yes	28 kbps	TBD

* Should be consistent with normal paper handling speed (mail, memos, etc), thus the delay will vary from under one minute (e-mail) to overnight.

** Assumes the link is available for six hours/day but is only used 5% of the time at 100 kbps.

*** B2B = business to business and B2C = business to consumer

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(5 to 15 Mbps).

When a 10 percent item request is made, one of the other (a) to (c) options must be used. In this case the usable speed of the downlink should to be at least a T1 (1.544 Mbps) or E1 (2.048 Mbps).

The downlink bitstream (to the user) probably will be a small fraction of the capacity of a transponder. Time division multiplex (TDM) is used to encapsulate individually addressed bit streams. The difficulty is the potential for over-subscription. Figure 1 shows the response of one direct-to-user satellite system with over subscription. Each time sample consists of five tests using either of two speed tests available on the Internet. The minimum (down triangle), maximum (up triangle) and average square speeds are shown. During very early hours of the day the service operates near its advertised "up to" rate.

During the business day, the average rate slows down but recovers in mid-afternoon. After business hours, the residential market takes over and continues until at least 2am (Eastern US time). Some of this is coming from the other three time zones served by the satellite. There are approximately 20,000 subscribers sharing the transponder.

Advertized speed can be achieved – but generally under lightly loaded conditions at night. During the day, speed sometimes drops by a factor of up to eight and approaches and sometimes is below a 56 kbps telephone line modem. This is an example of over-subscription and also will occur on cable modems. Service rates on a weekend have a longer ramp-down (to about 10am) but the rest of the day is similar. One solution is to use a separate transponder for the cache-filling (Webcasting) service or to delay its use to the non-busy hours. The first case (a dedicated transponder) is costly. The second alternative becomes a trade-off of cache latency (how update is it?) vs individual user downlink speed.

And what about the speed of the Uplink (SOHO to satellite)? Speeds of 56 to 200 kbps are expected, at least for the near term. As the Internet grows into its new form it is expected that there will be more collaboration and distributed computing like the forerunning seti@home. It is premature to estimate the demands for this type of new service as it evolves from an amateur to a commercial business status. Certainly it will cover wide geographic areas, be interactive and require a higher bit rate.

SOHOS AS SOURCES OF CONTENT

SOHO and small-to-medium size businesses will evolve towards being originators of content instead of just consumers. According to Dean Olmstead of SES, a great impediment to the development of broadband multimedia is the lack of content providers. This would seem to be an opportunity for a cottage industry (a SOHO) that would originate content, including real-time interactive.

Should personal caches contain everything that arrives? Probably no. Certain types of material will not be appropriate for certain residential or business environments and could be screened out. This is a problem like screening out certain TV programs. On the other hand, a user may have a frequent need to access a highly specialized database or source that few other subscribers would pick or be permitted to access. One approach is to consider this as a 10 percent request. The second is to request that it be added to the 90 percent group, perhaps at a premium price. It is assumed that such pages would have sufficient security to protect data from third parties.

SUMMARY

Our experience with telephone line modems (sub-56 kbps) has been that they are so slow as to waste time. Satellite-provided services that run at random speeds up to several hundred kbps have been much better, but have simply whetted our appetite for faster speeds and produced frustration when the system is overloaded and slow. In business, time is money. It is painful to watch money being wasted while waiting on a slow service. Large on-site SOHO memory caches will become widespread for the routine inquiries, but more specialized users, which will be common in the grid or Internet2 era, will still need to get unique data from other sites. Based on our experience we expect that the needs will be as shown in Table 4. SBi

Table 4: SOHO Speeds

Type of User	Near Term Speeds, kbps	Ten-Year Speeds Mbps	Cache Loading Speeds Mbps
Homes			
Entertainment	24* to 512	0.512 to 6	1.2 to 30
Office	56* to 512	0.512 to 10	
Small			
Businesses	24* to 1544	To 10	To 30
Offices	24* to 1544	To 10	
Professional	56* to 2048	To 20	

* Telephone speeds