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Trends in Transmitters 2022

Things to think about when buying your next one

Paul McLane
Editor in Chief

It's one of the most important (and exciting) decisions a radio engineer or technology manager can make: buying that transmitter.

Even with all the attention given nowadays to new streaming and online platforms, your OTA signal remains crucial.

What trends and recent developments should you know about to make an informed decision? What features, access, control and security considerations should you weigh? We asked executives from our manufacturing sponsors Broadcast Electronics, GatesAir, Nautel, Rohde & Schwarz and WorldCast Systems.

What considerations do experienced users take into account when doing their research and making their buying decisions? We asked veteran users Rob Bertrand, Andy Gunn, Mark Persons, Cris Alexander, Mike Cooney, Buc Fitch, Mike Martin, Greg Dahl and Don Stevenson.

This is the 90th ebook in our series that began in 2012. You can find all recent editions at *radioworld.com/ebooks*. Is there a topic you'd like to see us explore? Drop me an email at *radioworld@futurenet.com*.

THIS ISSUE

Above
Andy Gunn and Rob Bertrand

What is your highest value proposition?

Engineers at WAMU steer investments to where they'll do the most good

WAMU 88.5 American University Radio is "Washington's NPR station." Rob Bertrand is senior director of technology. Andy Gunn is director of engineering.

When you are considering a transmitter purchase, what is your approach?

Rob Bertrand: One of the biggest considerations is asking, how will this improve our overall efficiency as a business. There are technical answers — considerations around power efficiency or cooling requirements — but I'm also interested to know what support will be like.

Will this transmitter require less time to maintain than its predecessor? And when evaluating brands, what features might make maintenance simpler or more complex?

We recently rebuilt the full main and aux transmitter facilities at WAMU. Our goal was to minimize the amount of time someone needed to regularly have "face time" with the transmitters.

We deployed good old-fashioned GPIO control and status monitoring with our remote control systems, but we also integrated rich data via SNMP from our transmitters. This way we get the best of both worlds: the reliability and consistency of GPIO that is rarely disrupted with a software update or configuration change, and the additional visibility brought through SNMP monitoring.

We invested in redundant air chains of audio and support equipment, as well as redundant exciters for each transmitter. The goal was that we could suffer a failure anywhere in the plant and still have an operational transmitter. With liquid cooling and electrostatic filters on our HVAC systems, even filter maintenance is reduced.

While we do make regular visits, the goal was delivering a facility that if other objectives kept us away for some time, the site would keep on ticking even without regular intervention.

Andy Gunn: Time is always my limiting factor — time to perform routine maintenance, work on new projects or respond to issues as they come up. I'm most interested in building systems that will save me time in the long run — reduced maintenance time or shorter time to repair or bypass in the event of a failure — even if the initial installation or setup takes a few days longer.

The availability of parts and the stability of the manufacturer are major considerations. How would you obtain replacement parts? Does the manufacturer have a parts depot nearby or close to a shipping hub? Do they have a service center nearby?

Modern transmitters have similar feature sets — high efficiency, support for all HD modes and power levels, hot-swappable modules, and detailed telemetry and monitoring. The form factor, cooling and build quality can vary, though all the transmitters above 10 kW that I have worked with in the past 15 years have had very good build quality.

RW For someone who hasn't purchased a transmitter in some time, what recent developments should they know about?

Bertrand: I really think that above a certain power level, liquid cooling is a game-changer.

When I arrived at WAMU in 2016 I inherited a plant that, for several reasons, was supposed to be temporary. The transmitter, a wonderful modern model, was oversized for the air conditioning in the room, which had long outlived its own useful life. So the compressors never shut down and, as you might imagine, they failed altogether sporadically because they never stopped running.

This would create a vicious cycle where the emergency exhaust fan would then kick in, you get the picture. On a hot July day in Washington, this was not a good situation.

Being part of American University, my colleagues in central plant dutifully engaged an engineering firm to design a replacement HVAC system for us. Our cooling requirements far exceeded what a pair of split systems could deliver, particularly when factoring additional solar load, so the only choice was to go to a package system.

When all was said and done, I was left with the choice to spend nearly the same amount on a properly sized package-type HVAC system, or I could install a new liquid-cooled transmitter and kick the HVAC replacement down the road a few years.

I installed the liquid-cooled transmitter, and our problems went away literally overnight. Our power consumption dropped dramatically, and our stability increased significantly. The emergency notifications from the monitoring systems — or worse the actual power dips on the air that we were dealing with when I got here — evaporated.

Gunn: Modern transmitters contain a huge wealth of monitoring points — to the point where it may be overwhelming to decide what to monitor. While your main transmitter functions and alarms should always be tied into your remote control with physical GPIO wiring, having the rest of your transmitter data available via SNMP can be a boon to observing trends or catching early warning signs of a problem. While a summary alarm may let you know that there is a problem with the transmitter, having that additional data can let you know whether it was a small issue, or a major one.

I recommend spending time going through the transmitter's own interface to find the most critical data points — for example, cooling loop pump flow rate, loop pressure, cooling fan speed, etc. These can be vital when troubleshooting an issue that a single "Major Alarm" cannot.

The flip side is that you need a sufficiently powerful and advanced remote control system to handle the number of data points from GPIO and SNMP that your transmitter and other site systems have available. While it may seem fine to skimp on the physical GPIO interfaces, I trust a pair of wires more than SNMP, which is reliant on outside network systems as well.

If you're planning on getting a new transmitter but have a very old or very simple remote control system, I recommend upgrading this and planning out new wiring and break-out cables for ease of maintenance. Your future self, or engineers that inherit your site, will thank you.

RW We hear a great deal about virtualization of the air chain. What are the implications for how transmitters are designed and how users will choose and configure them?

Bertrand: My knee-jerk reaction is that I really don't want to see transmitter manufacturers getting into this business. Transmitter technology evolves slowly, while the IP-based technology used to deliver this kind of content evolves quite rapidly. The last thing I would want to have to worry about is marrying rapidly evolving (and somewhat

> **"We get the best of both worlds: the reliability and consistency of GPIO ... and the additional visibility brought through SNMP monitoring."**

> **How would you obtain replacement parts? Does the manufacturer have a parts depot nearby or close to a shipping hub? Do they have a service center nearby?**

prototypical) needs with the more stable and slower-shifting transmitter market.

Whatever solutions are chosen to deliver cloud-based air chains to the transmitter plant should remain separate and apart from the transmitter itself.

It's likely that if you are large enough to warrant leveraging this delivery mechanism, you are also going to want to leverage identical monitoring and control systems across your sites. Very few companies are in the position of being able to replace that architecture and their transmitters at a given site simultaneously.

It's an important trend but I think it should evolve and mature outside the world of transmitter hardware.

Gunn: I don't see this as being particularly helpful in a transmission chain outside of audio processing in an AoIP environment. Even there, I would be hesitant to have any virtualized systems in my main air chain. While most high-end audio processors are simply software appliances, the ability to physically bypass and produce a stable composite signal for the analog FM portion of a transmitter is too valuable to virtualize away.

However, as streaming and on-demand listening grow in market share for stations, there may be opportunities for virtualization in the processing and delivery systems at a station. If the virtualized systems can utilize AoIP, the transition here would make sense.

How do consumer trends and new platforms like smart speakers, apps and voice-controlled car infotainment systems affect how a manager should plan a transmitter purchase, if at all?

Bertrand: I think the strategy should start at a place of clearly identifying the places where we are delivering our greatest value and steer our investments accordingly.

Since I've been at WAMU, we have divested five FM signals over five years. As someone who loves over-the-air broadcasting this has been somewhat painful. However, as we looked at the audience and revenues associated with these repeater stations, it just wasn't defensible.

It will be different in different areas of the country; geography and internet availability means that similar FM networks still make sense in certain places. But in the Washington, D.C., region, our data showed us that it was really only our primary signal that was delivering meaningful audience.

[These changes] resulted in minimal revenue drop and near-zero audience drop. We lost those big recurring expenses, and we took the capital from those station sales and reinvested it into our primary and backup facilities for D.C. — buying four new top-tier transmitters, building a new FM combiner and antenna system, and making critical infrastructure investments to our facility there.

In terms of the digital side, this has also enabled us to direct more investment to those operations. We require fewer engineering hours to maintain such a complex and far-flung set of transmitters, so our engineering team is better able to focus on supporting content production in-house, making sure that our studio facilities can produce all the products we're growing, and that our streaming architecture is receiving the same level of attention as our RF infrastructure.

We've done all that without reducing staff, and also without adding engineering staff. We are just spending our time differently.

So as a station is thinking about how to handle transmitter purchases — I think it should be done carefully and with consideration for the highest value proposition.

What other questions should transmitter buyers be asking?

Gunn: What does a manufacturer's full on-site commissioning package offer, and what does it cost?

If you are not familiar with liquid cooling or need help preparing your site for a new transmitter, what can the manufacturer offer you to help?

These days broadcast engineers are expected to handle more and more of a station or group's technical needs, but have extremely limited time. Being able to lean on the manufacturer for help with the hands-on installation, setup and testing of the transmitter can be a big relief. It can change a two-week process into one week, or even just a few days. Having a site visit by a technician or installer in advance can also help resolve any issues that will be roadblocks to a smooth installation.

We all pride ourselves on our ability to learn new systems and be able to do it all ourselves, but there is something to be said for spending a bit of money to save a lot of time and have the peace of mind of working with someone who has done it before. You might learn a few things along the way.

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Commissioning is far more efficient today

Welton says test and setup have benefited from manufacturing efficiencies

Jeff Welton is Central Region sales manager for Nautel. He was the 2020 recipient of the NAB Radio Engineering Achievement Award.

For someone who hasn't purchased a transmitter in four or five years (or more), what should they know? What are recent developments in how transmitters are designed?

Jeff Welton: We created an ebook for general and engineering managers that addresses what we consider to be the top nine issues involved and includes questions that should be addressed during the preparation process. It can be downloaded at our website.

A lot of the design and manufacture is based on reducing costs by eliminating manual intervention as much as possible. If we can have a test technician connect a transmitter to a computer, perform the initial power-up tests and measurements and then let the computer take over for the proofs and functional testing, the results will be more consistent and repeatable than if they were done by hand.

Consider parallax when reading analog meters, for example — two different sets of eyes could get two different readings from the exact same meter.

This frees the technician up to handle other tasks and provides a higher-quality result.

A consequence, though, is that part of the setup procedure will be to tell the transmitter what power level and frequency are required. Really, that's a good portion of the entire procedure — these days, while not true for all manufacturers, most Nautel gear is shipped fully assembled, so the user simply needs to connect AC, connect the RF feedline, connect any remote control and audio wiring, then apply power. The transmitter will ask what frequency, what power level and what audio source.

At that point, although additional configuration can be done, it could be put on air and be ready to roll within a few hours of taking it out of the crate. This is a big change from the days when it took three days with a factory tech on site to run through assembly and commissioning.

> **A lot of the design and manufacture is based on reducing costs by eliminating manual intervention as much as possible.**

Virtualization of the broadcast air chain has been in the news. What are the implications?

Welton: We've done some work with Telos Alliance on this, and it is still an evolution. However, one of the big factors I see as a future likelihood is that a lot of features that have traditionally been outboard could be virtualized and packaged directly into the transmitter.

We're already seeing this to some extent with RDS generators and the like being made part of the transmitter control system. Going forward, it wouldn't be surprising to see situations where you could purchase a software license for your favourite processor, automation system or even control surface, virtualize it and install it directly into the transmitter controller, accessing it over IP and reducing the additional pieces of hardware that could be potential failure points.

As a result, some attention will need to be paid to whether or not your transmitter has the capability to either handle this sort of thing from the onset, or has the hooks or capability to be upgraded to accommodate it. Definitely having the processing power to handle some level of virtualization under the hood can add a significant amount of flexibility in how you configure your operation.

Hybrid radio platforms are becoming part of the landscape. What do transmitter buyers need to know?

Welton: The biggest thing will be RDS. Having it properly configured is going to be critical in a hybrid scenario, and reports are that stations with their RDS configured properly are by far in the minority.

We covered this in one of my TTT (Transmission Talk Tuesday) sessions a few months ago. We had David Layer,

VP of advanced engineering for NAB, as well as Lawrence Galkoff, general manager of Radioplayer Worldwide, and there was a lot of information exchanged on how proper RDS configuration will impact how your station appears on a hybrid radio receiver — or if it appears at all.

Have supply chain issues affected you as a manufacturer?

Welton: Absolutely they have. Longer lead times on components, components being rationed by their OEMs or the host countries, logistics challenges with moving parts or assemblies from point A to point B, they all play a part in how we do our jobs.

We've been fortunate to have leadership that has been quite proactive in getting ahead of these issues. So, while a transmitter that might have gone out the door six to eight weeks after receipt of order a year or two ago can now take 10 to 12 weeks in some cases, we're still getting the job done. We've invested a lot of time, money and resources into finding alternate sources, building stock where possible and working with our suppliers and our freight forwarders to keep lines of communication open, especially if it looks like there's about to be any sort of disruption.

MDCL has been allowed in the United States for some time. What should engineers know about it that isn't already widely known?

Welton: One of the big things is that the more aggressively you process the signal, the more impact the MDCL algorithms will have on the power bill, specifically the Amplitude Modulation Companding algorithm.

Essentially, AMC reduces peak power on modulation peaks, so the higher/longer these peaks are, the more compression is employed. So, in a nutshell, the harder you drive it, the more it drops the power bill.

Now, I'm not advocating half a dB of dynamic range and compressing all intelligibility out of the signal, but certainly it is something that might indicate a need for a conversation with your processor guru.

Beyond that, the technology has more than enough hours behind it now to have verified repeatedly that it makes a very significant difference in the power bill with little to no negative impact on the received signal. Certainly if you're running an AM station, especially at 5 kW or bigger, it's something that should be considered quite carefully.

What misconceptions do many people have about transmitters?

Welton: The biggest one is probably "we can't afford it." While that may be the case in some situations, in many it's more a case of not being able to afford not to.

Rather than focusing on the upfront price tag, which certainly can be frightening at times, it's a really good idea to look at the whole picture. As an example, a grounded grid tube-type FM transmitter has a nominal overall (AC to RF) efficiency of 50%, compared to upwards of 70% for a current solid-state transmitter. That means a minimum 30% decrease in the power bill, month to month. While it usually won't cover loan payments, that power savings will decrease the impact of a new transmitter purchase significantly and, once the loan is paid off that's money going into the bank every month.

Factor in higher tube costs and some challenges with decreasing life span in replacements, as well as the engineering costs involved with replacement and ongoing management, then it becomes even more significant.

Sometimes, certainly, you can't afford it. But again, sometimes you can't afford not to. We have a handy cost of operation calculator available on the Nautel website.

Above
Jeff Welton

Don't confuse PA with overall efficiency

The latter is a better gauge when shopping, says Mark Persons

Mark Persons is a longtime radio contract engineer who built 12 new commercial AM and FM stations for clients, and rebuilt or upgraded many others in the course of his career. Now retired, he received the Society of Broadcast Engineers John H. Battison Award for Lifetime Achievement in 2020.

What's your overall philosophy or approach?
Mark Persons: The transmitter needs to fit all criteria including, in the case of an AM transmitter, the ability to go to some very low power level for night operation. Not all transmitter designs can do that. Don't get surprised on this one after the fact.

What are the most important recent developments in how they are designed, and what do you wish manufacturers would do differently?
Persons: Transmitter remote control via the internet is a big plus nowadays. Also, a transmitter with a Smith Chart display showing antenna bandwidth is great for troubleshooting.

Any and all manufacturers should have a 24-hour hotline to call when problems develop.

Right
Mark Persons

How can a manager best calculate what it will cost to operate a transmitter over time?
Persons: A transmitter salesman should provide operating cost information for existing and new transmitters. The numbers should be passed by a knowledgeable radio engineer to verify the thinking is correct.

The concept of efficiency is often discussed, but many managers may not understand what it represents. Why does it matter?
Persons: Don't confuse power amplifier efficiency with overall efficiency. PA efficiency involves just the final stage of a transmitter. It was typically 70% in the days of tube transmitter designs. Today it is in the 90% plus range for solid-state transmitter designs and should not be used as a deciding factor when comparing transmitters.

Overall efficiency is what I look for. Define that as AC electrical utility power in watts going to a transmitter compared to RF power in watts of output going to the antenna. The difference is waste heat/heat load in a transmitter building. Then think about air conditioning costs for the difference in transmitter overall efficiencies model vs. model.

Is availability of parts for legacy transmitters that are still in service a serious problem in our industry? What could be done about it?
Persons: Remind transmitter manufacturers and/or transmitter salespeople when you've had problems getting parts or even factory advice for an older transmitter. As a result, you are purchasing from a company that still offers service for older models. That vintage unit might be a backup transmitter that needs to be available for service for a long time to come.

What should engineers know about effective use of MDCL, that isn't known as widely as it should be?
Persons: MDCL can provide a power savings, but sometimes at the price of reduced audio fidelity. Some hear it and some don't. Setting the right level of MDCL is like adjusting audio processing for the right sound compromises. It can be good or bad.

In countries like the United States, AM radio is considered a very challenged industry. Has the market for new AM transmitter purchases basically dried up?
Persons: AM transmitters are still being sold to keep viable AM stations on the air. Moving from a tube transmitter to a solid-state transmitter is a great choice for keeping operating costs down. That includes maintenance and power.

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Above
GatesAir Flexiva transmitter.

Top Right
Ted Lantz

Below
Intraplex IP Link100e, an AoIP module that integrates into Flexiva transmitters.

Total cost of ownership is a key consideration

Lantz says also look for a high level of redundancy

Ted Lantz is vice president, product line management at GatesAir.

What are the most important recent developments in how transmitters are designed and manufactured?

Ted Lantz: Total Cost of Ownership or TCO is a key consideration, whether digital or analog, that a broadcast station needs to determine.

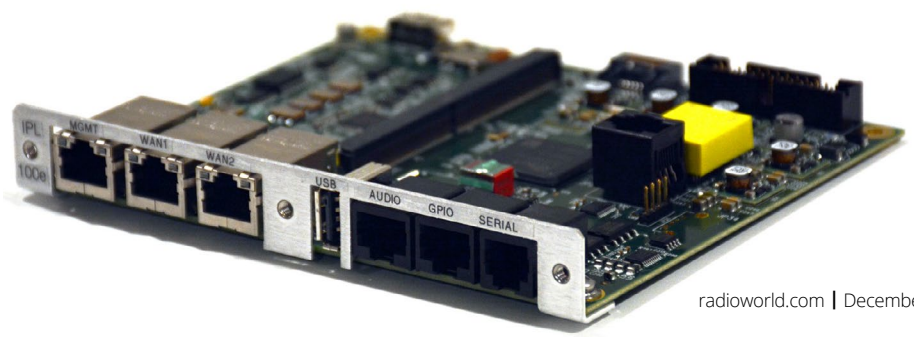
That includes overall efficiency of the transmission system along with whether a liquid or air-cooled solution is the best. Each has its advantages.

Redundancy, serviceability, security and integrated upgrade options such as Audio over IP represent other important considerations.

A high level of redundancy within the transmitter protects the broadcaster's revenue, along with the ability to service the transmitter while staying on the air. In addition, protecting the broadcaster's initial investment with upgradable features adds long-term value.

That includes having the ability to upgrade the transmitter from analog to digital or adding support for Audio over IP. GatesAir supports the latter with the new Intraplex IP Link 100e, a transport module that is easily added to our Flexiva radio transmitters.

Here is a checklist of items to consider: Overall TCO. Redundancy. On-air serviceability. Remote access. Security. And integrated options, such as audio processing, AoIP and dynamic RDS



We hear a great deal about the virtualization of the broadcast air chain. What are the implications of this evolution on how transmitters are designed and how users will choose and configure them?

Lantz: The transmitter will require support through an IP interface if the broadcast air chain is virtualized. More importantly, broadcasters will need to enhance reliability through the encapsulation of the IP data.

GatesAir addresses this through products such as Intraplex Ascent, which is a scalable cloud platform that facilitates reliable and secure transport. Integration of the IP Link 100e means that the transmitter now closes the loop by facilitating reliable and secure transport from the studio to the transmitter.

What do buyers need to know about hybrid radio, if anything, when choosing a transmitter?

Lantz: The ability for the transmitter to support upgrade paths with software or hardware for these advancements. Most of the hybrid radio platforms would be verifying that the transmitter has the IP ports to support this architecture.

Have supply chain issues affected you as a manufacturer? What's the impact and what are you doing about it?

Lantz: Supply chain disruptions have affected all industries. Semiconductor shortages have had the biggest impact. We have increased inventory for critical components in some cases and have instituted product redesigns in others. We use the latter strategy when vendors have end-of-life or lead times for components that exceed 52 weeks. In these cases, we procure components that will have less impact.

How would you describe your company's "design philosophy"?

Lantz: It is to provide the lowest total cost of ownership while providing the highest level of on-air reliability. As technology advances, we try to provide a path for future upgrade paths.

The better the efficiency of the transmitter, the lower the operate expense for the station. That adds money to the broadcaster's bottom line.

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2 Audio processing

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Think down the road when you buy

Dahl urges buyers to think hard about possible future improvements

Broadcast engineer Gregory Dahl, CPBE, is owner of Second Opinion Communications, a full-service integration company.

Can you describe your approach when considering a transmitter purchase or giving advice about one?

Gregory Dahl: Reliability and accessibility. How well does the manufacturer present the product and warranties, to include the past performance of service, parts and knowledge base?

Throughout the years, equipment servicing has shifted from component-level troubleshooting to module replacement. How many modules need to be onsite to service the transmitter effectively? If the station owner elects for no modules onsite, what is the readiness of the manufacturer for stocking and shipping modules?

Always plan for future improvements, don't limit the facility's ability to upgrade without major replacement of equipment.

Additionally, I would be looking at how the transmitter interfaces with other equipment — as an example, remote control I/O or audio processing. Many transmitter manufacturers have remote software for access with SNMP or physical I/O. How does this interface with your on-site equipment or is a replacement required.

The HD operation is always a consideration, and the system should be able to perform a level of transmitter output power for both FM and HD operations. Along with exceptionable RF grounding of the transmitter and RF transmission line, recommending a quarter-wave stub near the transmitter RF output port.

Right
Gregory Dahl

Name a feature or service that you wish transmitter manufacturers would add or make more widely available.

Dahl: One simple word: "schematics."

Transmitter companies contract with third-party companies to manufacture modules or power supplies. This forces end users to replace the module or power supply versus having the opportunity to troubleshoot the components of the module or power supply. It's a great revenue stream for the manufacturers, not so much for the station owner.

Virtualization of the air chain has been a focus of discussion lately. What are the implications?

Dahl: I believe it's more than the broadcast air chain that will be virtualized. As long as the FCC license is active, a physical component will be necessary to produce the RF signal; anything and everything else that can be created by software will be virtualized and can be controlled and modified remotely.

Virtualization will remove equipment from the transmitter location and placed into a controlled environment less likely to be damaged by excessive heat, insects/rodents, lightning and electrical surges.

Whenever we make improvements to a facility, there are always two sides of the fence. As we continue to move equipment from multiple transmitter sites to a central location, the probable failure of equipment could cause a cascading effect with more than one broadcast transmission.

When considering a centralized location and possible failures, it's essential that the virtualization platform's servers minimize downtime through redundancies, and that we provide multiple audio routes to the individual transmitter site, reducing a possible failure of the broadcast transmission.

Virtualization will also provide monitoring and auto correction if a route to the transmitter site is disrupted.

Recent years brought renewed interest in water cooling. Will use of that approach continue to grow?

Dahl: Heat has been and will always be a major concern for the RF signal amplification process. Liquid cooling provides the best method to remove the heat from the RF amplifiers and power supplies module from the components faster and better. Excessive HVAC systems are not necessary, and a normal conversation can be conducted next to the transmitter, including using the telephone with technical support.

100 R&S transmitters serve Camlica Tower

The tallest structure in Europe is a massive broadcast facility

The Küçük Çamlica TV Radio Tower (Camlica Tower) is a striking new addition to the Istanbul skyline. Opened in September 2020, it has replaced a number of older transmission towers in Turkey's iconic capital city and features restaurants, observation decks offering views across the Bosporus Strait, along with space for special exhibits.

The unique 365-meter-tall structure — the tallest in Europe — has already become a destination for tourists and locals alike and is expected to draw around 4.5 million visitors each year.

Despite its futuristic appearance and many visitor attractions, at its heart, the Camlica Tower has a practical purpose.

Built by transmission service provider, Kule Verici Tesisleri Isletim Ve Teknolojileri A.S., it is home to 125 broadcast transmitters and also supports transmission of over 100 FM radio stations across the city.

Before construction commenced in March 2016, the biggest challenge facing the Kule Verici Tesisleri Isletim Ve Teknolojileri team was to find a way to consolidate transmission of all the broadcast and FM radio signals at a single point. At the same time, it was critical to ensure that all these channels could be broadcast in the same high quality.

In the conception stage of the project, there were fears that the transmission challenge — in particular the FM part of the equation — was impossible to achieve.

Enter Rohde & Schwarz (R&S). The company was selected to provide 100 liquid-cooled FM transmitters. The high quality, efficiency and compact footprint of the transmitters made R&S the manufacturer of choice.

The fast remote control and on-site response, along with 24/7 support from the team at R&S' local Turkish office were also key factors for Kule Verici Tesisleri Isletim Ve Teknolojileri along with R&S' solid reputation as a trusted technology partner with a long history of serving the media and entertainment industry.

Kule Verici Tesisleri Isletim Ve Teknolojileri A.S. General Manager Ahmet Selami Sogut commented, "After intensive assessment of all the solutions available on the market, we determined that the Rohde & Schwarz transmitters were the most suitable solution for this important project. It was also critical for us to work with a technology provider that is known to be reliable, competent and a stable solution partner."

The R&S®THR9 high-power FM transmitter family makes terrestrial broadcasting of audio broadcast signals extremely efficient.

Featuring a space-saving design, these high-power transmitters deliver energy efficiency of up to 75 percent. The transmitters offer best in class capability for band II high-power transmitters. Liquid cooling simplifies maintenance over time, minimizes space requirements and ensures low- noise operation.

"Thanks to this project and the market-leading technology that Rohde & Schwarz has provided us with, we can now ensure our customers benefit from the opportunity to deliver FM broadcasting of the highest quality," added Ahmet Selami Sogut.

"By deploying the R&S transmitters we have seen energy savings, and enjoy rapid control and easy intervention, while the liquid cooling technology ensures the units' quiet operation. This together with their aesthetic appearance and small footprint have provided a great advantage in terms of bringing the new tower project to a successful conclusion."

The cooling system on the R&S®THR9 achieves full redundancy by employing multiple design strategies. Two pump modules operate in active standby to ensure high system availability. The heat exchangers are equipped with ultramodern fans that are highly efficient and have extremely low-noise blades. Separate AC supply lines for each pump module and each fan on the heat exchanger, as well as lightning and over-voltage protection circuits, provide optimal protection for the system.

Taner Demir, Rohde & Schwarz Turkey Managing Director said, "We are so proud to have been selected to provide our FM transmitters for this first of its kind project. Efficiency, flexibility and future proofing are all key areas of focus for our customers, and this is the ethos with which Rohde & Schwarz designs its solutions. This project with Kule Verici Tesisleri Isletim Ve Teknolojileri offers a perfect illustration of how our solutions meet the real world needs of our customers."

Kule Verici Tesisleri Isletim Ve Teknolojileri's Ahmet Selami Sogut concluded: "This is a pioneering project that others around the world will learn from and replicate. The fact that 100 FM radios broadcast from the same point with the same quality, and seamless operation of the system, as well as the speed at which we were able to deliver and meet the specific needs of the broadcasters we support, are all testament to the success of the Camlica Tower. We thank Rohde & Schwarz for their full support and solution-oriented approach from system design right up to the day we installed and operated our transmitter devices."

6 tips to protect your FM investment

WorldCast Systems suggests key steps to lower op-ex

Writers
David Houze
Product Manager and Application Engineer, Ecreso

Chantal Fourgeaud
Director of Marketing and Communication, WorldCast Systems

There is a lot at stake today for FM radio. With the challenges of rising energy costs, lower advertising revenue for stations, shifting consumer behavior as listeners turn to other media channels such as streaming ...

It's more vital than ever for FM broadcasters to choose the right transmitter and to know how to ensure its optimal performance. Staying on the air and offering the best listening experience is crucial, as is benefiting from the lowest Total Cost of Ownership.

In this article we share six tips for protecting your FM investment and lowering your operating costs — for example, the importance of choosing the right monitoring solution to improve equipment uptime, and how innovative technology can impact and improve efficiency.

Broadcasters have a number of solutions they can turn to and actions they can deploy to ensure continuous, high-quality, and cost-competitive radio broadcasting.

1 Look for the highest efficiency — This is one of the most important selection criteria for transmitters when measuring operating costs, as it has a direct technical and financial impact on your station. Higher efficiency means you can broadcast at the same power level while reducing your utility power consumption and heat dissipation.

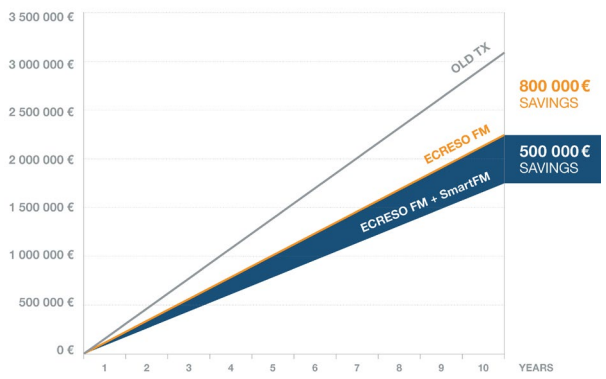
Factors that play into improving efficiency are innovative designs such as planar design on RF stages, the use of passive modules when possible, including a digital modulator that provides a pure and high-quality audio fidelity, and many built-in features such as sound processor, remote control and monitoring, audio silence detection, stereo encoder, RDS encoder and more.

2 Align high reliability with low cost of maintenance and repairs — We all want the most rock-solid solution. So what are the things to look for to measure a transmitter's robustness and, when the time comes, its ease of repair and maintenance?

Some questions to ask yourself:

- Has the transmitter undergone rigorous testing? These include Burn-In Testing, Highly Accelerated Life Tests (HALT), Parts Stress Analysis (PSA), Failure Mode Effects and Criticality Analysis (FMECA)
- How does it compare to other transmitters in terms of power supply protection? Is there an optional surge suppressor module?
- Is there an automatic switchover?
- Is it designed for easy maintenance to maximize on-air time?
- Does it come with a warranty? And how long is it valid?

3 Leverage innovative technology to boost energy savings — In addition to robust design, onboard features and efficiency, which all play into lowering op-ex, there is new innovative software technology that can



Right
Example of op-ex savings with SmartFM. The calculation is based on a network of 10 FM transmitters over a 10-year period. Comparison of "Old TX" at 55% efficiency, "Ecreso FM" with up to 76% overall efficiency and "Ecreso FM" with up to 76% efficiency and SmartFM.

accelerate energy savings. With the pressure of rising energy costs and, thankfully, companies' growing concern to limit their impact on the environment, improving energy savings is increasingly a key factor in transmitter selection.

Among these new technologies is SmartFM, developed and worldwide patented by WorldCast Systems. This sophisticated algorithm or AI brings broadcasters up to 40% energy savings. Beyond lowering business expenses, it improves Total Cost of Ownership by extending transmitter lifespan with less stress, less electricity consumption, cooling system requirements and less transmitter maintenance.

4 Secure your equipment from internet cyberattacks — In recent months, many companies have reported losing data due to increased cyberattacks worldwide.

More than ever, it's critical to protect your transmitter over the internet. The most powerful method to protect it from an unwanted connection consists in using a robust and secured router each time a transmitter can be reached by public internet. By doing so, most of the classic attacks (scripting, Denial of Services, hacking, etc.) will be blocked.

Another method is to switch from HTTP to HTTPS protocol, which encrypts the communication between the remote operators and the transmitter. This protects your transmitter from unauthorized access, shields your data and prevents off-air time for your station.

In addition, as often as possible, employ up-to-date technologies to connect to your transmitters to avoid known security breaches on your network.

5 Make sure you have remote access to your transmitter — This is a vital feature for a radio organization that wants to increase its on-air availability rate. Why?

- Reduce the off-air time with remote diagnosis and prevent multiple on-site visits to fix the faults.
- Be informed as soon as an event is triggered (hardware failure, audio silence, maintenance required)
- Adjust the configuration without sending technicians on-site
- Benefit from the highest quality of assistance from manufac turer support teams by providing them all the information required for investigations

Overall, your team will be more efficient, you'll save time and money and reduce downtime.

6 Schedule your maintenance proactively — Maintenance is one of the most demanding tasks on a broadcast network in terms of human resources. Today, some of your maintenance can be performed remotely when the transmitter provides a sufficient number of KPIs: fan speed, temperature, current, voltage, power and many others.

And when a KPI goes out of tolerance, technicians can be informed, diagnose the cause and schedule a maintenance when it is required.

Methods to monitor your transmitter's multiple health indicators:

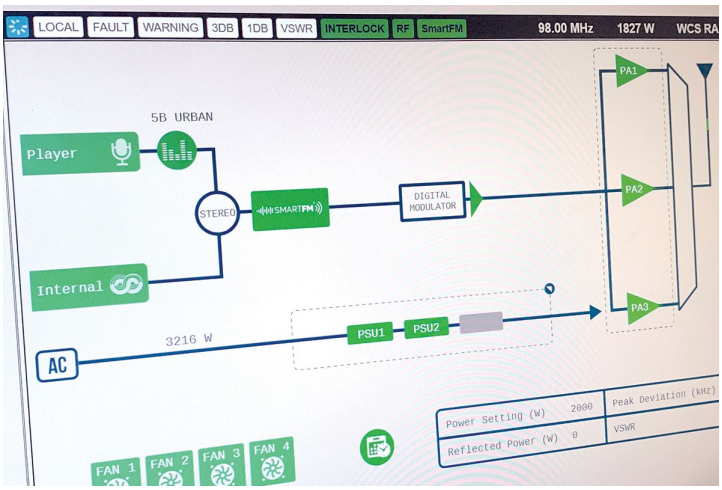
- Via standard maintenance protocol such as SNMP for integration inside a network management system
- Built-in email notifications on error detections
- Via direct connection equipm ent (on site or remotely)

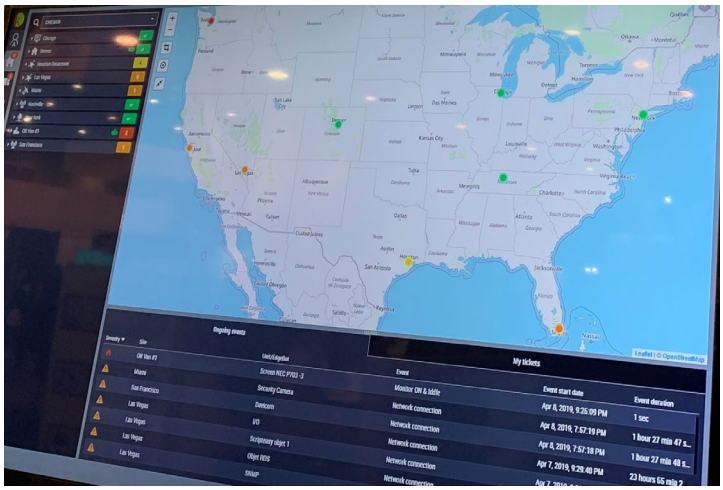
Takeaways

1. Look for the highest efficiency
2. Align high reliability with low cost of maintenance and repairs
3. Leverage innovative technology to boost energy savings
4. Secure your equipment from internet cyberattacks
5. Improve team efficiency and reduce downtime with remote access
6. Schedule your maintenance proactively

Left
An Ecreso FM 3 kW transmitter. The company cites efficiency up to 76% on the 3 kW and 5/10 kW models.

Below
KYBIO Media is end-to-end, unified monitoring and control software (NMS). Ecreso's Expert Maintenance Reporting (EMR) solution supports proactive transmitter maintenance.





Let's make transmitters more plug-and-play

Cooney also would like to see more affordable options for adding HD in smaller markets

Mike Cooney is executive vice president of engineering and chief technology officer of Beasley Broadcast Group and a past recipient of the Radio World Excellence in Engineering Award.

When you are shopping for a transmitter or asked for advice, how do you approach it?

Mike Cooney: Today there are at least three good transmitter manufacturers that make reliable products, so we now base our decision on how good their sales support is, what replacement parts costs, and how responsive their customer service is after the sale.

If we already have a manufacturer's product in a given market, we tend to go with that manufacturer again so there is a familiarity and the opportunity for less spare parts.

If someone hasn't purchased a broadcast transmitter in some time, what should they know?

Cooney: If you are buying an HD Radio transmitter, you need to consider if a single-box importer/exporter will work in your application or if you need separate hardware for the studio and transmitter site. Not every manufacturer still makes a cost-effective two-box solution, so this should be considered in your decision.

Right
Mike Cooney

Ninety percent or more of our sites still work better with the importer at the studio and the exporter at the transmitter. While the single-box solutions can be configured as either an importer or an exporter, they have a higher cost.

What would you like transmitter manufacturers to add or make more widely available?

Cooney: I believe the biggest need we have is a more inexpensive option for adding HD in the smaller markets for the broadcaster who can't currently justify the cost of a new HD system. Embedded exciter/exporters in the transmitters should help lower the cost of HD in the future.

We hear a lot about virtualizing the air chain. What are the implications of this evolution on how transmitters are designed, and how users will choose and configure them?

Cooney: Virtualization could greatly affect our ability to be good broadcasters, who are supposed to serve the public interest of their local markets.

The day is coming very soon where you will not need a studio in the local market, and I don't see how this can be good for the radio industry or the public interest. That being said, it will obviously save the broadcaster a lot of money if they don't need a studio.

As far as the technology, we need to make transmitters and especially HD technology more plug-and-play so the local engineer / IT person can safely configure and maintain the site. It is still not as easy as it should be to configure a transmitter site for HD, RDS, Artist Experience and PAD, but it is getting easier each year.

Hybrid radio platforms that combine over-the-air broadcast reception with online connectivity are becoming part of the landscape thanks to the work of organizations like RadioDNS, NAB PILOT and Xperi, as well as competition from the likes of SiriusXM 360L. What are the implications for the world of transmitters?

Cooney: I believe all the big transmitter manufacturers support Xperi's DTS AutoStage and the other car manufacturers' hybrid radio solutions, but you also need to use a service such as QUU or Artic Palm to get the full experience in the car.

The radio industry has done a poor job of giving the listener a consistent visual experience, and we still have stations without even RDS, let alone HD and PAD data. Satellite radio and the streaming services have a better visual experience than over-the-air radio, and as an industry we need to support these services to compete.

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The ability to adapt to future change is critical

Busi: Software-defined modulators are field-programmable and ready for future standards

Leonardo Busi is president of Elenos SRL, Broadcast Electronics, Elenos, Itelco Broadcast and ProTelevision Technologies, all members of the Elenos Group.

What are the important recent developments in how transmitters are made?

Leonardo Busi: The newest designs in FM and FM digital are based on software-defined modulators, which are field-programmable and updateable for virtually any analog or digital standard worldwide. This means improvements can be made in the field and hardware doesn't have to change.

If designed properly, the same modulator can also be used for TV operation, which means the manufacturer gets economies of scale, allowing a more competitively priced product for the customer. As the modulator can also be used for the operation in every TV standard as well as almost every radio standard like DAB, HD Radio, DRM and CDR it means the manufacturer acquires more experience that he can turn around to make the product even more reliable and constantly improving.

Below
Leonardo Busi

What do buyers need to know about hybrid radio when buying a transmitter?

Busi: As more and more listener devices offer the possibility to display both dynamic text and graphics drawn from both over-the-air RDS and digital data, as well as the web, it is important for transmitters to be transparent to the data path, and upgradeable as standards change. Bonus points for simple configuration with station playout systems. Coming back to the software-defined modulator, a transmitter must be adaptable for whatever comes next, whether it is DTS AutoStage or HD Radio. It must be adaptable and almost limitless in terms of its flexibility.

How can managers best calculate what a transmitter will cost to operate?

Busi: Total cost of ownership involves far more than AC to RF efficiency — the cost of sourcing parts, the cost of engineering time spent repairing, and the ability to update the transmitter via firmware rather than change hardware all contribute.

A manager should look at not what the cost is in the first year, but what it will be in five years, how easy is it to get parts, how trustworthy is a company to provide those parts. How good of an engineer is required to repair systems, and is the transmitter really designed for true full system redundancy.

Even with failures, a station must stay on the air, so having a transmitter designed with redundancy as the first criteria is critical.

Concepts of efficiency are often discussed, but not always understood.

Busi: Some manufacturers specify the PA efficiency, ignoring the energy losses in power supplies, fans, IPAs and even in combiners and splitters. It's easy to be fooled — ask specifically for the total AC load, with the fans running, at the rated power output.

However, highest efficiency is not the only criteria. Take for example a 10 kW FM transmitter at 72% efficiency versus 75% efficiency. In most cases it will save about $50 a month, but pushing a transmitter to its limit may cost

“Artificial intelligence will be incorporated in new transmitter designs so that the equipment will learn from the environment, and optimize their own parameters to maximize reliability, performance and efficiency.”

you a lot more if something fails, or the performance is not 100%.

Get the highest efficiency you can, it does save money; but do not let that be the only reason of selection. Often a manufacturer will obtain a high efficiency by “squeezing” the MOSFET device, but this produces an internal thermal heat reaction that reduces the life of the device itself.

When designing an RF amplifier you must consider the temperature of the device in the worst climate, not the “optimum” climate. For example, your transmitter should be designed to operate in an environment of at least 45° C or 113° F. Most producers consider the room temperature 25° C or 77° F, as if it were a consumer product!

A broadcast transmitter site should be considered closer to a military application rather than that of a consumer installation. Elenos and BE transmitters have the right efficiency and performance algorithms for the right room temperatures, keeping the maximum efficiency but not compromising reliability.

What features stand out as notable recent additions?

Busi: In our latest design transmitter, to be released very soon, we will introduce a giant step in redundancy and simplicity, significantly reducing the need for highly trained engineers to travel to the transmitter site as often, and therefore dramatically reducing the cost of repair, transportation.

In addition, all our transmitters in the future will include a software-defined modulator and central control system. The pace of change in our industry is increasing, and the ability to adapt to future change by installing a firmware upgrade makes tremendous sense.

How will designs change in the next five years?

Busi: Artificial intelligence will be incorporated in new designs so that the equipment will learn from the environment, and optimize their own parameters to maximize reliability, performance and efficiency. They will also be able to self-diagnose issues before they cause failure and recommend corrective action. It will become standard to have advanced warnings and suggested solutions. They will include the latest concepts in redundancy, and they will be made that they are so exceptionally simple to upgrade, repair and maintain, that a highly qualified RF engineer will not be needed to go the site every time to do even more complex repairs or maintenance.

Recent years saw renewed interest in water cooling.

Busi: At lower powers, typically less than 10 kW, it’s difficult to justify the additional cost and more importantly the complexity that a liquid-cooled transmitter inherently has. Liquid-cooled transmitters are more feasible when the transmitter is perhaps collocated in a site that has a liquid-cooling system already implemented for say, a TV transmitter, so the cooling system can be shared. But even that makes the entire system complicated and impractical.

If the cost of electricity is extremely high, or air pollution, pollen, dust or salt air is a concern, liquid cooling is a better choice. But in most instances it is difficult to cost-justify a new standalone FM liquid-cooled installation, particularly at low powers.

FM transmitters are very efficient, and as such the wasted heat as compared to TV installation is much less, so the saving are consequently less, but the complexity is far higher than a simple air-cooled system.

In countries like the United States, AM radio is considered a challenged industry. Has the market for new AM transmitter purchases dried up?

Busi: Not at all. It can be argued that the US A.M. industry was overbuilt; but slowly, as marginally profitable stations go dark, the remaining stations will see their effective range and business opportunities increase. I see over the next few years, with the implementation of all-digital HD Radio, the quality of AM will again be competitive.

Brand loyalty is a big factor

History and a good working relationship count for a lot

Above
Cris Alexander

Cris Alexander is director of engineering for Crawford Broadcasting, which owns 14 AM stations, nine full-power FMs and 13 translators. He is also the tech editor of RW Engineering Extra.

What's your philosophy or approach when you're in the market for a transmitter?

Cris Alexander: Brand loyalty is a big factor for us. If we have a history with a manufacturer and a good working relationship with support personnel, that plays probably the biggest part in the selection process. If we know them and they know us (and by this I mean their people know and trust our people), that counts for a lot.

Any advice for someone who hasn't bought one in a while?

Alexander: Today's transmitters are not your father's Oldsmobile. They have features and options that were unheard of just a few years ago. User interfaces are totally different and often GUI-based. Many transmitters offer SNMP connectivity and control. Efficiencies are much greater than prior models. Cooling requirements, both in terms of tonnage and airflow, are totally different.

What would you like transmitter companies to offer or make more widely available?

Alexander: Parts ordering through an "online store" would be a great step forward. We find that going back and forth with phone calls and emails to be cumbersome and unnecessary in today's Amazon world. If the part number is known (and it should be), online ordering should be a snap, with the engine tied to inventory so there are no surprises, and with user-selectable shipping and payment options.

What are the implications of virtualization on how transmitters are designed and used?

Alexander: See my RWEE "From the Tech Editor" column from August 2021 for my answer to this question and more.

Is availability of parts for legacy transmitters a serious problem?

Alexander: This is a problem, and engineers often have to get creative, either substituting parts, sometimes modified,

that they can get or in some cases changing the design of a circuit to use available parts.

This also plays into the useful life of a transmitter — no matter how good it is, when the point is reached where parts are no longer available, that transmitter has reached the end of its useful life.

We find that useful life to be getting shorter and shorter. Where a transmitter of decades past might have a useful life of 20 or 25 years, we're finding that today's transmitters may be more like 15 years. We'll know when we get there. But we must plan for a shorter rotation cycle.

Have supply chain issues affected transmitter manufacturers? What are they doing about it?

Alexander: We have found some supply chain issues with transmitter manufacturers, but by and large the ones we deal with have purchased adequate stocks of parts to stay ahead of demand — for a while, anyway.

How can managers shopping for a transmitter best calculate what it will cost to operate over time?

Alexander: That should be straightforward, especially for FM where power levels are constant.

Power consumption and heat load are published specifications that can be used to determine the annual/monthly power consumption to operate and cool a transmitter in kWH, which can be multiplied by the price per kWH utility cost.

The demand will also need to be considered, and that can be estimated fairly accurately by subtracting the load of the current transmitter from the kW demand figure on the existing bill, then adding back in the load of the proposed new transmitter. Add the cost of the demand in kW to the kWH cost to get electrical consumption.

The remainder of the costs are maintenance related, and the manufacturer should be able to provide a reasonable estimate of those.

Modulation-dependent carrier level control has been allowed in the United States for some time now. What should engineers know?

Alexander: We have found that MDCL is very worthwhile and can save hundreds if not more than a thousand dollars each month in utility bills, but there is a point below which it isn't worth messing with.

We used it on all our 50 kW stations. We have tried it all the way down to 5 kW and do in fact use it on one 5 kW station to reduce stress voltages on components in a high-impedance base network. It's likely not worth messing with below 10 kW in most cases.

We have found that AMC is the best algorithm, mostly because of receiver AGCs and the way they operate. Using AMC, you can maintain the same apparent S/N ratio as you have without MDCL.

> **Where a transmitter of decades past might have a useful life of 20 or 25 years, we're finding that today's transmitters may be more like 15 years.**

Conduct a careful analysis of performance

Uhlmann says the decision will affect infrastructure, workflows and more

Maurice Uhlmann is product manager for transmitter systems for Rohde & Schwarz.

RW For a reader who hasn't purchased a broadcast transmitter in some time, how would you recommend they approach it?

Maurice Uhlmann: The decision on which transmitter to invest in defines many operational aspects of a radio network for decades and involves considerations such as output power, signal quality and space. But such an important decision also defines the future monthly bills for energy, the number of people needed for operation and the overall servicing concept.

Furthermore, it defines the amount of investment needed to adapt the station to the new transmitter's characteristics like e.g., heat dissipation into the room. Therefore, a careful analysis of the transmitter's performance in relation to effects on infrastructure, broadcast workflows and operational processes, is highly recommended and can make the difference between a profitable and a non-profitable business.

RW What are the implications of "virtualization of the air chain" on how transmitters are designed and used?

Uhlmann: Rohde & Schwarz is already at the leading edge of virtualizing media content in creation and playout workflows, which the distribution platforms then get to their audiences. But virtualization is not something that should be considered anywhere in the broadcast chain for the sake of an industry "buzz." There must be real, tangible benefits to the processes so that efficiencies are gained or more profit made.

R&S transmitters can currently be configured remotely via web interface or via SNMP, and we can see how transmitters can be managed as a network from a central point which could be virtualized (but doesn't necessarily have to be). Such a step would allow centralized configuration, management, reporting, failure tracking etc., which in turn would drive efficiencies for larger networks.

RW What do transmitter buyers need to know about hybrid radio?

Uhlmann: As with traditional television broadcasting, challengers are constantly coming into the market and reaching audiences not only with new content but with new ways of engagement. Radio is no different.

While R&S is expert in the field of transmitters, all powers, classes, standards and formats, it seems that new platforms of engagement are emerging where radio broadcasters are looking to enhance "the listener experience" to enable perhaps more targeted advertising, more targeted listening and an overall more connected experience.

A more sophisticated overall platform is needed in which the transmitter, of course, plays its part. When investing in transmitters, buyers need to consider the most efficient and flexible transmitter system that will deliver content to the widest audience so that as many consumers as possible can interact using the online platforms.

Right
Maurice Uhlmann

How would you describe your company's "design philosophy"?

Uhlmann: The R&S design philosophy is based on the goals of creating extremely reliable, highly efficient and easy to use transmitters.

"Reliability" cannot be addressed by simple replacement concepts in case of a failure. No! Reliability is about avoiding failures and avoiding other reasons that require service maintenance. That can only be addressed by the selection of high-quality components, an architecture that has a long product lifetime in mind and a highly advanced thermal concept.

"Efficiency" is all about reducing your monthly bills for operating a transmitter. That is connected to the consumed power — direct or indirect — the number of people needed to operate the transmitter, space need for the transmitter and the level of active monitoring required to run it. Designing a highly efficient transmitter must consider all these aspects and optimizing them.

"Easy-to-use" stands for reducing complexity, providing all information needed at one glance and self-monitoring of key parameters of transmitter operation.

How can managers shopping for a transmitter best calculate what it will cost to operate over time?

Uhlmann: By far, the biggest portion of monthly bills for radio transmitter operation will be energy costs and staff. Focus on optimizing these positions and analyze precisely the different characteristics of products on offer. Even slight differences can have a big impact.

For instance the amount of dissipated heat from the transmitter into the room is a big cost driver if the room is cooled by an HVAC system. The dimensioning, the energy consumption and the dependency on service intervals of the HVAC system are defined by that amount of dissipated heat. Minimizing the heat load means reducing you your ongoing costs.

And don't forget to look at the full picture including effects on infrastructure, broadcast workflow and operational processes.

What level of efficiency can users expect today from the class of transmitters that you make?

Uhlmann: FM radio transmitters deliver today an energy efficiency of up to 75%. See the case study in this ebook about the Camlica Tower project in Istanbul, Turkey, which reduced power consumption significantly and also removed many blots on the landscape.

HD Radio transmitters with an injection level of –10 dB provide up to 57% energy efficiency if measured between AC in and RF out.

Recent years saw renewed interest in water cooling. Will use of that approach continue to grow; why or why not?

Uhlmann: FM radio transmitters deliver today an energy efficiency of up to 75%. That means a quarter of the consumed energy is turned into heat, which needs to be exported from the transmitter room — in an efficient way. Liquid cooling does a tremendous job with this efficiency. With the design of R&S it consumes only 500W to transport 15 kW of heat out of the room.

For transmitters with significant heat load of 5 kW and more, liquid cooling is an excellent approach to release the heat externally in the most efficient way — especially when space is at premium. Therefore, the liquid cooling approach is expected to continue to become more popular.

Performance now far exceeds radio's requirements

Today's transmitters are remarkable and can go well beyond even the most demanding requirements of the industry

Writer
Charles S. Fitch
P.E.
The author is a longtime contributor whose articles about engineering and radio history are a popular recurring feature in Radio World.

Above
The author checks input common point of one of several DA diplexed stations. Dense diplexing is more common in today's AM arena.

At 100, radio has taken on a full maturity. Most of what we are doing now is far more evolutionary than revolutionary. We've grown from an entrepreneurial, almost "cowboy" exuberance — creating a novel business out of a whole cloth of new technology coupled to uncertain dreams and ideas —to a staid, formal business-plan mentality.

There's nothing wrong with this, we've earned our place in America's fabric. In the final analysis, America depends on us. What we do is important.

As with other components in our industry, transmitters have moved from being precarious, volatile and revolutionary at the center of the enterprise —akin to the printing press at the core of newspapers — to being essentially a business appliance in the vein of, say, a Xerox machine ... needed but not necessarily romantic or at the center of the business.

With that as preamble, where have we "evolved" to?

Current and probably all future transmitter designs will inculcate the same performance and design advances as we see in other electronic devices — whether it be frame relays, modems, signal multiplexers, digital processing ... high-density, advanced circuitry using microprocessors and programmable arrays as well as innovative power consumption reduction schemes to make them more compact, less expensive in the grand scheme and more efficient overall.

On top of everything else, we have come to an interesting moment: The technical performance of new transmitters far exceeds even the most demanding requirements of the industry. Spec-wise there's not much meaningful performance difference between major manufacturers that the listener can hear.

How do you chose? As ownership and management look intensely at cost containment/reduction as a primary strategy to increase profit or ROI, the calculated true cost per hour looms largest. These economic factors include the initial outlay, power consumption including operation and climate control considerations, MTBF and a general category we can call loyalty.

Loyalty in this instance is how much business do you do with the transmitter's manufacturer, what has been your support experience both in and out of warranty, how much do they cost per hour/per repair, what are they like in stress as can you reach them after hours. Can they ship on weekends?

To reverse the concept, do you consider your transmitter provider a partner in your success or just an invoice?

What next?

A few final observations.

At the moment, out in the trenches of radio, I find a dichotomy. One comes either upon SOA new, all-solid-state transmitters sitting compactly in the wide open spaces where much bigger rigs had been just a few years ago, or upon older gear kept online because of discrete designs that can be maintained and repaired rapidly in situ.

Also, the most notable and worthwhile improvement in contemporary equipment is web-enabling. The headcount in our industry has dropped as concepts and tools have improved productivity to an incredible level. The most vivid area of personnel reduction are the technocrats; this has brought us to the point that engineers are not even part-time in some of our largest station complexes.

The ability to monitor performance, evaluate problems and troubleshoot from "anywhere, anytime" is a true advance. Whether from the manufacturer or your service source, you can usually arrange for someone to keep tabs on your site.

As to the future? From my modest travels through the industry, I think the big wave of replacements that brought us to the present service-oriented architecture is about done. Web-enabling, MDL, Class D concepts have brought us to a high plateau of performance and choice. It will be interesting to see what further improvements might be developed to make it worthwhile for stations to replace existing equipment.

The days of babysitting transmitters are long over

Mike Martin looks for systems that require very little oversight

Mike Martin is operations manager of KQAL(FM) in Winona, Minn.

What's your philosophy or approach when thinking about a transmitter?

Mike Martin: I look for three things: reliability, efficiency and features. The days of babysitting transmitters are long over. No one has that kind of time anymore. Once a new transmitter is installed it should be expected to just work with little oversight — routine maintenance like cleaning air filters will always be required of course.

Ownership is always looking to reduce costs, so efficiency is a no-brainer. Features that permit off-site monitoring like a graphical user interface are essential. I want to know exactly what my transmitter is doing without going to the site. Just knowing voltage and current doesn't cut it anymore.

For someone who hasn't purchased a broadcast transmitter in four or five years or more, what should they know?

Martin: Component-level repairs are pretty much a thing of the past. Tiny surface-mounted components make that nearly impossible for all but the most advanced shops. Maintenance today is swapping out boards. That makes repairs much easier but at the same time more expensive and ownership needs to understand this.

Can you name a feature or capability that you wish transmitter manufacturers would add or make more widely available?

Martin: Some transmitters are already eliminating the need for ancillary equipment by including audio processor cards and RDS capabilities. One thing still missing in HD transmitters is more built-in functionality for PAD data so that "middleman" software isn't needed. Being able to send song/artist metadata from my automation system directly into the HD transmitter would really simplify things.

Right
Mike Martin

Above
KQAL's tower.

What specific technical features are vital to look for?

Martin: A graphical user interface is a must-have. I'd never buy a transmitter without one. Knowing every single parameter of a transmitter's operation from fan speed to heatsink temperatures to even a spectrum display, all viewable from my office or phone, only adds to my comfort level of knowing all is well.

What other questions or concepts should a manager should be thinking about?

Martin: Who is going to maintain it? Is there local staff? Is the staff hours away? Is it called only in an off-air situation? The less staff there is and the further away it is, the more management needs to invest in a top-of-line brand that is known for reliability. A transmitter purchase is not a time to pinch pennies. Your bottom line depends on being on the air.

Liquid cooling is a boon to efficiency

Stevenson says be sure to consider the entire facility in your calculations

Above
Pump stands for the liquid-cooled transmitter.

Don Stevenson is the chief engineer for Radio One Dallas / Reach Media.

When you're considering a purchase or asked for advice about buying a transmitter, what is your overall philosophy or approach?

Don Stevenson: Start your search by looking for equipment manufacturers with a proven track record for reliability. Determine the required power levels for the type of operation desired. If you are designing an FM transmitter plant, will you also be doing HD? If so, how will you be creating the HD? If low-level combining is used, make sure you have enough transmitter power to handle it.

Once you have narrowed your selection down, consider the efficiency of the transmitter and the entire facility. A higher efficiency will reduce operating costs, and the savings in cost of operation should to be considered in the transmitter purchase.

For someone who hasn't purchased a broadcast transmitter in awhile, what should they know?

Stevenson: Solid-state transmitters are much more efficient than tube-type transmitters. As more of the aging tube-type transmitters are replaced with solid-state models, the tube prices are going up. As the tube prices go up, the economics for the decision to go solid-state become clearer every day.

Can you name a feature that you wish transmitter manufacturers would add or make more widely available?

Stevenson: Liquid cooling is very helpful with increasing the efficiency of the transmitter facility. This technology is relatively new to radio, but TV has been doing it for decades. Removing the heat from the building helps in reducing the HVAC load and therefore reduces the overall cost of maintenance of the building HVAC system.

What misconceptions do many people have about transmitters that you'd like to dispel?

Stevenson: "Liquid cooling is too expensive." While the cost of a liquid-cooled transmitter is more expensive than an air-cooled transmitter, it will save you money in the long run.

When replacing a transmitter you must also consider the operation of the entire transmitter facility. This includes the HVAC system. A liquid-cooled transmitter will remove a significant amount of the heat load from the building. This will save in less electricity to cool the building and less run time on the systems in place. This will reduce the amount of money spent on HVAC maintenance and increase the overall life of the systems.

The concept of efficiency is often discussed, but many managers may not understand exactly

what it represents. Why does it matter?

Stevenson: Efficiency is a way engineers can measure the cost of operation before equipment is purchased. The concept is very important, as this is the greatest consumer of electrical power in the transmitter facility. Transmitter efficiency is often measured by comparing the electrical power going into the transmitter and how much RF power is coming out of the transmitter. The power that was lost in the transmitter is manifest as heat. In an air-cooled transmitter, that hot air is normally exhausted into the transmitter room or vented outdoors.

Is availability of parts for legacy transmitters that are still in service a serious problem in our industry? What could be done about it?

Stevenson: Tube-type transmitters are becoming more expensive to maintain. This is due to tube cost constantly rising and the quality seems to be less consistent than many years ago.

Manufacturers try to support these transmitters as best they can, but the parts are becoming more and more difficult to find for some of the older transmitters. This can result in significant delays in repairing a transmitter.

The benefit to using a solid-state transmitter is it uses many amplifiers and power supplies to create the power. A failure often times will only result in reduced power. A tube transmitter only has one final amplifier, and a failure will result in a complete failure of the transmitter.

Top
Overhead are the valve assembly and lines for the liquid cooling system, with the RF combiner for the two transmitters visible center left.

Above
Don Stevenson with KZMJ's 60 kW transmitter, a GatesAir Flexiva model.