Voice over IP (VoIP) Over Satellite

A White Paper by Galaxy Broadband Communications Inc.
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Voice over IP or VoIP is fast becoming accepted as a communications platform. The purpose of this paper is to describe the particular challenges with VoIP over satellite, including the inherent latency of satellite connections and their effect on VoIP quality.
At Galaxy Broadband we have been involved with VoIP over satellite for many years and understand the unique advantages and disadvantages users of this technology are faced with. We have experimented with various hardware and software configurations and service providers over the years with both success and failure. This paper will provide background of the issues and present our recommendations.

Who Should Consider Using VoIP Over Satellite
If you are contemplating purchasing a satellite Internet system just so you can eliminate your telephone company and save $35.00 a month, we suggest you reconsider. Voice over Satellite Internet should be considered as a viable option only if you do not have a reliable wired telephone line. Those in remote areas where cell phone, radiophones, or satellite phones are the only options to communicate with the outside world can benefit from this technology and should seriously evaluate the benefits, including cost savings.

VoIP as a Technology
VoIP begins when a regular telephone is connected to a local device called an ATA or VoIP router. This device converts actual sound waves into data packets by way of a process referred to as a codec. Not all codecs are equal, and it's very important that the user use the right one, especially when using a satellite connection. These packets travel in the same way as data packets to a destination (VoIP Service Provider) where they are converted back from data packets to sound waves for the calling number to hear.

An amusing story we like to tell about VoIP over satellite Internet is about a geologist working at a drilling location in Northern Alberta. Prior to installing his new system, the geologist had to drive several miles to a hilltop to make a cell phone call which was usually hit or miss whether it connected at all. Given his daily billing rate this was an expensive proposition, let alone the inconvenience factor. His newly installed satellite Internet configured for VoIP offered calling from the comfort of his camp but if the connection halted or missed in any way, even a single syllable missing, he would immediately complain and cuss about the technology! Why would he react this way when 99% of his calls were good enough to carry on a conversation? You won't see him or anyone else tossing a cell phone out the window during frequent "burps" so why the lack of tolerance in VoIP? The answer lies in a peculiar perception about VoIP created by a combination of expectations in new technology and popular culture.

VoIP over Satellite Internet works, but it's not perfect. In fact, VoIP is not a perfected technology in itself, let alone the additional complications due to the satellite link. The voice quality can be quite good, often better than a cell phone call, but it is definitely not toll quality to most modern terrestrial telephone networks.

Satellite Latency and its Affect on VoIP
Latency is the term that describes the time it takes to get a packet to its destination. It is usually expressed in milliseconds, or ms. Since the satellites are located 23,000 miles above the equator, and satellite signals travel at the speed of light, this journey takes approximately 540 ms. You then add on the latency of the various Internet hops and servers plus the VoIP provider's network to end with a total latency in the range of 650 ms to 700ms or more depending on the state of the Internet itself. Another contributing factor could be the quality of your satellite signal which may cause packets to be resent. This latency is heard as a delay between the sender and the receiving ear. Users of VoIP over satellite need to learn how to communicate with this inherent latency much like the older press-to-talk radio phones. Further, the delay requires the users to be patient and refrain from interrupting the caller.

VoIP on the Ground
Even using terrestrial low latency connections, VoIP is still facing challenges due to the multiple hops and connections of the Internet itself. The technology is good, and likely getting better, but still not perfect.

Shared Networks over Satellite
Satellite Service Providers offer service plans in two major categories. The lowest price group are referred to as best effort networks designed for general Internet access for a typical home, farm, or small business with web surfing and email the primary uses. The second category are commercial grade connectivity plans with Quality of Service. Quality of Service or QoS is an industry term for networks that offer end users specific optimization and performance assurances and tend to be closely managed.

Both of theses network types are shared networks meaning the available bandwidth is shared among all users. Virtually all Internet access providers including cable and DSL share their bandwidth with multiple users, but since satellite space is much more expensive than local wires, the satellite services tend to have more users to share the cost. The price is a good indication of the number of users sharing the available bandwidth. Given a similar speed offering, the lower the price the more users share the available space. Overloaded networks will result in fluctuating performance.

"Best Effort Plans" Networks
As the term implies, packets sent and received arrive at their respective destinations at the earliest possible time depending upon the traffic. No users or particular applications receive priority. All home or small office Service Plans offered by virtually all internet access service providers on satellite or terrestrial are "best effort". The price per month is a good indicator as to the number of users allowed on the network as the more on, the lower the cost to all. This results in fluctuating speeds depending upon the time of day. Peak times like evenings or after school gets out tend to have more users on the network as compared to early in the morning. If a VoIP user is conducting a conversation during congested periods, the voice packets will slow or drop resulting in missed syllables.

So, given the need for more users to share in the overall cost of the network itself and the additional latency of the connection itself, VoIP over best effort satellite networks will encounter performance problems.

QoS Networks
Think of a Best Effort plan (above) as a freeway with congested traffic where traffic stops and starts according to the number of cars trying to drive on the road at the same time. If the freeway had a priority lane (an HOV or high occupancy lane is an example in some cities) or an open lane that only some cars were entitled to travel on, these cars would travel faster without congestion because the lane is open. This is the benefit of a QoS Service Plan on a managed network. Time sensitive traffic can be prioritized to reach its destination sooner and without starts and stops. However, this comes with an added cost.

For end users needing VoIP over satellite Internet to work consistently well a QoS managed network that specifically prioritizes voice packets is required.

Minimum Connection Speed
The codec used by the VoIP provider is the key determining factor on connection speed for VoIP to work consistently well. Most big name VoIP providers that sell primarily to terrestrial cable and DSL customers are designed to work without the latency of satellite. These services don't work well on satellite and tend to use codec that need a higher minimum bandwidth. Satellite service providers use codecs that require 30 kbps or less to function well. It is important that the end user works with their satellite service provider to insure the VoIP router or ATA device is configured with the correct codec for satellite.

The Importance of a Properly Installed Antenna on Performance
Most people today are familiar with satellite TV which is a one-way service, meaning a satellite TV dish picks up radio signals from 23,000 miles out in space. Satellite Internet not only picks up signals, but it also sends radio signals back to the satellite 23,000 miles out in space! This two-way communication requires a very precise antenna properly mounted so it can hit a receiving dish 20 feet wide on the satellite. Any "misses" result in lost transmissions so they must be sent again, slowing the speeds. If the user is transmitting a voice packet, these misses result in a lost syllable or two. Data packets lost are rarely discernable but VoIP packets lost can be heard. Using weather proven antennas, well engineered mounting systems, and a professional installation will result in a dish that can consistently send an accurate signal to hit the satellite every time.

911 Calling
911 Service for VoIP providers requires special attention since in many cases, there is no land based telephone line attached to a physical address that emergency responders can go to. It is important to consider the ramifications of this before deciding on VoIP, and with the added mobility of satellite, it becomes more of an issue. Most VoIP service providers have specific 911 Service solutions that may include a call center equipped with a database of last known location but the end user is responsible to keep this updated.

Summary
Voice over IP over Satellite Internet works but the degree that the end user is generally satisfied with the service will depend entirely upon the quality of the satellite service and the connection itself. QoS networks will work best and offer consistent quality. Low end consumer service plans will not, as a rule, perform adequately. That said, the expectations of Voice over IP over Satellite need to be

thoroughly discussed with professionals in advance of the buying decision to avoid disappointment as described in the story of the Alberta geologist.

Rick Hodgkinson President & CEO of Galaxy Broadband Communications was one of Canada's satellite pioneers. He was one of the very first to introduce satellite communications technologies for voice, data, and entertainment to the oil & gas industry beginning in Northern Alberta in 1981 and has evolved to the national stage with the formation of Galaxy Satellite in 1992 and later with Galaxy Broadband, both leading companies in the Canadian satellite industry. Galaxy has grown to be one of the key providers of Broadband Satellite Communications to both consumers and businesses in Canada. http://www.galaxybroadband.ca