Delivering Stable Picture Quality In Unstable Network Conditions

By: Paul Shen, CEO, TVU Networks

The ability to broadcast live from virtually any location is compelling for broadcasters, who are continually searching for ways to get better footage of live news and events to their viewers faster than the competition. In the past, broadcasters relied heavily on traditional satellite and microwave trucks to broadcast live on location. However, today broadcasters are beginning to turn to mobile uplink solutions such as the TVUPack, which transmit the signal over 2.5G/3G/4G wireless networks.

Mobile uplink solutions are a cost effective alternative electronic newsgathering tool that provides the flexibility to capture and transmit footage on location without being tethered to an expensive OB van. Although the promise of mobile uplink transmission solutions is compelling, these solutions must overcome several technological hurdles in order to deliver a professional quality picture.

This paper explores the two major barriers to delivering stable picture over wireless networks and examines other considerations network engineers should make when evaluating a mobile uplink solution.

The Two Barriers to Quality Picture

The promise of 3G and LTE networks is a dramatic increase in bandwidth, enabling greater amounts of data to move over the network than ever before. However, despite the bandwidth gains, transmission of a professional broadcast quality video signal can use up 5-10 Mb/s, easily overwhelming even today's largest bandwidth 4G connections. Despite the fact that network capacity is growing at an exponential rate, a single pipe cannot accommodate the amount of data required for stable, professional-quality picture.

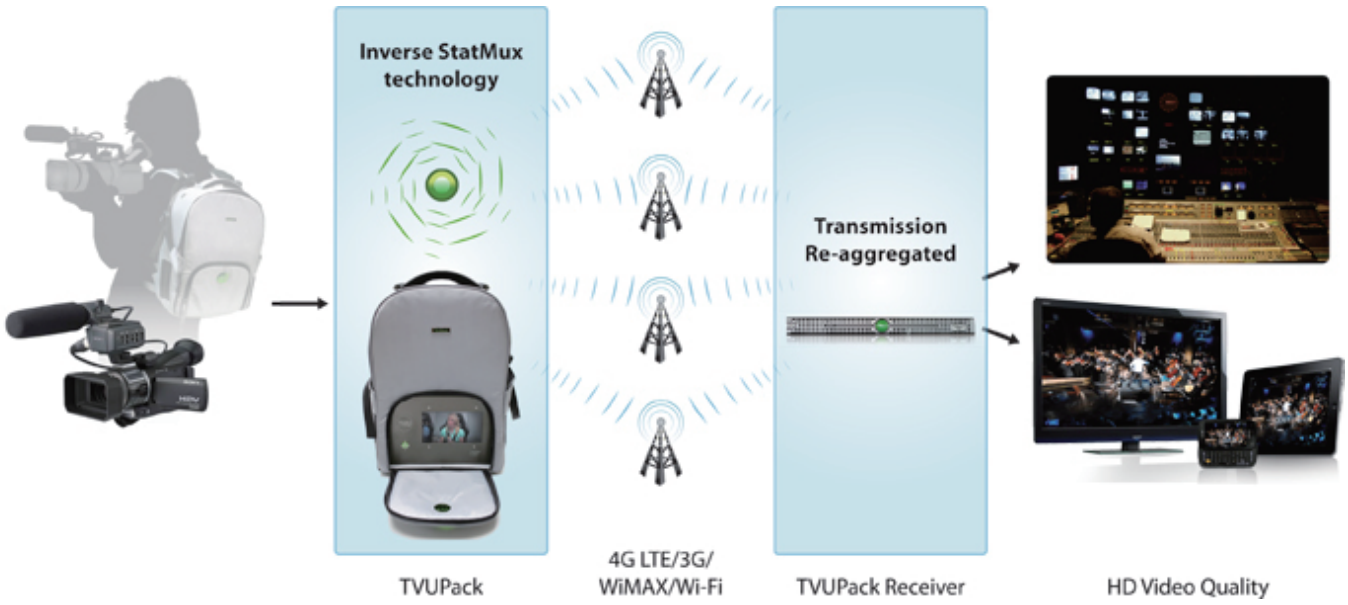
When looking to deliver strong picture over a wireless network, bandwidth is only part of the story. 3G and 4G networks all have certain characteristics that don't exist in traditional wireline networks. Even if 3G and LTE wireless networks could provide sufficient bandwidth to transmit a professional-quality HD signal, the network is still inherently not capable of providing Quality of Service (QoS).

Why is QoS important? Without QoS, packet loss is inevitable. Packet loss manifests itself as block artifacts on video and discontinuity on audio. In more extreme cases, packet loss can even cause the complete loss of picture altogether. Because delivering quality picture is the objective for any professional live shot, preventing packet loss is critical for any reliable mobile uplink solution.

TVU's Solution: Inverse StatMux

In order to combat the bandwidth and QoS hurdles inherent in wireless 3G/4G networks, TVU Networks has developed a proprietary technology called Inverse StatMux. Most broadcast engineers are familiar with the term StatMux (statistical multiplexing). On a high level, StatMux is a process where multiple signals are combined and transmitted over a fixed channel. As its name suggests, Inverse StatMux does the opposite, taking a single signal source and then reverse multiplexing the signal across multiple channels for transmission. The transmission is then re-aggregated at the receiving end. With Inverse StatMux, the TVUPack is able to mitigate the effects of constrained bandwidth by transmitting the video signal over multiple channels simultaneously, enabling broadcasters to push a larger amount of data over the network, resulting in a better picture signal.

Diagram A illustrates how Inverse StatMux is able to utilize multiple connections to push more data through the network.



Additionally, Inverse StatMux combats network instability by intelligently monitoring each network connection in real-time, and making corrections and adjustments as network conditions change. If connection performance degrades, the Inverse StatMux process enables the TVUPack to reallocate the data that was streaming through the degraded connection to other open connections, preventing data loss.

The process of intelligently monitoring network conditions and dynamically adjusting the video compression rate in real time enables the TVUPack to match the video data rate with true available bandwidth, which in turn results in higher picture quality. The end results in terms of picture quality can be dramatic. Diagram B demonstrates common differences in picture quality when a signal is optimized with Invers StatMux versus an unoptimized signal transmitted using other mobile uplink technologies.

Packet loss can cause significant picture degradation with block artifacts or even complete loss of picture altogether.

Inverse StatMux technology mitigates packet loss to ensure quality picture delivery despite unstable 3G/4G network conditions.

Exploring the Alternatives

In the past, a number of other mobile uplink solutions have attempted to tackle the bandwidth problem by using bonding, a technique that was originally developed in the IT networking industry. Bonding is a process where multiple signals are grouped together and transmitted through a single virtual channel. In a stable environment, such as one with multiple OC3 connections, bonding is a good technique to overcome bandwidth limitations because it aggregates all of the available bandwidth, enabling users to get better throughput. However, the 3G and 4G environment is not stable, and the bandwidth, latency and packet loss rate changes constantly. As a result, real throughput is much lower over 3G/4G connections using bonding technology.

Since unstable network conditions are a fact of life when dealing with wireless networks, uplink solutions that use bonding struggle with delivering quality picture. If one of the signals feeding into a bonded connection is degraded, nothing can detect exactly where in the transmission process an error occurred, and packet loss is inevitable.

The End Game

There are a number of mobile uplink products that transmit over wireless networks available, so if they all use similar connections, why should anyone care how the signal is pushed through the pipe? At the end of the day, television broadcasters should care how the data is transmitted because it affects the one thing that matters most: picture quality. It doesn't matter how skilled a camera crew or field reporter is if they can't deliver quality footage back to the broadcast facility.

When examining wireless uplink products, engineers should identify robust solutions that can mitigate the effects of bandwidth limitations and network instability and transmit picture in HD with true resolution. Even if an uplink product uses multiple 3G and 4G connections to transmit the signal, many products are incapable of transmitting a true HD signal because they can't optimize the data in transit. Many products use shortcuts such as downsampling the image prior to transmission and upsampling the image when it reaches the receiver. These shortcuts result in color loss and softer picture. Even though they may claim the picture is in HD, it isn't true HD.

Other products may transmit signal over multiple wireless networks, but lack the necessary processing power to encode an HD video signal, because the hardware itself has limited performance. Picture quality once again suffers because the product doesn't have the computational power to do encoding in HD.

It's no question that mobile uplink products are a powerful newsgathering tool for broadcast organizations. Hundreds of broadcasters around the globe are using mobile uplink solutions like TVUPack to supplement or even replace their current ENG solutions. However, broadcasters must take care to keep the proper end game in mind when evaluating different offerings.. Because no matter how well a camera crew can capture a breaking news story or live event, trusting the wrong uplink technology to deliver the picture can leave viewers in the dark, which is the last place broadcasters want their viewers to be.