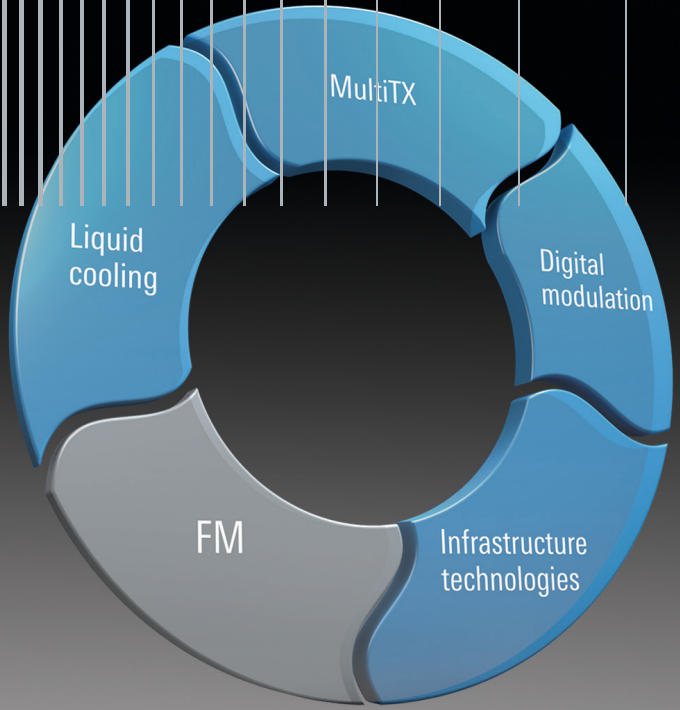
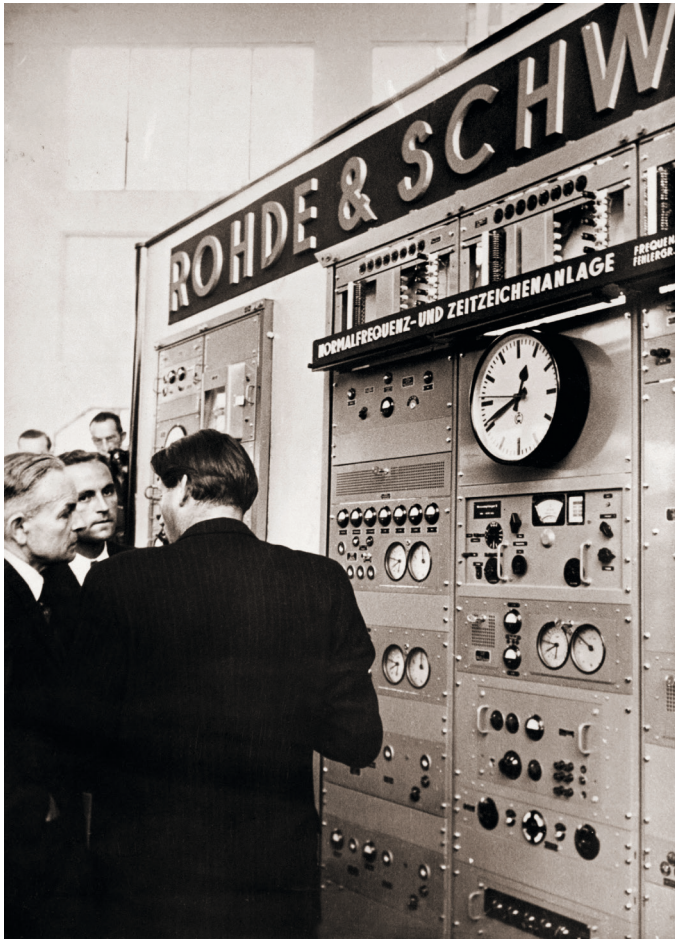
Technology mix for FM sound broadcasting systems

ROHDE&SCHWARZ



General

Broadcasting systems do not rely on one technology alone; they host a multitude of technologies in their system components. This also applies to band II sound broadcasting systems, which incorporate a number of important technologies in addition to frequency modulation. Some of these technologies have been well-known and successfully employed in terrestrial sound broadcasting systems for many years. In addition to these established technologies, there are innovations that were only recently introduced in FM sound broadcasting systems. This paper discusses the use of diverse technologies for sound broadcasting systems, focusing on the aspect of enhanced system performance.



Dr. Lothar Rohde, one of the two founders of Rohde&Schwarz, in 1949 in front of one of the first sound broadcasting systems.

Global advancement of FM as a sound broadcasting technology

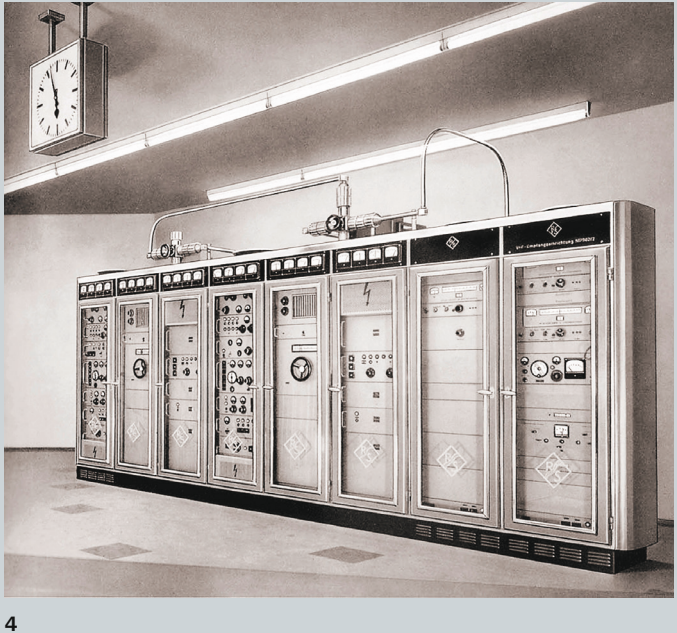
In 1949, Rohde&Schwarz built Europe's first VHF FM transmitter.

The beginnings of sound broadcasting with FM

Sound broadcasting as a wireless communications medium emerged in the 19th century. In the 1880s, the existence of radio waves was proven first theoretically, then experimentally. This was followed by rapid advancements. From the first radio broadcast transmitted in the US in 1906, it took only a few years until sound broadcasting had spread all over the world. Most radio listeners today receive frequency-modulated (FM) VHF radio. The technique of frequency modulation was developed in the 1920s; the first patents were filed between 1928 and 1934. Unlike amplitude modulation, which had been used almost exclusively until then, frequency modulation is insensitive to interference. Frequency-modulated signals in the VHF band offer excellent sound quality in a range perceptible by the human ear.

Launch of FM in Europe

In 1949, Rohde&Schwarz built Europe's first VHF FM transmitter and put it into operation in Munich (southern Germany) after a development time of only six weeks. Offering high transmission and reception quality, the transmitter met with a very positive response, and the network was rapidly expanded.



Rohde&Schwarz VHF transmitter in 1963 (5 kW 1+1 system).

The advent of transistor technology made it possible to produce much smaller and lighter radio receivers. At the end of the 1950s, Sony put the first VHF transistor radios on the market. People were enthusiastic about the new technology, and transistor radios spread around the globe in the 1950s and 1960s.

Technological enhancement of FM

The great success of FM led to further enhancements of this technology. From the early 1960s, it was possible to receive stereo signals by encoding the left (L) and the right (R) channel into sum (L+R) and difference (L–R) signals.

In the 1980s, Rohde&Schwarz played a key part in developing the radio data system (RDS), which was officially launched in 1987 and used mainly in car radios to provide alternative frequencies. RDS is in use even today, and in some countries it plays a significant role in providing traffic information.

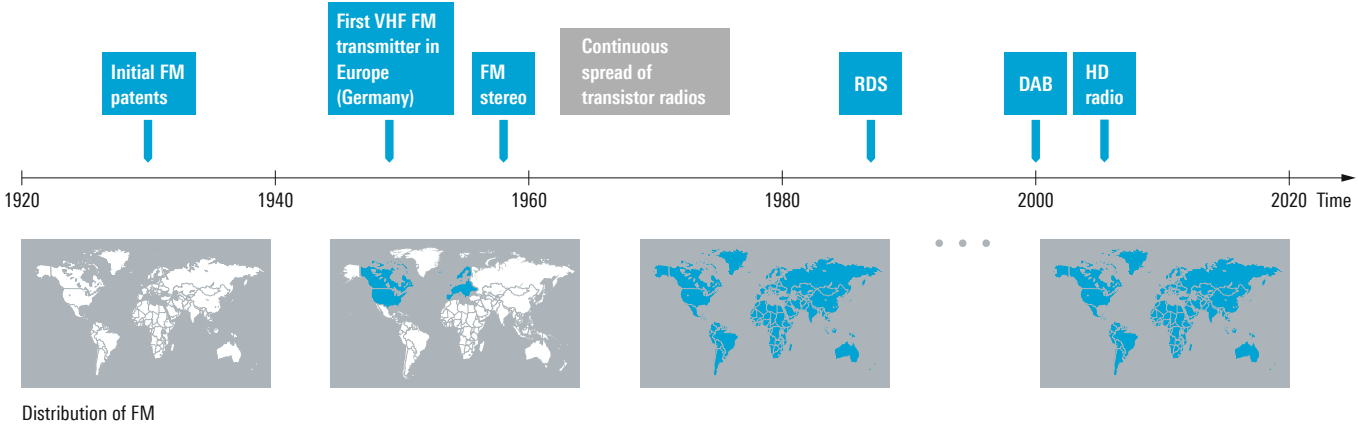
Development of other broadcasting standards

Concurrently with the enhancement of FM, new sound and TV broadcasting standards emerged. In the 1990s, Rohde&Schwarz played a prominent role in the creation of the DAB broadcasting standard. Another new sound broadcasting standard was HD Radio, which was introduced in North America. This technology allows hybrid transmission of analog FM and digital HD Radio content.

Current distribution of FM as a sound broadcasting technology

FM receivers are used all over the world today due to their simplicity, high (sound) quality and low cost. FM technology is deployed today in large transmitter networks in every country in the world. Internet radio and portable media devices will complement, but not replace, the use of FM technology for sound broadcasting as a mass medium.

Advancement of frequency modulation technology



Distribution of FM

Liquid cooling

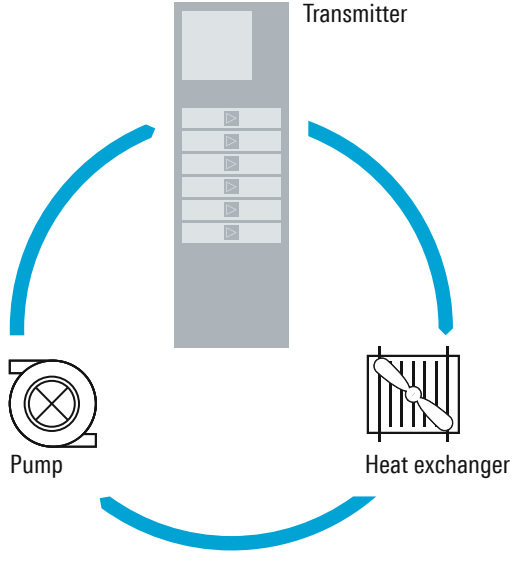
Liquid cooling has been used for terrestrial TV transmitter systems for several years. The closed cooling circuit encompasses the transmitter, a pump unit and a heat exchanger.

Compared to air cooling, liquid cooling essentially offers the advantage of a smaller footprint since the pump unit can be integrated in the transmitter rack and the heat exchanger is installed outside the building. Cooling is considerably more efficient, reducing the heat load from the transmitters in the transmission site.

Liquid-cooled transmitter systems require substantially less installation effort than air-cooled systems. Whereas an air cooling system calls for air ducts and backup fans, liquid cooling requires only a number of thin cooling hoses.

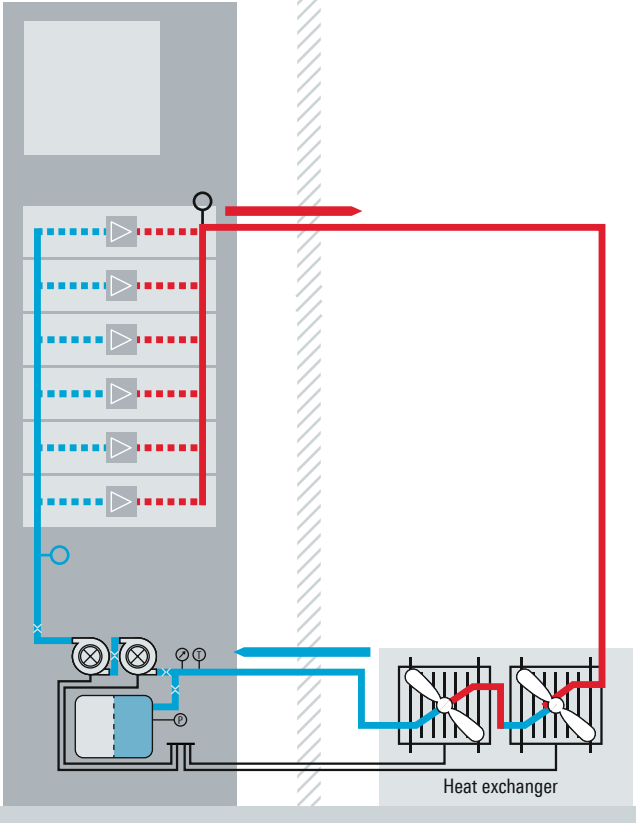
This yields another benefit: significantly lower maintenance requirements. And, liquid-cooled transmitters generate considerably less noise than comparable air-cooled systems.

Liquid cooling circuit



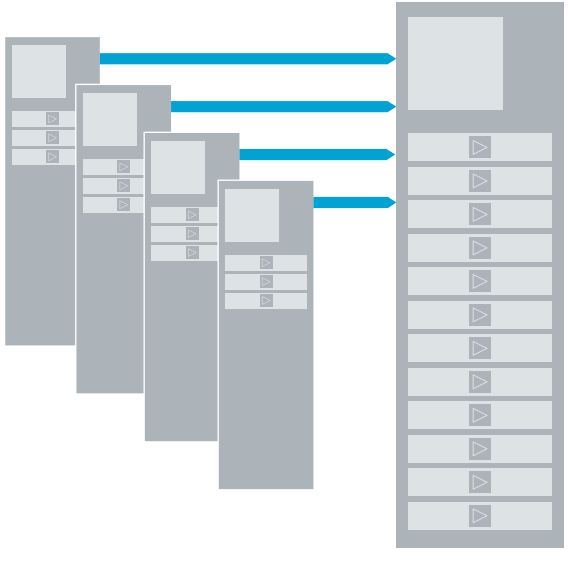
Space savings in a transmitter station due to liquid cooling

Up to 80 % space savings
in a transmitter station.



MultiTX system technology

MultiTX system with four single transmitters installed in one rack



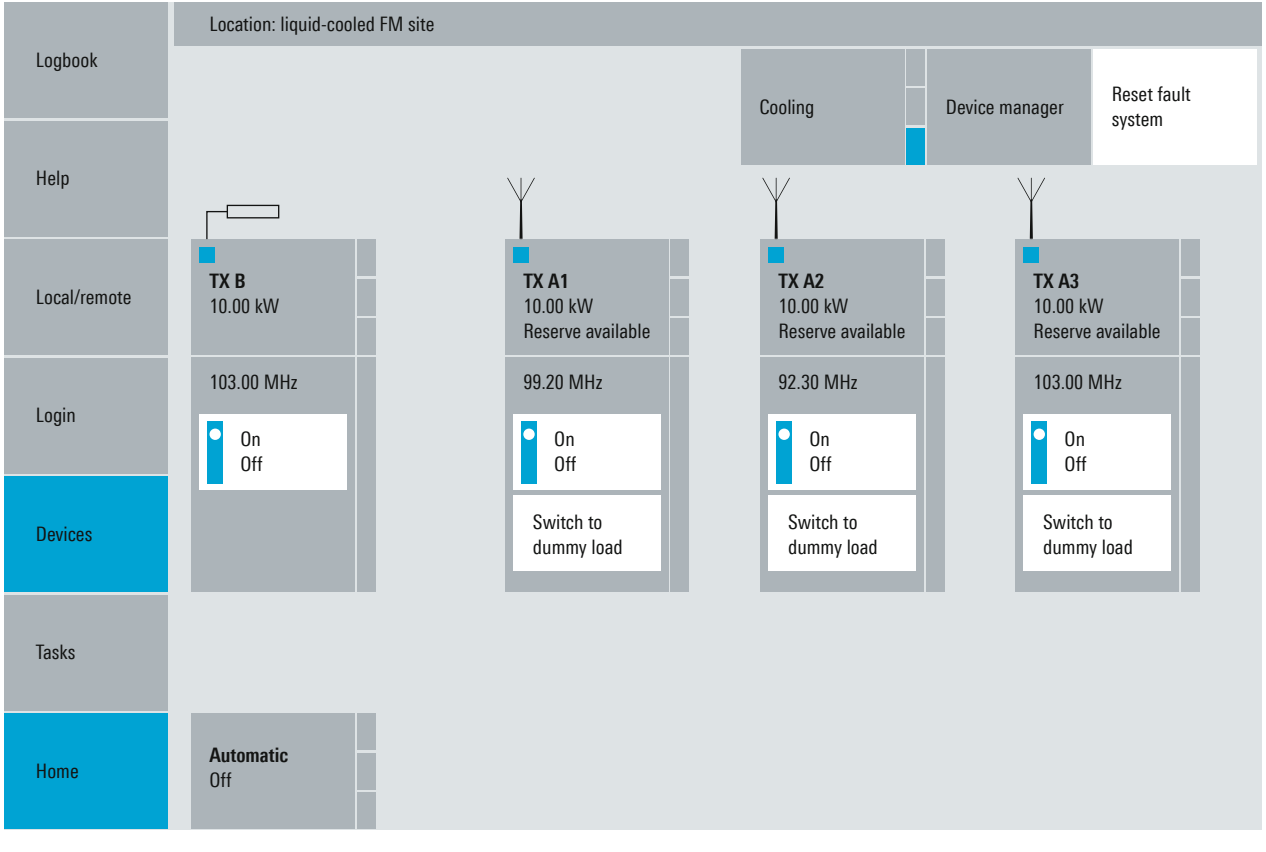
The MultiTX system concept from Rohde&Schwarz allows up to four transmitters to be installed in a single rack – now also for liquid-cooled FM high-power transmitter systems. This saves a considerable amount of space.

The transmitters are monitored by a system control unit that also provides a graphical user interface for the entire MultiTX system. The transmitters can be configured with a single-drive or a dual-drive exciter, depending on requirements. It is also possible to implement N+1 configurations in a single rack.

A MultiTX system can accommodate not only multiple transmitters in a single rack but also the pump unit, saving further space.

The MultiTX concept therefore opens up new dimensions in flexibility and scalability at affordable cost, plus it meets the high availability requirements placed on a transmitter system.

Layout of a GUI as a central interface for a 3+1 system in a single rack

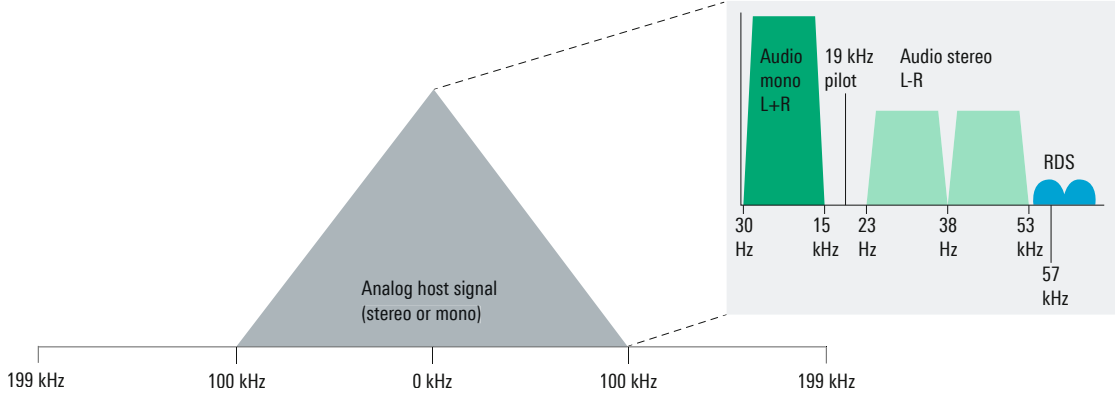


Digital data in band II

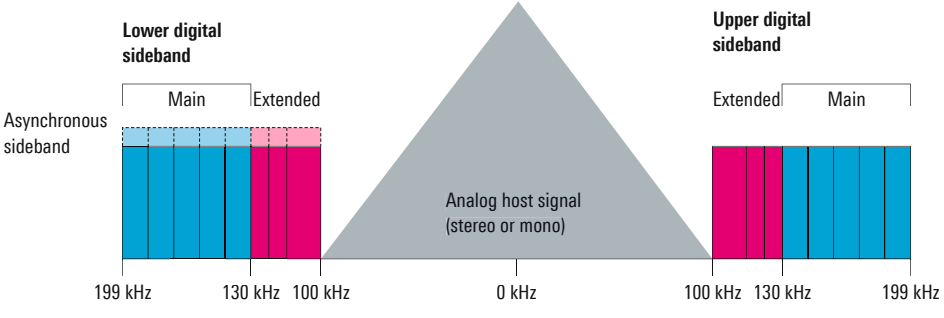
Systems designed for analog and digital modulation in band II can process a variety of digital data carried in a signal. This includes auxiliary services such as RDS in FM operation, analog and digital audio data transported in hybrid signals as with HD Radio, as well as purely digital signals. In order to handle all relevant technological standards, a transmitter needs to incorporate the following core components: an exciter with a suitable coder board, a power amplifier and an appropriate audio interface.

To support digital standards, the amplifier must be capable of switching to linear amplification. The coder board, which handles modulation, uses FPGAs, which can be programmed as required for any digital broadcasting standard. Modern transmitter systems also have the infrastructure necessary to feed digital data such as RDS or digital audio data.

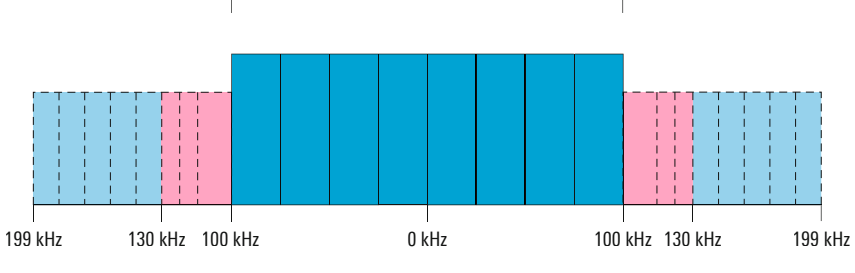
FM baseband with RDS data



FM HD radio – hybrid mode



Fully digital radio standards



Integrated infrastructure technology

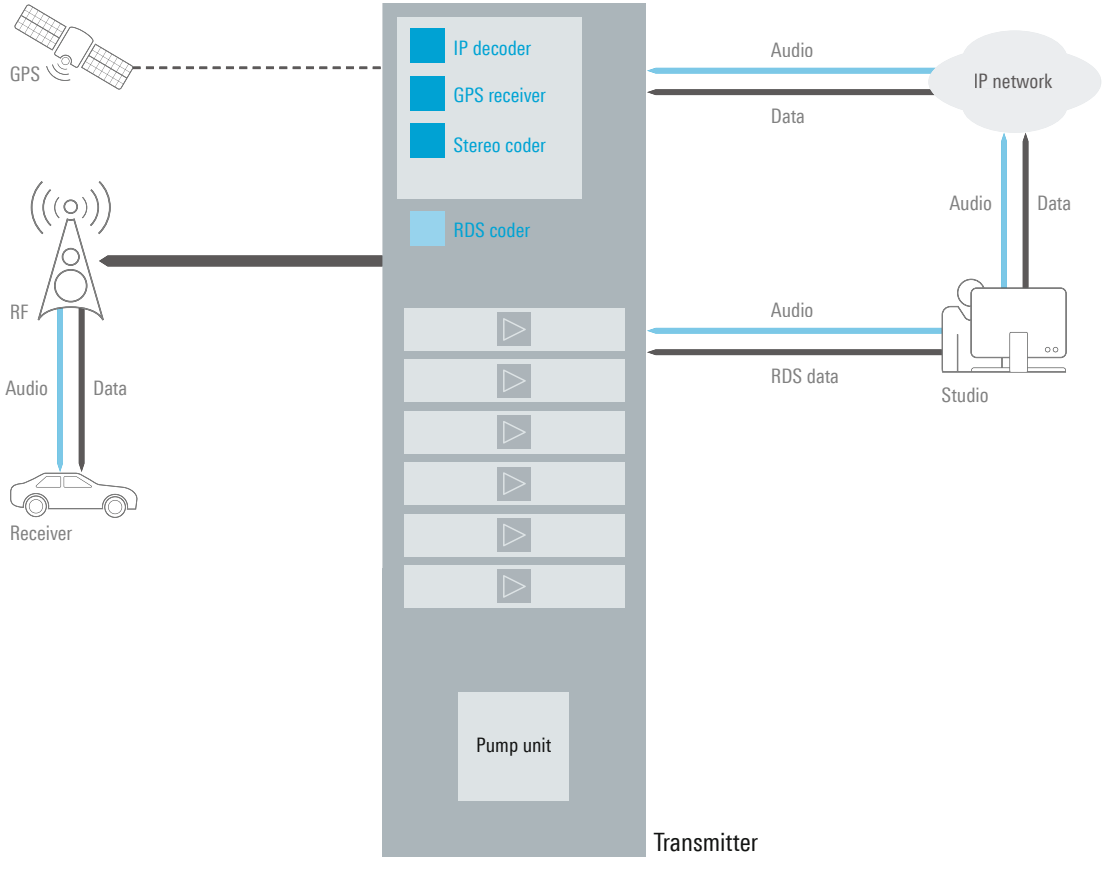
The infrastructure for sound broadcasting systems contains equipment that provides extended functionality. Such additional technologies include stereo coding, traffic information processing by means of RDS coding, and the processing of IP signals to be fed to the transmitter. Installing such equipment in a station usually requires an additional rack, and therefore more space. However, using programmable ICs, many of these functions can today be integrated into the transmitter system.

Some applications require the use of GPS receivers for transmitter synchronization. GPS receivers are often installed as separate devices next to the transmitter system; however, suitable GPS modules can also be integrated into the transmitter system.

The cooling system is also part of a transmitter system's infrastructure. The infrastructure for a liquid cooling system can be partly integrated into the transmitter rack. Thanks to their high power density, modern transmitter systems also allow the pump unit to be integrated into the rack.

Many infrastructure technologies that previously called for separate equipment can today be integrated into a sound broadcasting system, saving a considerable amount of space.

Integrated infrastructure technology



Technology mix for band II

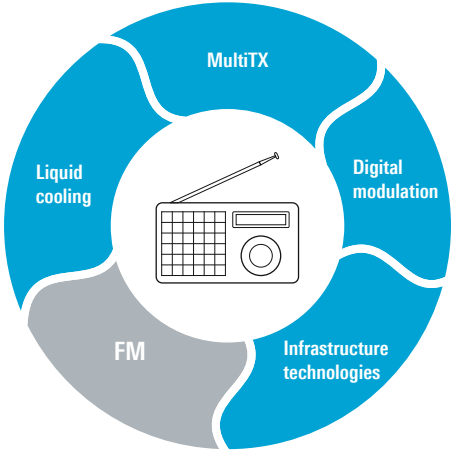
When designing latest-generation transmitter systems, an appropriate mix of technologies is crucial. A MultiTX configuration combined with liquid cooling, for example, allows multiple transmitters and a pump unit to be integrated into a single rack.

Using the technologies discussed here, a band II sound broadcasting system can meet all the requirements with respect to high performance, small footprint, minimum service effort and high efficiency, and will be optimally prepared to meet future challenges.

The new transmitter generation from Rohde&Schwarz combines all these technologies to provide latest-generation high-power transmitter systems.

For further details, visit:
www.rohde-schwarz.com/Tx9

Technology mix used in R&S®THR9



Summary

The R&S®THR9 is a family of high-power FM transmitters that combines multiple technologies.

The development of the R&S®THR9 family was backed by decades of experience gained by Rohde&Schwarz in transmitter system design.

Combining MultiTX technology with a liquid cooling concept yields outstanding power density and very high efficiency.

The R&S®THR9 transmitter family also features excellent efficiency in terms of operation, configuration and safety of investment.

The R&S®THR9 transmitters are currently unique on the world market, delivering highest efficiency at smallest footprint.

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