

GTX ULTRA-WIDEBAND TECHNOLOGY
Mitigating Risk and Improving Performance with
Next Generation of Wireless Microphones

Executive Summary

Alteros responds to the management and technical experts who are looking for information about how they can handle the difficult technology decisions and product investment choices in the highly volatile and hostile RF spectrum landscape.

Alteros, Inc. was formed in 2016 when Audio-Technica spun off the U.S. based R&D team forming a technology start-up company in order to better address the complex technical and operational needs of the high end broadcast, live, event and theater markets. This small flexible group of highly skilled engineers holds numerous technology patents, awards, and has over 60 combined years of direct successful experience working at high profile events such as the major awards shows, concerts including the world's largest tours, and national and global sporting events, and with some of the industry's most notable engineers and producers. The combination of world-class technical ability with extensive operational experience gives us a solid background from which to provide the best possible solutions to optimum performance and value.

On a strategic executive management level, Alteros suggests a three-fold approach to navigating this extremely volatile disruptive technology period of global wireless change.

- 1) Require all facilities and locations to run a **SPECTRUM STRESS TEST**. The stress test is simple – examine all current daily wireless needs (taking into account wireless microphones, comms, IFBs, IEMs, cameras) and evaluate the ability to meet those needs if the 600MHz spectrum were to become immediately unavailable. How does this facility or location perform under this stress? Start making plans now to address the results of this spectrum stress test in order to remain operational.
- 2) All new projects involving wireless gear should require a spectrum and technology plan to include: A “**wireless resource density study**” and an “**alternative spectrum requirements study**” that reference the results of the stress test. The **resource** study defines the number of wireless channels in operation within the current spectrum available for this use, compared to a projection of number of wireless channels needed in 3 years listing the spectrum projected available for use at that time. The **alternative** study lists a plan for alternative spectrum wireless products which will be put into place over time in order to address the increasing wireless channel counts or decreasing available spectrum as pointed out in the resource study. For example, if 50% of spectrum in use will be unavailable in 3 years, and wireless channel count remains the same, 50% alternative spectrum product must be put into place within the 3 year time-frame. The **alternative** study should specify the specific products and spectrum to be used, along with the potential risk to additional auctions or operational obstacles within the new spectrum. Wireless gear is a substantial investment. The purchase of new gear should take into account long-term operational security in order to maximize the return on investment.
- 3) All new projects should be undertaken in partnership with a solid wireless technical team. Some organizations are fortunate enough to have a team of highly-qualified digital RF engineers on staff. Maintaining this expertise is expensive and time-

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consuming. Traditional RF technical staff, although experts with legacy wireless gear, may not have the digital and coordination knowledge-base for operating effectively in the rapidly changing advanced technology spectrum. Organizations should either ensure up-to-date training with adequate staffing for digital technology implementations, or develop a working relationship with a technical team that can supplement, consult and train (if needed) existing personnel in the tools needed to address system set-up and operation in the new environments.

Alteros provides access to the team of highly skilled engineers who offer consultation on technologies and configurations, products, product development and sight-specific customization, typically at no charge other than the purchase of appropriate gear.

Our goal is not to replace all your existing product, but to protect your return on investment by developing a long-term operational path. We do believe legacy systems should be used as long as is practical, and understand it may be essential to utilize these systems for key situations or “money mics.” Eventually, the risk of interference and unreliable operation will determine when/how/or which wireless gear should be transitioned to alternative products. One of the most significant benefits of the Alteros GTX Wireless Microphone System is that when it is employed at a specific space, venue or event, it actually frees-up more than 7.2 MHz (more than a full TV station!) of spectrum which can be used to ensure continued operation of key/legacy wireless gear for as long as is operationally practical or legal. This advantage should not be overlooked. Obviously there are solid technical performance and features that make the GTX Wireless Microphone System a superior advanced technology product, but from a strategic management perspective, the ability to help keep existing gear operating as long as possible is an obvious financial benefit that no other carrier-based (traditional analog or even newer digital FM systems) wireless system on the market today can provide.

Regarding the actual product, Alteros’ first product offering is an alternative spectrum/alternative technology fully digital wireless microphone system which was designed for use in conjunction with a professional broadcast facility. After two years of in depth in-studio and field testing, we are in production and installing systems which meet (and in many cases far exceed) many of the high end broadcast, live/event production, and theater requirements. The products are in daily use, and are proven to be highly reliable.

The Alteros GTX wireless microphone system utilizes UWB technology (ultra wideband) operating at 6.5 GHz to transmit and receive wireless mic signals using proprietary IP that allows reliable professional audio performance in highly demanding environments. The system is fully digital from immediately after the microphone element throughout the system. There is no continuous carrier wave utilized, and this offers a very robust performance advantage in crowded spectrum/highly dense locations. There is no continuous wave to add or subtract with intermodulation by-products, or the products or waves of other carrier-based wireless communication devices. Our system operates with an FCC required limit of -41dBm output power. It is basically “invisible” and has no effect on other devices. Conversely, traditional

wireless devices do not operate on our frequency band and (whether analog or digital) will not have any effect on the GTX system. Other sources of interference (such as LED lighting or video walls) have no effect on the GTX system. The system is designed to be used studio-to-studio, floor-to-floor and building-to-building without any concern for frequency coordination or interference issues. To exemplify this point, we have demonstrated this system a number of times in studios, stages and/or outdoors in the highly crowded mid-town Manhattan environment. Each time, we were able to turn on the system to operate without any consideration for frequencies in use in the building or surrounding areas. The system simply turned on and worked. We did the same when the system was used at the U.S. Tennis Open in August/September of 2017. The system is simple to set-up and use, and it does not interfere with any other systems in use. This is the optimum system to use if there is a requirement to operate in densely populated RF environments, environments with a very high noise floor, and specifically the difficult environment of the largest urban areas. Our system is already proven to be entirely immune to any of the usual challenges of operating under these conditions – and it will never be affected by changes in those conditions (despite the fact that those conditions will continue to become more challenging).

The current system requires only 3 pieces to operate; as opposed to legacy wireless systems which require specialized antennas, filters, combiners, distribution amplifiers and expensive connecting cables. The GTX wireless mic system consists of a GTX3224 Main Control Unit, the GTX32 transceivers (integral receiver/antennas) and GTX24 belt-pack transmitters. The GTX32 transceivers connect back to the GTX3224 Main Control Unit via standard CAT-5 cable in a home-run configuration to define and cover the operating space. Connect transceivers to the main control unit, turn on transmitters and the system is ready to operate. No frequency coordination, license, database registration, STA or other permission is required or necessary.

The GTX3224 Main Control Unit provides many user control and interface functions, and processes all operation and outputs for the system. The GTX3224 provides multiple format digital audio outputs for use of up to 24 simultaneous transmitters per system. The GTX3224 offers MADI BNC outputs, either single mode or multi mode fiber, and DANTE with AES67. All outputs can be utilized concurrently, making it possible to send different format signals to different control rooms at the same time. Another important feature of the GTX3224 is an extremely robust construction which employs two fully independent IEC cable AC input power supplies. This allows the GTX3224 to be connected to independent power feeds within a facility or event if desired. The system will work via a single supply if desired. The redundant supplies are continued through the internal circuit construction so that any failures are limited or controlled in scope. The connections to GTX32 transceivers are modular (4 isolated groups of 8), and all audio outputs are individual PCB modules with separate power supply lines.

When setting up the GTX wireless mic system, each system can utilize up to 32 GTX32 transceivers to define and cover an “operating space.” Alteros realizes that the concept of using many antenna/receivers to cover a space is a rather new or foreign concept compared to the legacy/traditional wireless. For more information, see our separate document about the reasons and advantages of using multiple receiver/antennas to create a coverage mesh. Each GTX32

transceiver communicates control information to the wireless transmitters and receives and processes all 24 channels of audio transmission. Thus, reliability is greatly enhanced by an up-to-32-way diversity reception method.

Many settings require high channel counts. The GTX wireless system does not operate in a TV channel sense, and the 24 simultaneous channel system can be used over and over again in the same facility from studio-to-studio, or event location from space to space. With no frequency coordination or concern for any RF noise or other sources of wireless signals such as comms, IFBs, or other brands of wireless microphones in use, the system can be set up to use as many as 24 channels of transmitters simultaneous in each studio/space. This far exceeds the usual maximum channel count from an overall coordinated operational standpoint. However, it is only fair to point out that if utilized in the SAME immediate area, the maximum # of transmitters that can be used with the currently available system is 24. An additional band which will allow 24 additional mics (for a total of 48 channels in the same immediate area) is in process, and should be ready for sale in 2018. To be clear: for example if there are 8 studios in a facility, each studio can simultaneously operate up to 24 channels of GTX wireless microphones or 192 simultaneous transmitters operating in the facility without any concern for frequency coordination or interference. If there are multiple pop-up stages for a remote use setting, the stages may share the same system, or separate systems may be employed with spacing for simultaneous operation. Our team is available to help determine the best possible set-up.

The currently available transmitter for the GTX wireless system is the GTX24 beltpack which operates via two standard AA Alkaline batteries, with a 6 hour battery life. It is small and lightweight. An internally-mounted circularly polarized cross-dipole antenna eliminates the need for an inconvenient external (or whip) antenna. The transmitter has an operational duty-cycle of only 1.2%, so the beltpack never becomes warm. It may be placed directly against skin with no discomfort. In fact, due to the unique nature of the wireless method, the GTX24 beltpack can be used directly against any tradition analog or digital wireless transmitter with no concern for negative effects. Thus, there is no reason to require any transmitter output power adjustments. The Transmitter output power is defined by the FCC with a -41dBm limit. The beltpack transmitter has a standard LEMO connector and may be ordered in either a 2-wire or 3-wire configuration for use with many of the popular lavalier or headworn mics from various manufacturers. If using the system with the popular Audio-Technica lavalier microphone, the AT899 (in both black and tan color), an additional convenient feature is available. A momentary switch (non-latching) is located in-line along the microphone cable. When pressed, the switch directs audio to “off air” channels, redirecting audio output to MADI channels 25-48 (instead of on-air 1-24). If desired, these “talkback” channels can then be grouped in 10 different customizable groups via an powerful remote companion computer control platform. The switch also functions as a convenient “cough switch” for on-air talent.

For a rechargeable option, the beltpack battery compartment is designed specifically to accept traditional AA batteries as well as popular rechargeable (and longer life) AA batteries.

A handheld transmitter is also in development for early 2018. This transmitter will feature an industry-standard replaceable capsule mechanism so that popular industry microphone capsule

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preferences can be accommodated. The GTX handheld transmitter will also feature a talk-back function similar to the current GTX24 beltpack, and operates via 2 x AA batteries.

Virtual/remote interface and control is an essential function in today's environments. The GTX wireless microphone system has a powerful remote computer interface program which allows for all GTX3224 system information to be monitored or controlled, as well as offering a number of other unique operational and confidence logging features. The included computer software companion can be used to operate the GTX3224 Main Control Unit by remote, and the companion software allows for the set-up and configuration of both "talkback" groups and "cue" groups via the 56 available MADI channels. Besides set-up and configuration, the companion software also offers a number of set-up and debug modes that can be used to ensure that the system is operating at its peak effectiveness. System status and configuration is displayed and reported real-time. Each GTX32 transceiver which is connected to the GTX3224 Main Control Unit is monitored for optimum performance. Every CAT-5 cable connected to the GTX3224 is measured, and each cable length is reported on screen. The quality of service over the CAT-5 cable is continuously monitored and BER is reported. Should a cable begin to become unreliable (for example if a ground wire is becoming intermittent) the system will report and display a rising BER warning. The companion control software also allows for time-stamped logging of the full BER operation of every piece of gear used within the system for a full 31 days. Should some sort of negative audio "event" happen, a review of the time-stamped logger can show and determine the exact quality of performance for all pieces in use in the system. The companion remote interface software is currently accessed through an RS232 connection. The Ethernet connection functionality is already operational within the GTX3224 Main Control Unit and an ethernet-based, platform agnostic version of this interface software is in development. The features and function are fully operational in current form, and the new form, which will be available first quarter of 2018, will allow phone and tablet use as well as PC.

No project or product is complete without considering the set-up, training and support needed to ensure on-going operational integrity. Alteros feels that this is an area in which we have a unique ability. We are a small, flexible, and talented start-up team and our product is produced under our supervision either in San Jose, CA or Stow, OH. Every system that we sell will automatically include access to the actual product designers, not just application engineers or support personnel. The experts who invented this technology will make site visits to determine all operating needs and review the best possible configurations for each setting within the facility. We will attend the system install, and work with staff to ensure that all operation is as required, or we will make changes to the system and configuration to ensure success. As a small flexible/direct company, we have the ability to work with users to make certain each system is tailored to optimum fit and function. On our site visit and needs determination, we will include evaluation of existing wireless frequencies and devices and will work with you as a partner to recommend the best compatibility for the entire system. We will train staff in the use and many features of the system, and we will provide on-going direct support for the life of the product. Continuous improvement firmware upgrades will always be available free-of-charge. Alteros' goal with all customers is to become a technology partner so we can help accomplish the best possible RF operation even in very challenging/changing environments.

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With this goal in mind, in addition to discussing system features and essential deliverables, Alteros would like to point out that although it would be wonderful for every studio, every facility, or every event to operate using the GTX wireless microphone system, this is not something we expect or even recommend. The days when a single wireless system solves all problems or addresses all needs are gone. All professionals should be planning to use multiple wireless methods and products in order to provide for operational security and quality into the future. The GTX wireless microphone system has a number of features that none other can claim. However, perhaps the key feature of this system is the ability of a system in use to actually CLEAN UP the RF noise floor in a facility. Every GTX wireless channel deployed removes 300-400MHz of spectrum (depending upon how simultaneous channels are managed and coordinated) from on-site RF noise floor and coordination. The GTX wireless mic system may not be the most ideal system for long-range outdoor use (although it can be configured to do so, and the system does have FCC approval for outdoor use), but using it will also help to “protect” the ability to carry-out that long-range outdoor use with other systems. It may be such a new technology that key talent/producers would prefer to keep the most critical applications/talent on more traditional wireless. This is understandable. By employing some channels of GTX wireless microphone system within a facility or location, the scarce RF available for highly critical applications is PROTECTED. And, as spectrum becomes more and more scarce or densification raises the RF noise floor higher and higher, utilizing some channels of GTX wireless microphones within a facility or location will help to keep those traditional systems operating as long as possible. It is a win-win situation.

Features which may be useful for enhanced performance, and which serve to even further differentiate our product from traditional wireless include the following:

The ability to set a “System ID” to limit the locations in which a GTX24 transmitter can operate. This function was specifically requested by a broadcaster in order to prevent accidental transmitter interference on the occasion when talent walks from one location to another. Each GTX24 transmitter can be assigned a “System ID” which defines the location it will be allowed to transmit. A GTX24 transmitter only receives permission to transmit when its System ID matches the System ID of the corresponding GTX3224 Main Control Unit. Thus, even if a transmitter is left on, and talent walks into another studio or location, their transmitter will not turn on and transmit. This ID-based “tether” system allows free-wandering protection against transmitters left on.

The ability to play a steady-state 1kHz test tone via the GTX24 beltpack transmitter is an especially useful feature. When the system is set to “test mode” (via the GTX3224 Main Control Unit touch screen application) the GTX24 transmitters will transmit a continuous 1kHz sine wave tone as long as they are linked via a full-round trip to the system. This makes talk-out/walking-out a space to confirm coverage especially reliable. The steady state tone is a much more reliable method than speech in which there can be very brief and un-heard breaks. If a steady state tone is confirmed for coverage in an area, the user then has the added assurance that all 24 GTX24 transmitters will work exactly the same in this space. This is an unprecedented

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difference from traditional legacy wireless systems. Even if one legacy transmitter walks out (talks out) as reliable in a space, a second, third, or fourth may not. And, if there are four solidly-working legacy wireless systems in a particular space and an addition transmitter (or more) is desired – the entire coverage and connectivity may be changed. Commissioning must be done frequently and repeatedly with any analog or digital wireless system that utilizes a continuous carrier wave. With the GTX wireless microphone system, if one GTX24 transmitter works in a space, all 24 will always work in that space. More can be added at any time with no change in set-up and no change in performance reliability.

The ability to set a user-defined battery life warning level allows for customized warnings (the battery level light changes from black to red) based upon the user entering the desired minutes left for operation.

The ability to sync to either Blackburst, Word Clock, or DANTE master to a house clock system, with that sync extending all the way to the over-the-air transmitters' signals. No more pre-show "clap test" is required. When the main control unit is synced to house, the GTX24 beltpacks will also be synced within 1ppm precision. If no house clock is available, a high precision internal system clock will maintain free-running system synchronization.

An instrument version of the GTX24 beltpack transmitter is currently in Beta Testing. It is available in early 2018, and offers extremely low-noise, compander-free, low latency, full frequency response performance.

The GTX wireless system offer very flexible set-up, zoning and redundancy. Each GTX3224 Main Control Unit can operate up to 32 GTX32 transceivers and 24 GTX24 transmitters. This means that a single GTX3224 Main Control Unit may be used to cover the coordination needs of more than one location (as long as the location remains within the 1,000 ft range of the CAT-5 cable connection to GTX32s), or more simply put, the GTX3224 can run multiple studios or locations.

In addition to dual power supplies and modular construction, reliability and redundancy are very important in the professional broadcast environment. Alteros also offers switches and accompanying software which can be used to connect GTX systems for either facility or location-wide zoning, or which can be connected in order to act as immediate fail-over redundancy for GTX3224 Main Control Units. Each switch handles 8 channels of audio or GTX32 transceivers (depending on set-up). The switches are the SWX8 passive switching and the SWX8C switching with control, and multiple switches can be employed.

Many configurations are now utilizing fiber transport. A fiber-break out system will be available in 2018 which will then allow the deploying of the GTX system over any size or complexity of location.

The GTX3224 Main Control Unit features a local (at control unit) headphone amplifier with gain control for quick and easy monitoring during set-up.

Alteros sincerely hopes that this executive summary and the information that follows will help explain the GTX Wireless Microphone System, and encourage the adoption of this solution which so strongly offsets spectrum risk. We look forward to further discussions, additional questions, and the opportunity to work with our customers on a continuous basis to help modernize and improve wireless microphone operations not just for the next few years, but in an on-going successful partnership in which our wireless and technical experts can be consulted to solve even yet unforeseen operational challenges. Although we are proud of our “box” – the wireless system we have developed – we feel we also offer a unique value: access to a partnership with the technical team of wireless experts who saw the future of spectrum and made UWB a viable wireless technology for professional applications. We won’t stop there. We will continue to develop new and improved solutions through our evolutionary/revolutionary development cycles in order to keep our customers in the forefront no matter how spectrum or technology changes.