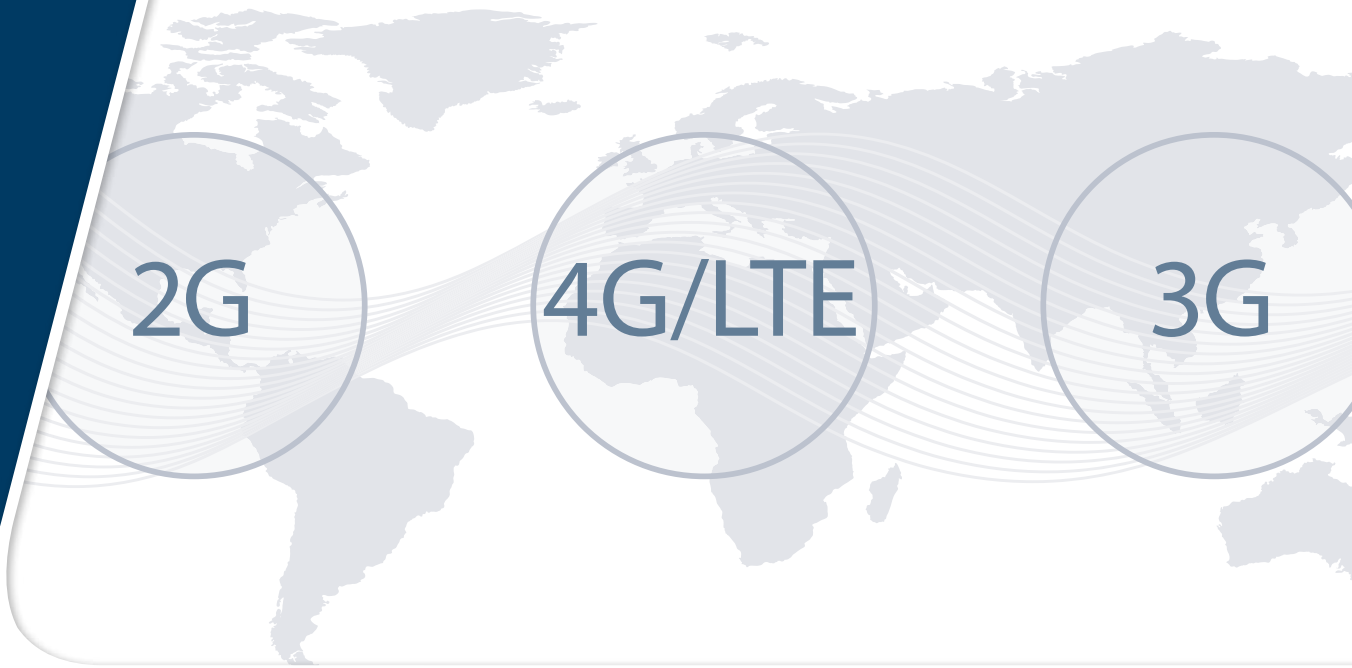
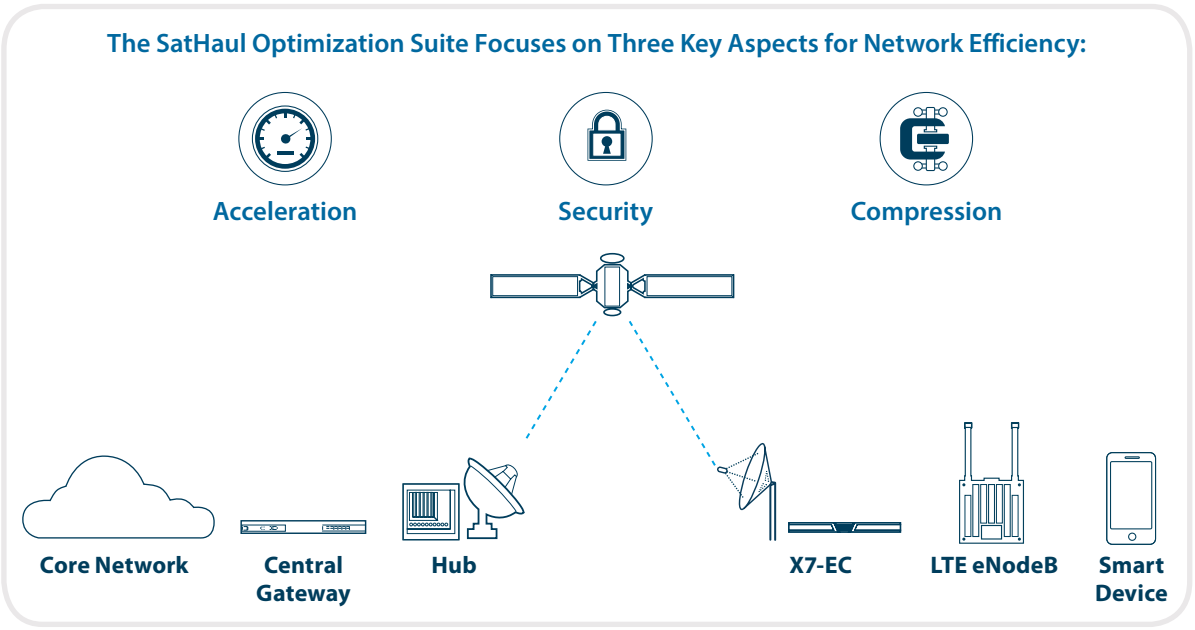


iDirect SatHaul Optimization Suite – Solution Overview

The growth and popularity of mobile voice and data services are causing mobile operators around the globe to evaluate different backhaul technologies to meet the rapidly increasing demand for their 4G/LTE network deployments. As mobile operators build out these networks they want to provide a consistent user experience for their subscribers whether they are in the heart of a city or a rural town, at a special event or on the move.

As networks expand beyond urban environments it becomes difficult or cost prohibitive to use terrestrial backhaul technologies like fiber or microwave. This is where satellite has filled the gap to provide ubiquitous coverage by enabling backhaul in areas that other technologies can't reach. The challenge for satellite has always been that bandwidth is expensive, so it has always been a secondary technology to serve this market. The good news is that advances in satellite architecture are enabling more bandwidth to become available via high throughput satellites and advances in satellite ground infrastructure are improving the experience and efficiency of using the technology.

iDirect is focused on delivering satellite infrastructure solutions that meet the varying requirements for mobile connectivity, from 2G voice to the latest in 4G voice and data services. The iDirect SatHaul™ solution is designed to provide the hardware and software to help mobile operators expand coverage in a smart and profitable way. One of the differentiators when using an iDirect solution for 4G/LTE connectivity is the iDirect SatHaul Optimization Suite that provides increased throughput and enhanced experience for users of LTE over satellite.



The following are key 4G/LTE features of the iDirect SatHaul Optimization Suite.

TCP Acceleration

When a subscriber has a 4G device they are expecting a high quality connection with multi-megabit throughput capabilities to deliver the latest in Internet connectivity, including streaming audio and video.

When using satellite to backhaul TCP/IP traffic one of the challenges that can impact throughput performance is the approximately 600ms delay that is introduced through the roundtrip time sending a signal to and from the satellite. This delay in receiving an acknowledgement makes the TCP software think the link is congested and therefore limits the amount of data that can be sent.

iDirect has implemented TCP Acceleration specifically for mobile networks, which allows for the acknowledgement to be sent back to the base station from the satellite terminal before being transmitted over the satellite. This allows for larger amounts of data to be quickly transmitted without being impacted by the satellite delay. Ultimately this translates to the end user getting the high-speed experience they expect with the acceleration being transparent. This means preserving protocol information such as IP addresses and port numbers.

An interesting side effect of intelligent handling of TCP acknowledgements and retransmissions is a large reduction in the bandwidth used on the return channel.

IPsec

As mobile subscribers use their various devices from smart phones to tablets for surfing the Internet, shopping, banking or healthcare they are sharing user information that must be kept safe and secure.

A standard LTE implementation will use IPsec to secure all communications by authenticating and encrypting the data from the LTE eNodeB through the network to the Security Gateway at the EPC. In the past, it was not possible to optimize all of this information, as the traffic was encrypted.

The iDirect optimization software is designed to integrate into the "chain of trust" in the mobile operator's network. This means that IPsec traffic can be decrypted, optimized, and re-encrypted inside the optimization device's CPU. This allows the security of the traffic to be maintained throughout the entire network path, even when it is travelling over the satellite link. iDirect uses a processor with hardware encryption support to make sure that this process does not impact the performance of the satellite terminal or the throughput of the traffic.

IPsec can be supported and maintained while at the same time optimizing the traffic to improve the efficiency and user experience of running over a satellite link.

Header Compression:

When an operator deploys satellite for backhaul, the most expensive part of the solution is the cost of the satellite bandwidth. Even with new high throughput satellites multiplying the availability of capacity, bringing down cost and increasing throughput, it is still an expensive proposition. For that reason, the ability to compress traffic becomes very important to maximize on the investment in bandwidth.

LTE networks provide the user with end-to-end IP connectivity from the handset to the end service, such as a web site or a voice server. They do this by carrying as many as five different protocols each one on top of the next. Each protocol has its own protocol header, much of which does not change from packet to packet. Carrying all this header information is both inefficient and expensive over satellite.

iDirect provides header compression that works by removing the elements that are not relevant to save on bandwidth. The LTE header stack is compressed over the air interface using a standard called RoHCv2, and we are using the same standard to compress the headers over the satellite link.

This technique is especially effective when small packets are being transmitted. For example, in Voice over LTE (VoLTE), the header exceeds the size of the user data being transmitted. With header compression up to 70% can be saved on the bandwidth that would be needed for VoLTE transmission.

Payload Compression:

As highlighted above, it is important to send and receive as little data as possible when using satellite as the backhaul. With the increased amount of data traffic on 4G/LTE networks it becomes even more important to optimize the traffic before sending it over the satellite link. Aside from the header information, you have the actual user traffic or payload that is being transmitted. In order to compress this traffic you must be able to see and understand what type of voice or data traffic is being transmitted.

Depending on the type of traffic there may be additional compression that can be applied that will also help save on the amount of bandwidth needed to transmit. iDirect utilizes some of the latest compression algorithms to optimize the payload traffic while maintaining a good experience at the device level. For general web browsing or text based traffic, payload compression can have a strong impact compared to traffic that has already been zipped or isn't able to be compressed. Overall this may save an additional 10-15% on the amount of traffic that is sent over the satellite link.

How do I deploy the iDirect SatHaul Optimization Suite?

The iDirect SatHaul Optimization Suite is available in three different options

1. Embedded in specific iDirect satellite remote routers
2. As a separate standalone appliance
3. As a software license that can be embedded into other mobile network appliances

A mobile operator may choose a different form factor depending on the environmental conditions and the application being supported. So for connecting remote or rural locations, enabling emergency services, or providing connectivity in mobile environments the iDirect SatHaul Optimization Suite can be deployed in the appropriate form factor and improve the capabilities of using satellite for backhaul.

At the satellite teleport, a standard server will act as a central gateway and will be located next to the iDirect hub. The central gateway will convert the traffic back to standard mobile interfaces – S1 for LTE, Iub/Iuh for 3G and Abis for 2G, where it will continue its journey back into your core network. Multiple servers can be used at the teleport to increase capacity or to provide resilience.

Make the most of your satellite connected sites by saving bandwidth and providing a higher quality of service to your customers with the iDirect SatHaul Optimization Suite.

Improving 2G and 3G networks:

Many operators are still running 2G and 3G networks and are looking to expand the reach of those services to new or underserved areas as well. Whether it's the 2G Abis or the 3G Iub/Iuh protocols, the need to optimize these connections when using satellite can make or break the business case.

The iDirect SatHaul Solution Suite includes optimization capabilities for 2G and 3G networks as well. For 2G it is more about the intelligent handling of voice calls to make sure that you are limiting the bandwidth, without impacting the quality of the call. With 3G it is the mix of voice and basic data services, so a higher amount of IP traffic being transported. This means that traffic must be intelligently sorted, organized and then optimized to maintain quality of service requirements for different types of traffic and to overcome the various challenges of latency and packet loss.

These various optimization techniques can deliver satellite bandwidth savings up to 50% at a site depending on the traffic profiles. If a mobile operator is trying to optimize 2G, 3G or 4G/LTE traffic, the iDirect SatHaul Optimization Suite can deliver these advanced capabilities in a single box.

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Advancing a Connected World