Physical Considerations When Buying a Transmitter

The Physical Trade-Offs of Small vs. Tall Transmitters and Rack-Mountable vs. Self-Standing Integrated Racks

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INTRODUCTION

While a lot of focus is spent on comparing specifications, performance and efficiency when buying a new transmitter, there are many physical attributes of modern transmitter design that also deserve consideration. Much of this may be common sense, but it doesn't hurt to take a moment to review the physical trade-offs of small vs. tall transmitters and rack-mountable vs. self-standing integrated racks.

ERGONOMICS AND SAFETY CONSIDERATIONS

What is the weight of the rack-mountable transmitter? Does it imply that two or even three people may be needed to lift the system safely in to and out of the rack? Are those people always readily available? If it's on the heavy side, does the rack-mountable transmitter come with slide rails? Can slide rails be easily installed? Does the transmitter's weight compromise safety and rack-tipping considerations? What cabling accommodations are necessary to allow for easy sliding in and out?

The good thing about a self-standing, integrated transmitter is that once you have it in place it rarely needs to be moved. However, it is still important to consider the weight of the more commonly-removed components such as power modules. Can these components be safely lifted in and out of the transmitter? Are the commonly-removed components located high or low? Does the transmitter door have adequate space to swing open fully? Do you have adequate room to easily access the back panels?

You'll also want to consider the ease of access to controls on both rack-mounted and self-standing, integrated transmitters. Are the controls and displays located near eye level or might you be reaching up or stooping low? If it's a rack-mountable system, can the screen and controls be placed high enough without compromising safety and creating an easily tipped rack?

HEAT LOAD AND VENTILATION CONSIDERATIONS

Consider heat load and ventilation, as well as intake and exhaust paths. Even though rack-mountable transmitters are designed for rack mounting, you should still consider the other components in the rack and the significance of their radiated and exhausted heat (i.e. what is being dumped into the shared rack) to ensure the ambient temperature for the transmitter is maintained within specification.

Specified rack units (RU) may not factor in the required blank space above and below the unit, which effectively adds to the total RU of the transmitter; ensure you have the required space. It may be necessary to purchase open-frame vs. closed racks in order to aid in cooling; something that should be known in advance of receiving the equipment as a new rack may have to be purchased. Existing racks may already have doors on the front or rear, with locks required for security; ensure adequate cooling can be achieved.

Self-standing integrated transmitters tend to have defined ventilation paths with heat load and proper de-rating already factored into the design. These types of transmitters are typically easier to adapt to intake and exhaust ducting; whereas ducting for rack mount units (assuming the heat load must be ventilated out of the room) tend to impede access, so a common ventilation system would be required for the entire room.

INSTALLATION CONSIDERATIONS

How easy will it be to move a self-standing, integrated transmitter in to the facility? For example, you'll want to consider the transmitter's weight, the door widths of the facility and transmitter room, turning space, etc.

Regardless of rack-mounted items or standalone systems, an allowance has to be made in calculating door openings to accommodate the equipment in its packaging. A standalone system may be several inches larger in all dimensions than the final physical dimensions, due to the need to have it crated for shipment. Will the system need to be uncrated in order to get it in most doors?

After putting the transmitter in place, you'll want to consider other installation elements like connections. Will there be heavy coax hanging off a rear RF output connector? How accessible are the remote interface connections? Are the remote connections terminal blocks or harder to wire D connectors? How accessible are the AC terminal blocks or input connectors?

In the case of a rack-mountable transmitter consisting of several units connected or combined together, how complex is the wiring between the units? Could this complexity lead to future potential points of failure via loose or defective connectors, especially in the case of RF connections which may be prior to protection circuitry? How easy will it be to ground the system for proper lightning protection? Are ferrites provided for surge protection on AC, RF, remote and audio wiring entry points? Or are they provided separately for customer installation, or not provided at all?

MAINTENANCE AND SUPPORT CONSIDERATIONS

Can maintenance be easily performed while the transmitter is in the rack? If not, have you allowed for a work area close by? How easy is it to access the parts that fail more often like fans or blowers? Similarly, how easy is it to clean the air filter, if there

even is one? Can maintenance be accomplished while on the air via hot swappable components? While there are some exceptions, this is where a self-standing, integrated transmitter can have a big advantage over a rack-mountable system.

How easily can you access components? In the best case, you simply slide out a downed component. Worst case, you might require two staff to remove a heavy unit from a rack and transport it to a work bench, and then remove bottom covers and multiple boards, wire harnesses and components to reach the failed item.

When considering manufacturer support, what might you need to return to the factory or service centre? Is it just a module or might you need to return the whole transmitter for service.

TOTAL COST OF OWNERSHIP CONSIDERATIONS

While the basic purchase price of a rack-mountable transmitter can be much less than an integrated system, don't forget to factor in the funds for a quality rack and rails if these are not currently available in your facility. Also, there's a significant difference between the basic purchase price of a transmitter and its long-term cost.

Ensure that your maintenance needs are going to be met by your chosen system and that the long-term maintenance costs are factored in to the total cost of ownership. The initial savings of a compact, rack-mountable transmitter could become insignificant when compared to potential off-air costs and more complex maintenance.

TRANSMITTER WEIGHT CONSIDERATIONS

Although the technology exists to make a 5 kW and even 10 kW FM transmitter in a rack-mountable format, they typically weigh 100-200lbs and over. That is a major consideration if the transmitter needs to be pulled in and out of the rack for service.

General occupational health and safety guidelines would suggest these designs are too heavy to lift comfortably. For example, the maximum weight allowed for your airline baggage is 70lbs. Nautel engineers have designed our rack-mountable transmitters to be lifted comfortably; for example the VS300 is just 23lbs, the VS 2.5 kW is 65lbs and the J1000, 1 kW transmitter is only 50lbs.

EASE OF ACCESS FOR MAINTENANCE

To make our rack-mountable transmitters even easier to maneuver and access, the J1000 transmitter weight of 50lbs is split between two boxes, and the VS2.5 transmitter is shipped with slides that when correctly installed give easy access to components without removal from the rack.

RELIABILITY CONSIDERATIONS

Squeezing a lot of components and power in to a small box presents challenges in keeping everything cool. To achieve minimum design enclosure size, many manufacturers are forced to configure fans in the pull mode at the air exhaust position. While this may seem innocent enough, it means that air is heated by first passing over hot circuitry before flowing through the fans.

Hot air in a fan increases the fan failure rate since a fan's bearing life is related to the temperature of the air flowing through the fan. Contrast this with the Nautel design philosophy which is to ensure that fans are utilized in push mode so only cool air passes over the fan bearings. The result is optimal fan life, fewer fan repairs, and greater transmitter reliability. Nautel designs also address filter placement such that you can change filters without taking the transmitter off the air.

REDUNDANCY AND HOT-SWAP MODULES

A key trade-off between compact rack mount designs and tall self-standing rack systems is the impact on redundancy and hot-swap modules. A transmitter designer needs mechanical space to build-in redundancy and hot-swap-ability. Rack-mountable transmitters tend to not have "hot-swappable" power components (i.e. those components that are more likely to fail) as access to those components is quite restricted while mounted in the rack. It's a good idea to investigate and understand which components are "hot-swappable" prior to your purchase.

Self-standing integrated racks have more flexibility in their design to house redundant RF modules and power supplies. Consider Nautel's NV10LT transmitter. It houses four parallel RF power modules, easily accessible for removal in the event of a failure, without taking the transmitter off-air for servicing. Each of those RF modules has four parallel RF power amplifiers. The transmitter also has eight power supplies (two per RF module) that are easily hot-swappable. These parallel devices provide the advantage of soft-failure. Soft-failure means that components can fail, but rather than go off air the transmitter either fully accommodates for the loss of these redundant components or stays on the air at partially reduced power.

Small rack-mount boxes tend to compromise on redundancy, as there is typically not enough space to accommodate two of everything. That is why Nautel focuses on applying redundancy where needed; on RF power amplifiers and critical power supplies. Even the compact VS2.5 has four parallel power amplifiers and three parallel power supplies.

CONCLUSION

Over four decades of experience and listening to our customers has shaped the design of Nautel's transmitters. From an engineering standpoint, we not only consider the basics of size and weight, but also critical quality elements like reliability, robustness, high-operating efficiencies, and built-in redundancy. And from the customer's perspective, we know that while some prefer small, compact transmitters others place a higher value on having plenty of room to access the inside of the transmitter for easy maintenance.

So just when does it make sense to build a rack-mountable transmitter versus a self-standing, integrated-rack transmitter?

At Nautel, we think rack-mountable makes sense when the transmitter can be designed to weigh less than 80-100lbs (36-45kg) and when hot-swap maintenance is less of a consideration.