LinkIP Bandwidth Defragmenter Application Note

1. INTRODUCTION

The LinkIP is LinkSat's multi-application router that was originally developed as a service platform for LinkSat's patented Scanned Channel Assigned Networking (SCAN) bandwidth manager. It provides the LAN to WAN interfacing and supports multiple WAN interfaces. The LinkIP WAN ports serially interface with satellite modems, typically via RS-530, RS-422, or V.35 interface. Although developed for mesh routed multi-destination networking, the LinkIP has proven to be a highly versatile platform that can be adapted for many other applications. Its ability to interface with and control multiple satellite modulators and demodulators enables the router to act as a multiplexer / inverse mux. This feature was originally developed for the SCAN bandwidth manager so that a LinkSat remote terminal could transmit and receive multiple circuits simultaneously. By logical extension, the LinkIP is also able to effectively convert multiple small segments of fragmented bandwidth on a satellite into one large segment.

Satellite service providers typically have numerous small segments of orphaned or stranded bandwidth on satellite transponders that are not usable because they are too small. Over time, these fragments unavoidably occur as a result of old circuits taken down, new circuits put up, and moving carriers at customers' requests. If several of these small segments could be combined, the resultant bandwidth would be usable and salable. This would not be a problem if restacking or shuffling of the carriers could be done on a regular basis. In most cases, however, users of these existing carriers will not allow their carriers to be moved.

The LinkIP can solve this problem because of its ability to serially interface with and control up to 12 satellite modulators and/or demodulators. This capability allows it to take an incoming data stream on its LAN port, split it up and feed it into multiple data interfaces on satellite modulators, and transmit the multiple modulated carriers simultaneously. At the other end of the link, the distant end LinkIP receives and demodulates the carriers simultaneously. The router re-assembles the data streams and routes the aggregated data stream out of its LAN interface (see *figure 1*).

2. LINKSHRINK COMPRESSION ENGINE

Further throughput can be achieved with the use of LinkShrink, the LinkIP's internal data compression engine. LinkShrink is LinkSat's proprietary lossless data compression system that was designed specifically for LinkSat's RMD solution. Its high-performance data compression algorithms can achieve 60% or more bandwidth savings on compressible data. Head to head

tests with other satellite equipment manufacturers' compression systems using same data files consistently show LinkShrink achieving much higher levels of compression.

The LinkIP hosts the LinkShrink compression system. The lossless, low latency engine compresses both packet header and payload. LinkShrink makes compression decisions on a packet by packet basis. Each packet is handled by the compression system based on characteristics, TOS, IP protocol, UDP port, TCP port and combinations of these as well. Packet headers are compressed first. The resulting datagram may be sent through a stream compression engine depending on its characteristic. If the requirement is for maximum compression it is sent through the standard stream compressor. If the packet is sensitive to latency, such as a voice signaling packet, it is sent through the zero latency stream compression. The resulting packet is then encapsulated in the LinkCast protocol and routed out to the satellite modulator.

Compression can be set up or bypassed on a per WAN port basis, and can be set up or bypassed on an IP stream, destination IP address, or packet type basis as well. Packet prioritization is achieved by using the router's QoS capabilities, or can be set by IP protocol, UDP port, TCP port, combinations of UDP port and TOS. Although already extremely low, throughput latency and packet jitter can also be controlled by adjusting the level of compression.

As with any compression system, compression levels achieved by LinkShrink depend on data type. Compression ratios of 2:1 or better can be achieved with highly compressible data, for example VoIP, TCP and UDP file transfers, and uncompressed voice. Ratios of 1.5:1 or better can typically be achieved with compressed voice in VoIP networks, e.g. from media gateway equipment and on A-bis and A-ter links.

3. DEFRAGMENTED BANDWIDTH EXAMPLE

In the example depicted in *figure 2*, a segment of satellite bandwidth has three 1024 kb/s carriers and three 2048 carriers, with small bandwidth fragments between the carriers. In *figure 3*, the LinkIP earth station is transmitting five carriers into these fragments (3 x 256 kb/s, 1 x 512 kb/s, and 1 x 768 kb/s) for an aggregate throughput of 2048 kb/s occupying about 1 MHz of space segment, assuming a 2:1 compression ratio can be achieved with LinkShrink.

The LinkIP will interface with virtually any satellite modem, so there is no need to purchase new modems if there is an inventory of existing modem equipment. Because the LinkIP solution will support of legacy modems, inexpensive used or refurbished modem equipment can be utilized.

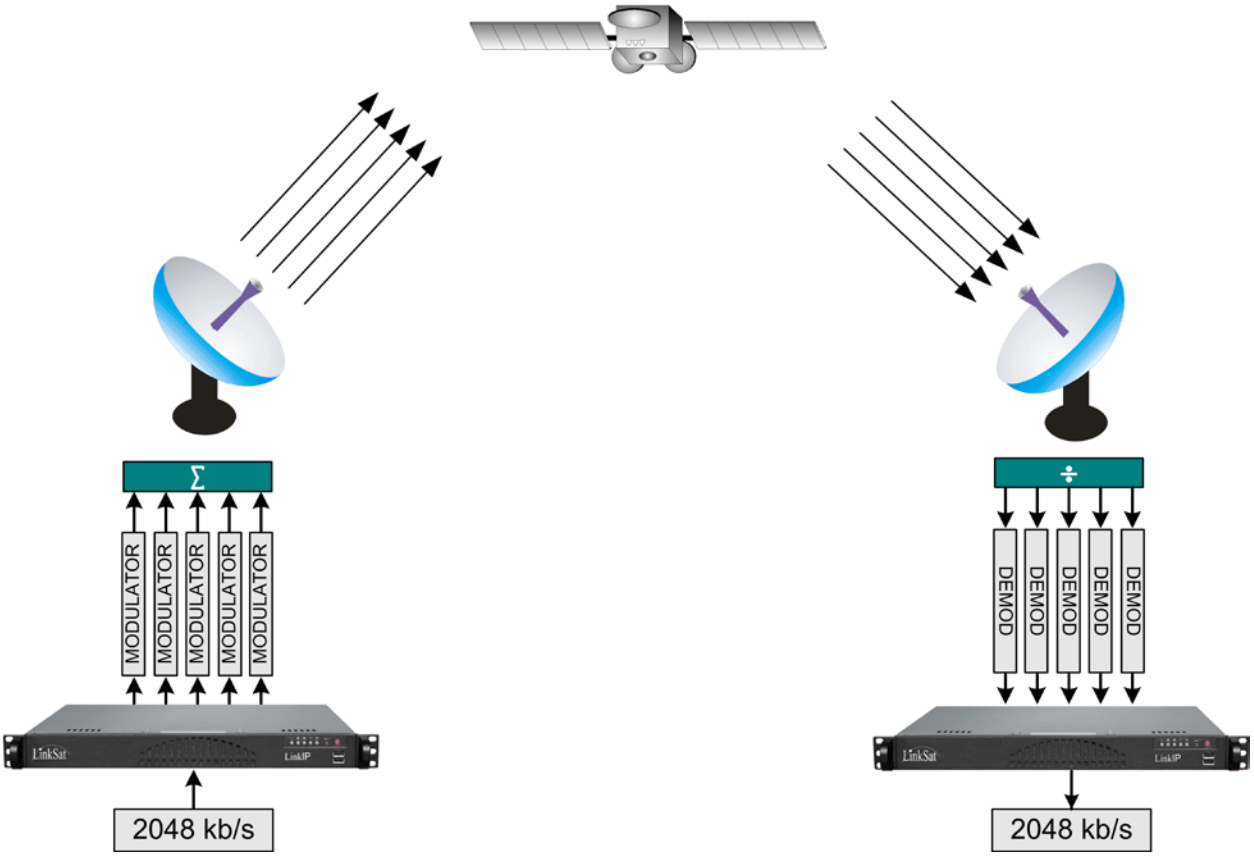

Figure 1

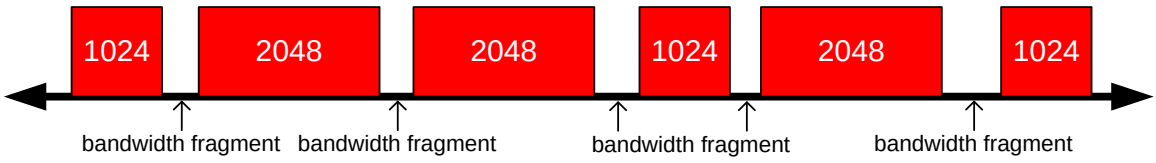

Figure 2

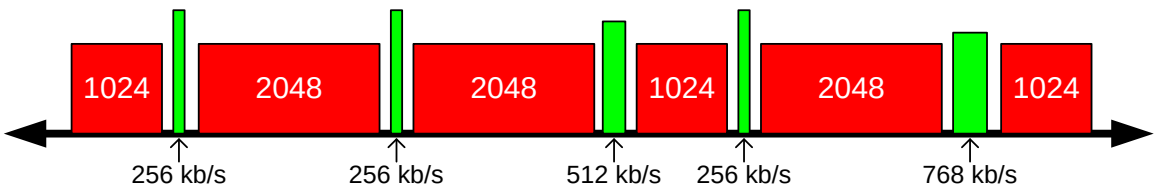

Figure 3

The above examples are highly generalized; however, the LinkIP solution is highly versatile and can be customized in a number of ways. For example, the block diagram in figure 1 shows a one-way data flow, however, this can be two-way using full modems in place of the modulators and demodulators. The following bullet points outline some of the LinkIP's capabilities that apply to the fragmented bandwidth application:

- LAN interface – The standard interface is 10/100/1000 Ethernet. If a different physical local interface is required, the LinkIP can be equipped with virtually any type, e.g. T-1 / E-1, ATM, OC-3, frame relay, etc.
- WAN interface – RS-530/ RS-422 is the standard modem interface. The LinkIP will interface with most current production satellite modems, e.g. Comtech EFData, Advantech, Datum, etc.
- Legacy modem support – LinkIP interfaces with virtually any satellite modem, enabling use of existing, "off-the-shelf" modems.
- Remote M&C – The LinkIP and all connected modems can be locally controlled via a web browser-based user interface, or remotely via satellite or terrestrial connection.
- Data compression – The LinkIP has an optional data compression engine that can typically increase over-the-satellite throughput between 5X and 10X
- Multi-destination network architecture – Because the LinkIP encapsulates the data into IP frames, the outbound carriers can be multi-destination or multicast transmissions; each receive site can filter, route, or discard received packets
- Multi-application platform – LinkIP supports voice, video, and many other data transport protocols
- SCAN bandwidth manager – SCAN can be added at any time to automate carrier activation/ deactivation for bandwidth-on-demand applications

More information on the LinkIP and SCAN can be found on our website, www.linksat.com. Contact the LinkSat sales team sales@linksat.com for detailed technical data or pricing.

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