SnIP Technical Note

SnIP Performance and Throughput

Revision History
Rev 0.1 9-17-2010 Initial Release.

1.0 SnIP Overview

The Satellite network Interface Processor or “SnIP” is a fairly complete Linux computer on a small card which can be installed in the interface space of a PSM-500 series modem. It can serve as both a selectable data interface and an IP based monitor and control element for the modem independently.

Purpose:

The purpose of this technical note it to present and explain the performance and throughput of the SnIP when used as an Ethernet packet based data interface for the PSM-500 series satellite modems.

Satellite communications faces several significant issues not common to other communications methods that impact performance negatively. Foremost is the satellite delay of 250 mS from end to end. Next the available bandwidth of most satellite circuits is limited.

Aggravating this long delay and limited bandwidth is the design of Ethernet and IP networking and standards that assume wide bandwidth and very short delays. The SnIP is also very small and low power and has limited processing power to handle some solutions to these issues.

We will also discuss some methods to overcome these limitations.

1.1 Summary of Results

The SnIP is capable of processing about 6,000 packets per second total for both traffic directions. Throughput is therefore a function of average Ethernet packet size as well as the modem data rate. A “rule of thumb” is that the approximate maximum UDP packet kbps can be derived as 45 to 50 times the UDP packet size in bytes. Thus if the average packet size is 250 bytes then the SnIP can handle an aggregate transmit and receive 12.5 Mbps.

For TCP/IP traffic, which normally uses large packet payloads, the packet processing speed of the SnIP is not a significant factor, but the round trip delay over the satellite creates another limit to throughput due to the time required to return acknowledgements. This results in a maximum rate of approximately 250 to 800 kbps without some form of “packet acceleration”.

External packet processing in the form of PEP or “packet acceleration” is therefore required for TCP/IP traffic at a data rate higher than approximately 600 kbps. External packet processing in the form of UDP packet aggregation is required for UDP traffic greater than approximately 40 times the average packet size.

2.0 Equipment Setup for Testing

To determine the SnIPs limitations the majority of the test procedures used below set the modem for maximum data rate of 29.52 Mbps. We are attempting to remove the modem rate limitations from our testing of the SnIP as much as possible.

For purposes of throughput we used no delay which might limit the packet rate presented to the SnIP. This is because our purpose is to determine the SnIP's maximum throughput in both Mbps and packets per second.

Testing was accomplished in two standard network configurations:

- Point to point network link using bridging, pass-thru and routing modes to connect two LANs.
- Point to multi-point network using an external Cisco 3600 series router and all SnIPs in routing mode.

One computer at each of the link ends was set up with the "iperf" performance testing software program. One iperf program is started in server mode while the other end is configured in client mode. All tests were run for the standard iperf 10 seconds. The typical commands that were used in this testing is as follows

Server side TCP/IP traffic test invocation
iperf -s
Client side TCP/IP traffic test invocation
iperf -c <ipaddress of server>

Server side UDP traffic test invocation
iperf -s -u
Client side UDP traffic test invocation
iperf -c <ipaddress of server> -u -b <bandwidth> -l <packet size in bytes>

Therefore when testing UDP traffic the server end computer iperf is invoked first and waits for connection from the client. Then the client is started with the appropriate command and the test proceeds for the standard 10 second time and results are displayed.

Each of the configurations and link modes were checked a second time by adding the "-d" option to perform the test in both directions simultaneously.

2.1 Test Result Data

Using TCP/IP traffic with no delays the iperf program will automatically use packet sizes that are sufficiently large that they never reach the SnIP's maximum number of packets per second. Thus it will always read the modem channel data rate times the efficiency of using HDLC wrappers. That is approximately 94% with large packets. However, when satellite type delay is added, throughput is severely limited by the time it takes for returned acknowledgements. This limit has been reported in multiple literature as approximately 250 Kbps. But the actual limits are very soft and our testing showed that a throughput of almost 800 kbps to 1 Mbps is possible.

When using UDP packets the packet size can be set and then used to determine the maximum number of packets that can be sent through the channel without losing or dropping packets. This had to be determined empirically by repeated trials adjusting the program output bandwidth using the -b option until not packets were dropped. This process resulted in the information in the table below.

The maximum data rate in Mbps shown in the table is the maximum data rate that results in no UDP packets dropped.

Packet Size Bytes	Max Data Rate in Mbps	Packets per Second	Notes
58	2.9	6249	Packets per seconds limited
68	3.4	6250	
82	3.9	6022	
100	5	6250	
138	7.5	6802	
178	8.2	5780	
200	10.1	6327	
218	10.8	6211	
300	14.7	6135	
400	19.9	6211	
500	24.8	6211	
700	27.9	5076	Channel bandwidth limited
800	28.1	4504	
1000	28.3	3663	
1400	28.7	2638	

The data above shows that the SnIP in routing mode is capable of approximately 6,000 packets per second.

The data also shows that when the average packet size is greater than approximately 600 bytes then the SnIP is no longer limiting the data throughput, but the channel bandwidth is the limiting factor. Those cases are shown in light yellow in the table. This transition is dependent on the set modem data rate – for example if the data rate is set to 4 Mbps then that data rate setting is the limiting factor for packets greater than 80 bytes average size. Put another way, this data can be used to determine if there is any SnIP processing reduction in throughput based on other modem data rates. For example if the modems are set to 4 Mbps then there is no limitation due to the SnIP for packets as small as approximately 80 bytes average.

Each of the configurations and link modes were checked a second time by adding the “-d” option to perform the test in both directions simultaneously. In any case where the throughput was limited by the packet rate of the SnIP, the total throughput remained the same but was split between the outbound and inbound directions based upon the relative data rates of the two. That is if the data rates were identical then each direction received approximately 50 % of the available throughput.

Interestingly the bridge and pass-thru modes were capable of slightly fewer packets per second than the router modes. The factor that repeated was that bridging is capable of approximately 90% of the 6,000 pps or 5,400 packets per second.

MAB
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