



Public Safety Video Streaming Demands A Rethink



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Executive Summary

The public safety community is recognizing that live video streaming is a necessity to help emergency managers and responders on the scene of an incident improve their situational awareness and ultimately protect lives. However, a single SIM connection to transmit video is unreliable and jeopardizes success. Professional video streaming transmitters offer the redundancy necessary for reliable video transmission in all situations versus some situations.

This paper examines:

- The deceptive “reliability” of smartphones
- Research into the true nature of cellular network reliability
- Why single SIM card video streaming solutions are unreliable for public safety
- Optimal aggregation of bandwidth from multiple wireless sources
- Why network latency can be a problem for emergency responders and managers
- The importance of maintaining video quality
- How the public safety community can learn from broadcasters who have solved the wireless reliability problem

Introduction

There’s an unseen threat to the public safety community that is rapidly growing.

That problem boils down to the seeming reliability and ubiquity of wireless networks. Conditioned by years of reaching for a smartphone, dialing and getting connected, those in the public safety community have been lulled into a false sense of confidence that a connection will always be available.

This level of comfort is unwarranted. Voice calls require a relatively low data rate to be successful—somewhere in the range of 20kb/s, which may tend to gloss over network problems and falsely give the impression that a network is robust and reliable.

A 2019 research report by Rootmetrics underscores just how prevalent problems with reliability are. Nearly 40 percent of what the researcher described as “wholly dependent power users” of mobile phones reported being affected by poor connectivity several times a day. The research organization defined “wholly dependent power users” as those who “rely on mobile connectivity for both work and lifestyle reasons.”

“This small but influential group of wholly dependent power users are especially attuned to network performance and the importance of connectivity,” the report says.

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A 2021 study by researchers from Tsinghua University, Xiaomi Technology Co., the University of Minnesota and the University of Illinois at Urbana-Champaign, revealed the scope of problems with cellular reliability.

Working with Android phone vendor Xiaomi, which serves millions of cell customers in China, the researchers found “cellular failures are prevalent” on all of the models studied and that an average of 23 percent of the devices experienced at least one failure. Further, they found a failure can last for up to 3.1 minutes.

Closer to home, a 2012 Pew Research Center study found nearly three out of four cell phone owners occasionally experienced dropped calls, and 32 percent reported dropped calls a few times a week or more.

With so high an incidence of dropped calls and other reliability issues, the wisdom of using a single cellular network connection to transmit video that might mean the difference between life and death during an emergency seems unwise.

The bandwidth required to transmit video reliably from an unmanned aerial vehicle (drone) or a camera on the ground to emergency personnel requires far more than the minimal 20kb/s needed for a voice call, which the research shows frequently can fail. How much less likely is a data hungry video transmission to make it to its destination via the same network?

Reliability

As simple as it may sound, the solution to transmitting video reliably from the field to help first responders boils down to enabling more bandwidth. Cell phones have a single SIM (Subscriber Identity Module) card used to connect to a network.

While a single SIM card and a single connection might be good enough for non-essential, low-bitrate voice calls, relying on that approach for mission critical public safety video communications is not.



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There are many reasons a wireless service provider's network may prove to be unreliable, especially when relying on a single-SIM-card connection, including:

- Being in a remote location far from the nearest cellular tower, such as wild fire crews fighting blazes in the U.S. West and Mountain States
- Low signal strength
- An excess of users hitting a single tower for service as is common at crowded stadiums
- Cell tower maintenance
- Work on the backhaul infrastructure from the tower to the network

Latency

If unreliability of a wireless network connection is public safety enemy No. 1 when it comes to transmitting drone video from the field, a close second is latency. Even though data packets move across a network at incredible speeds, depending on several factors, including data routing and switching, a time lag can develop between the moment something is captured by a video camera and the same action is seen on a remote video monitor, tablet or cell phone.

For police departments responding to a shooting, firefighters deciding where to concentrate their efforts or other first responders needing accurate situational awareness, the greater the latency, the less useful the video.

Some solutions supporting wireless transmission of drone video, for example, rely on RTMP (Real-Time Messaging Protocol) to move bits across a wireless internet connection. However, to deliver that streaming video to a viewer, such as an officer on the scene needing near real-time situational awareness, that RTMP stream is sent via a Content Delivery Network (CDN), removing all control over latency.



All of this processing takes time, adding latency to the transmission from sender to viewer that otherwise could have been avoided. Again, for the general public a bit of delay may be OK, but for first responders making split-second decisions about life-and-death situations such latency is unacceptable.

In contrast to unpredictable latency, TVU delivers performance with sustainable sub-second latency that can be practically imperceptible to viewers.

Video Quality and Ease-of Use

Two other factors play heavily in whether or not a particular video streaming solution is right for the public safety community: video quality and ease of use.

While at a minimum today's cell phone video cameras support HD-quality acquisition, what's transmitted may suffer degradation in image quality due to the encoding used for streaming.

Streams are compressed. Picture elements and frames of video may be discarded and compression algorithms may be so aggressive that the quality of the video images being streamed becomes unacceptable. That can be a problem for public safety command personnel who need situational awareness and must make critical judgments about supporting events when they are not on the scene.

As is the case with single SIM smartphone reliability, video quality transmitted by a phone may be acceptable for public safety use some of the time. But can an agency charged with public safety truly fulfill its mission when a critical tool delivers less than 100 percent of the time?

Any video streaming solution under consideration for public safety use also has to be easy to use. A drone pilot responsible for flying the aircraft does not have time to be concerned about the video streaming when the platform is airborne. Focus must be directed towards piloting the aircraft and associated responsibilities.

Professional IP video streaming solutions provided by TVU Networks offer single-button-push connectivity so drone pilots can focus on their mission critical piloting while allowing the highest video quality possible by leveraging all available bandwidth resources.



Broadcast Tech For Public Safety

The public safety community has seen firsthand the valuable role live video streaming plays in protecting life and property. While adoption has been steady, video streaming is often viewed from a consumer perspective. Given reliability and latency issues, consumer solutions like smartphones and individual cell phone network connections are not up to the performance requirements of the public safety community. Fortunately, the public safety community needs to look no farther than the broadcast industry for the solution.

Rather than relying on a device with a single SIM and one cell connection, solutions used by the broadcast industry are available that aggregate bandwidth from multiple sources to enhance reliability and reduce latency—or the lag that can occur when transporting IP packets across a network.

A step beyond simple “bonding technologies” are solutions from TVU Networks that employ a patented technology called IS+ (Inverse StatMux Plus) that not only aggregates wireless bandwidth from multiple sources, but also intelligently distributes IP packets to be transmitted across those connections based on factors such as network robustness, performance, latency and availability in a particular area to ensure optimum transmission. IS+ even dynamically controls the quality of video being transmitted to match changing network conditions that are responsible for fluctuating data throughput.

In addition, thanks to support for a sophisticated forward error correction (FEC) algorithm, TVU Network solutions detect when data packets are lost during transmission and resend them to ensure flawless playback.

An example of a TVU Networks streaming video transmitter that uses IS+ is TVU One. It offers support for up to six internal SIM cards and modems from different wireless carriers, the ability to connect additional external wireless modems, Wi-Fi network connectivity, Ethernet and even support for external microwave radios and satellite links. Together, these bandwidth resources under the management and control of IS+ deliver reliable wireless connectivity in even the most challenging conditions.



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Recently, a federal agency working a wildfire from a remote region in Montana was able to transmit HD video of the blaze with scarce cellular bandwidth that fluctuated between 135kb/s and 750 kb/s.

For more than 15 years, TV broadcasters have relied on professional video streaming solutions, such as TVU Networks' TVU One transmitter, to provide live shots and edited stories from remote locations around the markets they serve. These solutions have proven so reliable and offer such low latency that they have largely replaced dedicated terrestrial microwave and satellite links for newsgathering.

TV broadcasting and the public safety community have much in common when it comes to what is required of video streaming, especially in terms of reliability and latency.

Public safety agencies and the public they protect are best served by adopting the solutions that are reliable, low-latency and easy to use with high video quality. Relying on a smartphone and a single SIM connection simply won't do.

About TVU Networks

With more than 3,000 customers worldwide, TVU Networks offers IP and cloud-based workflow solutions to a wide range of industries, including public safety, news, sports, entertainment, house of worship and government.

Based in Mountain View, Calif., the company has been at the forefront of technology development to enable IP transport of video and the AI-drive media supply chain. More information about how TVU Networks products are used by the public safety community is available online at: <https://www.tvunetworks.com/public-safety/>

