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New Bonded Cellular Video Transport

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on Mobile News Gathering
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How can Bonded Cellular Save Money?

The way bonded cellular technology can help you save money is by eliminating your Satellite Truck, your ENG Truck or your Mobile Production Truck.



Let’s crunch some conservative numbers. Take the daily rental of a sat truck; say \$2,500 per day. Assume you rent it 25% of the days in the year for your workflow operations. You will come up with a number close to \$250,000. Obviously, some people might use a vehicle more or less, so that number varies.

I think you'll get the idea that bonded cellular solutions are not that expensive. It makes financial sense, and the technology has come such a long way that with latency as low as 1.5 seconds, we can broadcast quality video live on the air. If it makes sense for your business workflow, if it makes sense for your business model, we're here to help you maximize your revenue and ease your workflow. At the end of the day, if we can save you a lot of money, that's a win-win for everyone.

What Are the Common Uses for Bonded Cellular?

In short, many of these products started out with roots in news gathering, but it has branched out tremendously into live events, sports, as well as many other applications.

Will Bonded Cellular Replace Mobile Trucks?

Here’s the big dilemma today. Every corporation, college, high school, broadcaster, and news agency... they all want to broadcast live. Americans, in particular, don't like to read anything anymore. We want everything delivered to us in a video format. If it is breaking news, sports, or other events, we need to broadcast from anywhere live.

We will still have some of the more traditional sports mobile production trucks, sat trucks, electronic news gathering, microwave trucks, and so on. I don't think these vehicles are going to go away, and we're not trying to replace them in every application. I don't think

George Hoover at NEP is threatened by bonded cellular. We're not going to put Monday Night Football with instant replay, graphics, and commentators through bonded cellular. We might have some B-roll from the parking lot or an interview in an odd location supplementing a program like that. However, bonded cellular is used for NCAA, college sports, and even high school sports.

Bonded Cellular for the Mobile Truck

Bonded cellular can be used as a backup to the primary feed. If you're a person who owns a satellite or microwave truck, we're not trying to put you out of business. There's an angle for you. Say you're trying to sell satellite services. You made this multimillion-dollar, or a couple hundred-thousand-dollar investment, but not every client of yours can afford a satellite connection. Add bonded cellular as an option. There’s a trend where we put bonded cellular on the vehicle, on a satellite truck, on a Ka truck. It gives you diversity. You have two paths.

Fox Sports, particularly in Southern California, is now covering close to 700 high school football games every fall. They have these small production crews going out with small vans, with a TriCaster and a bonded cellular rig in the back, and they broadcast high school football, believe it or not, live. Every game can be caught live and then it's archived for a few days so that you can watch your game. If you can't make it to your child's high school sporting event, you can catch it on Fox West or Fox Prime Ticket. So, it's pretty exciting stuff. It opens up some options.

You can also get bonded cellular in a rack mount with an ASI output, particularly for an ENG or satellite truck. It's great for hybrid applications. Say you’ve using Ka-band satellite, and you want to supplement it with some cellular connectivity. You put the external antennas on the roof of your truck. Now you have the live, auto record, store, and forward capabilities of bonded cellular at a fraction of the costs of satellite. The second encoder with ASI output can drive your satellite as a redundant transmission to the cellular transmission.



Absolute Ease of Use

In most applications, the talent can go out alone, and the way they're able to do this, they'll go out with the camera, tripod, and the cellular backpack. They typically hook the backpack on to the side of the tripod, set up their shot, and turn the backpack on.

It's very easy to initiate the connection. You have presets for the different studio connections. If the operator should get into trouble, they can just press that simple live button on the side of the display; master control can take over and operate the link remotely. You don't need to send a two- or three-man crew. You don't need an engineer, and you don't necessarily need a camera operator. One person can set it up, frame the shot, and broadcast live, so you can send one person to cover the story.

This gives you the ability to broadcast live from virtually anywhere in the world for disasters, news, sports, and live events. Our customers invent new applications every day.

ASI Output and a Second Encoder

Two is always better than one. This applies to encoders when you are transmitting live from the field. All bonded cellular systems have an adaptive bit rate encoder that adjusts the video bit rate according to the available bit rate on the cellular and IP networks. Most providers will locally record the adaptive bit rate video for the record, store, and forward functions. Most customers want to record high-quality video at all times. A second encoder can be used to record high-quality, constant bit-rate 4:2:2 video for the record, store, and forward functions. You could argue the system is over engineered. A second contribution grade, 4:2:2 encoder similar to an Ericsson, Fujitsu or Ateme built in for free saves an additional cost of about \$15-20K and 1 rack space in your truck.

Many broadcasters will transmit live for breaking news stories. The high-quality version recorded with the second encoder is pushed near live using the store and forward functions. The production team will grab the live recording and use it as a proxy to start editing, adding graphics, etc. A few minutes after the live transmission, the high-quality version arrives in the receiver ready to finish the edits, which can be done 10-15 minutes behind the live transmission.

Fragmented MPEG4 Recording

Why is fragmented MPEG4 recording important? Most MPEG4 recorders require that the file or video stream finish recording before editing the file. Typically, the file sizes can be several Gigabytes in size, or minutes or hours in length. With fragmented MPEG4 recording, the files are recorded in smaller or fragmented chunks. This permits immediate use of the live and near-live recorded files. This can have a significant impact on production workflow, saving delays of minutes to hours getting produced content to air.



Cellular Network Diversity

The units will have multiple cellular modems. There are four major carriers (Verizon, AT&T, T-Mobile, and Sprint) here in the United States. You could have up to eight modems. Usually, what we'll do is have two from each of the major carriers. So we'll have two Verizon, two AT&T, two Sprint, and two T-Mobile. Ninety-nine percent of the time, Verizon and AT&T carry most of the load. You want the diversity. If there's a big crowd at a ball game, you'll be thankful. We've seen many situations where having two modems from Sprint or T-Mobile has saved the transmission. We recommend a system with eight cellular modems.

With two modems for each of the four carriers, you are always guaranteed transmission bandwidth. The beautiful thing about bonded cellular is if you only get 300 or 500 KB per second per modem, aggregated over eight modems you get two, three, and four MB per second easily. Broadcasters often get up to 15 MB per second back to master control with as little as 1.5 seconds of latency.

The system will adapt to changing network conditions. Urban environments like New York City and rural environments like Vermont each of these environments poses a unique set of challenges. The product is rock solid; it will adapt. If necessary, it will even drop down to SD mode. It will still show a 16x9 image. It will appear HD-like or have an HD aspect ratio.

Satellite, BGAN, LAN, and Wi-Fi

A few systems support up to two LAN connections, Wi-Fi, BGAN, and satellite. This provides up to 11 bonded IP transmission paths for your video, audio, and IFB live transmission.

Some systems have a tight integration with the BGAN systems. A common problem is the BGAN link is left connected after the cellular link stops transmission. This costs money! A system with better integration will disconnect the BGAN automatically when transmission stops.

Bonded Cellular Transmission Path

What happens is all 11 transmission paths are used to bond and stream the live video, audio, IFB, and telemetry through the cellular and IP networks, to the Internet, and then they're captured by a receiving appliance that sits in master control. Some basic systems can receive a live transmission from up to eight field units. They can output one or two live SDI signals and up to 16 IP outputs. Larger receiving appliances can receive 16 field units with four SDI outputs and 32 IP outputs. If you have reporters roaming around, you can switch live seamlessly between four cameras via SDI or 16 via IP.

IP Workflow Ready

All Broadcasters are planning or implementing an all IP workflow. ESPN is one of the first networks to have all IP routing for their master control. It makes sense to use a bonded cellular system that has been IP ready for over a year with multiple IP and SDI outputs. The AVIWEST DMNG StreamHub receiver can receive up to 16 DMNG PRO transmitters, DMNG Laptops, DMNG APP (iOS & Android) plus live video streams from other receivers. The AVIWEST receiver can simultaneously output up to 4 HD SDI, up to 32 IP outputs, and up to 16 IP inputs. It supports numerous protocols such as BONDING/SAFE-STREAMS, RTMP, RTSP, HLS, and TS/IP. The DMNG StreamHub receiver is incredibly powerful and IP ready maximizing your return on investment.

Extreme Examples of Bonded Cellular

Example 1:
There's got to be 50,000-plus fans at this rugby game in Hong Kong, and the system works flawlessly. The signal went out live.



Example 2:
This particular shot makes me laugh. If you notice the helicopter pilot here, he's about to fly the helicopter, and I think he's got flip flops or sandals on. You can see here they have quad antennas mounted vertically and horizontally to maximize their coverage as they're flying around. I'm not sure in this particular picture, but you could theoretically have one on each side of the aircraft. This operator, I'm sure he's strapped in; he's on the intercom. You see he's tethered to help him keep the camera steady. He's going to be broadcasting live from this helicopter using AVIWEST technology.



Example 3:

I'm sure there's no electricity right now where these guys are shooting. Who knows how many miles of water they had to wade through to get the interview. Thankfully, they're operating on low-voltage batteries, so there's a minimal risk of getting electrocuted. There's probably minimal to no cellular signal where they are. They're using the high-gain antenna on a pole, and they have a third operator just to hold that pole. He's holding the backpack there probably because if it were on the camera operator's back, it would be sitting in the water. I don't think there'd be any other way to get this interview out live. Certainly, a sat truck is not going to be able to wade through four feet of water. It just gives you an example that when there's no other way to get the story, our bonded cellular may be your only choice.



Example 4:

TV2 of Oslo, Norway, rented a bag from us here in Hollywood, and they were able to broadcast live from the Academy Awards — a distance of over 11,000 miles.

By using bonded cellular, we'll help you eliminate an expensive telecom circuit. We'll help you eliminate the need for an expensive sat truck, ENG van, and mobile production truck. Bonded cellular can cut your crew and talent down to one or two people. Many times the talent uses bonded cellular alone. This is not possible with a SNG or ENG truck.

Will Bonded Cellular Always Work?

One of the critiques of cellular years ago was, "Well, it's not going to work in a crowded stadium with 50,000 fans Instagramming with their cellphones." Yes, there are going to be those cases. No wireless technology is going to work 100% of the time. At VidOvation, we deploy many wireless systems, and I tell the end users that every technology has its limits. Let's say you're in the basement locker room trying to interview players after a basketball game, and the walls are reinforced concrete. You're not going to get much of a cellular signal. Now, if that shot is important to you, we could jump on to a Wi-Fi connection down there, use a distributed antenna system, or even hook a licensed mesh network to the cellular device. There are private LTE systems VidOvation can provide that create a private cellular network for your use only. There's always a solution to the problem. Hopefully, we can solve the problem within your budget. Sometimes there are solutions to the problem that are just too cost-prohibitive, or the pain isn't deep enough to warrant the expense of solving the problem.

AVIWEST's Bonded Cellular Video Transport

I'm sure most of you have heard of bonded cellular before. We started representing AVIWEST for the North American market about a year ago. We have demo and rental equipment available for folks that want to try the technology. We have offices in Southern California and New York. AVIWEST technology was used by a Norwegian broadcaster to broadcast live from the Red Carpet for the Academy Awards over a distance of 11,000 miles, with about 1.5 seconds of latency.

It just goes to show that there is no distance limitation for bonded cellular, assuming you're near or within a cellular network footprint. Of course, there are going to be areas in the world where there is no cellular, and we can hook to other IP connection such as LAN, WIFI, satellite, BGAN and more to supplement cellular.

AVIWEST is a very engineer-centric company. They have a large engineering team coming from the video, multimedia, and embedded electronics markets. They've worked at some of the major companies in the broadcast television industry, such as Thompson, Envivio, and Tandberg Television (Ericsson). They take product design very seriously.

They understand that just getting a crude connection is not enough. The picture has to look good. The picture can't break up. If there is a problem with the cellular network or the Internet, the unit will adapt and minimize the likelihood of any dropouts or other issues.

Dedicated Hardware

So what is at the heart of this device? As I mentioned, it's two encoders with one adapting in real time to the bonded cellular network. It looks at the bit rate and the latency. It's not only the bandwidth but the delay of the IP pipes that the device is watching and reacting to. The second encoder is used for recording and the ASI output. Some of the solutions out there now are a PC thrown in a backpack or suitcase. This is a dedicated piece of hardware with two hardware encoders and video processing. It's not a glorified computer, PC, or Linux box. It's dedicated hardware for live bonded cellular streaming.

Antenna Optimization

The patented, high gain, antennas are tuned for each of the frequencies, and transmission technology of the cellular carriers, whether it be CDMA or LTE. The internal antennas are optimized for that particular type of transmission, modulation and radio frequency. The VSWR (Voltage Standing Wave Ratio) is precision tuned to maximize best-in-class RF efficiencies. The antenna system compensates and is optimized for the operation of multiple cellular modems in close proximity. It's all state-of-the-art design. That's what sets this system apart, the antenna technology.

A common question we get is "Do I need to external Quad High Gain antennas for additional signal?" The answer is typical No. The external antennas are the same as the internal. The only time the two optional Quad antennas are needed is when you are transmitting from inside a vehicle or building. You want to place the antennas on the roof or outside using the screw or magnet mounts. The DMNG RACK 180 is a rack-mount version of the DMNG PRO transmitter. I can be installed inside a vehicle or in a flyaway rack. In either case, the DMNG RACK 180 has no internal antennas, so the two QUAD Antennas are required.



Modem Optimization

How do cellular modems work in close proximity? If I took eight iPhones® and taped them together in close proximity, how can the radios operate so close together? What is the magic? There's a coupling effect where one antenna affects the gain of another because of the proximity of the electromagnetic waves around the different antennas. They interfere with each other. However, through optimization, AVIWEST has overcome this drawback.

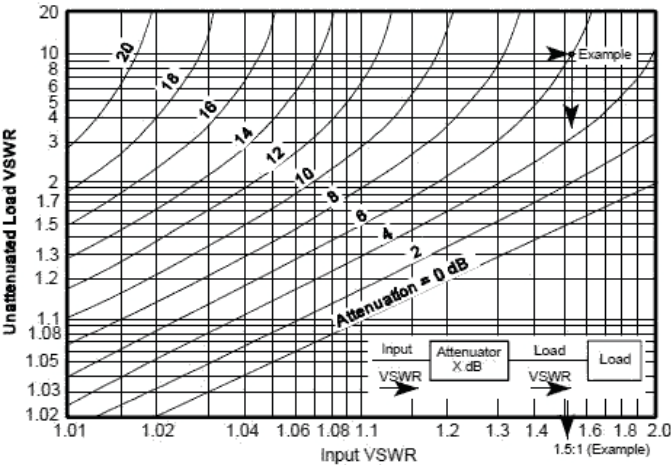


Figure 1. Reduction of VSWR by Attenuation

We have apps for live streaming on both Android™ and Apple® smartphones, and a new Mac® DMNG Laptop app. Then we also have rack-mount versions, which are great in a vehicle or building. Typically, you'll use an external antenna and put that on the roof of the vehicle or the roof of the building. We have all the different configurations and technology covered. We refer to the studio receiver appliance as the DMNG StreamHub. You can have up to 16 backpacks or transmitters or DMNG Pros transmitting simultaneously to a server appliance.

Then there is the DMNG StreamHub software. You can see the bandwidth and throughput of each modem individually and combined in real-time, and also display their performance over time. All of this sits in a DMNG Manager, which manages the whole ecosphere.

Integrated Color Display

The nice thing about AVIWEST is the full-color display on the side. You can control the unit remotely from your notebook or laptop, or you can just control it right from the touch interface on the side. You can pick which studio and which receiving device. It first checks whether you have a video connection. Then, it shows you the bit rate, starting out slow, ramping up, and capping out at your high bit rate.

Live, Store and Forward

Most people primarily stream with 1.5 seconds of delay or buffering. If there are issues with the cellular network, you can adjust the latency from 1.5 to 20 seconds. The device will output video live, but it can also auto record. It has an SD card so that you can record video internally. You can store and forward. If you're shooting an important segment, you might want to record while you're simultaneously broadcasting live. On the rare occasion the cellular network should die on you, you don't have to worry. When you finish your shot, move to a location where you have a cellular signal again and continue pushing the file.



Interruptible Foldback (IFB)

Some other players claim to have IFB and tally functionality, but I have never seen them work reliably. The AVIWEST tally interface and IFB work. The director and master control can talk to the camera operator and talent through the cellular device.

You can mount this in a backpack so the operator can wear it on their back, or use the iPhone remote app or Android app. The IFB is not like a group or a party line where the person who's transmitting from Bangladesh is hearing instructions going to the person in London. You can talk to each transmitter independently.

Ethernet Ports

You can see on the side of the unit that they're a couple of Ethernet ports. One could be used for hooking up a notebook computer to manage the device, or the internal Wi-Fi can be used to do this. You can also turn the device on as a hot spot, allowing reporters to use it to get on the Internet to write their story and get it out.

It's quite convenient. Some news agencies will use one device on the camera to get the video out, and if they need a lot of Internet connectivity on a campus or at an event, they'll have a second unit just set up as a hot spot. Or one device can be employed for multiple uses. Obviously, you're going to want to give the video connectivity priority to the bandwidth, so your setup will depend on what you're trying to do.

Test Signal Generator

There's a test signal generator built into the backpack. It's always a good idea to turn the link on first and see what kind of cellular coverage you have. The unit can be turned on and the test signal put through while the tripod is being set up or the camera is being prepared. This way master control can take control of the transmitter unit once the transmitter is on. The bandwidth and settings can be changed.

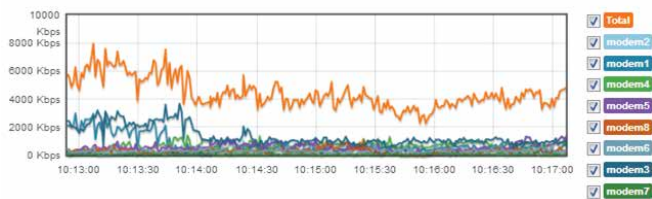
Error Correction Functionality

Another great feature is its elaborate forward error correction (FEC). The algorithm may be able to recover a lot of lost packets. However, actual packet loss is often pretty low, which means you don't have to worry too much about this in the first place.

In severe network situations the system will use Automatic Repeat reQuest (ARQ) for lost packets not recovered by FEC. In most circumstances the FEC automatically recovers lost packets.

Powerful Management Tools

The AVIWEST DMNG Manager is pretty cool. Master control can manage all of your assets and resources throughout the world. You have a Web page showing all your assets in table form, and a map to physically see where the backpacks are located via GPS. Master Control has geolocation, can monitor systems, and easily push firmware updates. It can even remotely shut the backpack down for the operator in case they forget to turn it off.



You can put your assets in different groups. For example, Disney could have an ABC group and an ESPN group. You could have different assets for your different networks, or you can designate different crews. Maybe you have crews out there with more than one backpack or transmitter each. DMNG Manager shows you the geolocation for this particular asset, the IP address that it's using, and that its status is live. Seeing the live status allows operators to hold off on firmware upgrades until a better time. The software can keep a history of what's happening. You're probably getting the idea that you can use this to manage your whole ecosystem here.

DMNG Manager provides increased flexibility. You can map a given stream to the Internet — to YouTube, Ustream, or a CDN — if you want to distribute the video not only to master control but to other locations or go directly to the Web without any post-production.

Safety & Compliance

When you use the device in a backpack, there's an RF shield since the operator will be wearing it on their back with cellular modems nearby. The AVIWEST team and VidOvation don't mess around; we take operator safety very seriously. You can see here that we not only comply with the FCC requirements but also with the European Union requirements.

If you have any questions about this, we'd be happy to provide you with the SAR Compliance statement from AVIWEST.

Conclusion

Flexibility is especially important today. As the number of available networks grows, broadcasters need to be prepared. Choosing a system that supports a wide range of networks, including 3G/4G cellular/wireless, Wi-Fi, Ethernet, and satellite, may be the optimal choice.

If bonded cellular is not right for you today, maybe we have something else that you need, or can help you somewhere down the road. If any of you are struggling with any video communication issues, we'd love to hear from you.

Thank you for reading!

[Click Here to request an AVIWEST Bonded Cellular demo.](#)

[See our bonded cellular unit here!](#)

