

Rohde & Schwarz satellite amplifiers empower SES 8K satellite broadcast

By Christian Baier, Product Manager, Satellite Amplifier Systems at Rohde & Schwarz.

We live in interesting times. Just a few years ago, High Definition TV provided viewers with a quality of experience that provide a 'WOW' factor and was guaranteed to maintain their loyalty to the channel. Today, HD is accessible over a diversity of smart devices and has become the norm.

In an effort to attract viewers, broadcasters constantly strive to achieve a better quality of experience. By the time the next Olympic Games arrive in Tokyo, host broadcaster, NHK, has declared its intention to produce coverage in 8K.

This ambition is creating ripples on a global scale. In Europe, satellite operator, SES, has for the first time broadcast an 8K television signal via its satellite system. The broadcast happened last May during the SES Industry Days in Luxembourg. In this demo broadcast, the uplink signal transmission was enabled using R&S PKU100 Ku-band satellite uplink amplifier from Rohde & Schwarz.

This new satellite amplifier is proving capable of creating significant new opportunities for satellite operators. In this article, Rohde & Schwarz's Christian Baier explains how these amplifiers differ from traditional tube-based designs and what advantages this brings to the user.

SES 8K satellite transmission showcase

So, to start this story, let's first understand a bit more about SES's Luxembourg 8K satellite transmission showcase.

Using the DVB-S2X standard, SES transmitted an 8K TV signal on a single 36 MHz transponder via its Astra 3B satellite. The demo video had a staggering resolution of 7680 x 4320 pixels (8K), which is four times higher than for 4K. The signal was encoded in HEVC and transmitted at a rate of 80 Mbit/s.

The 8K content was broadcast with a frame rate of 60 frames per second and 10 bit color depth. A native IP-formatted signal was used in addition to learn about the requirements to be met for a fully IP-based broadcast infrastructure.

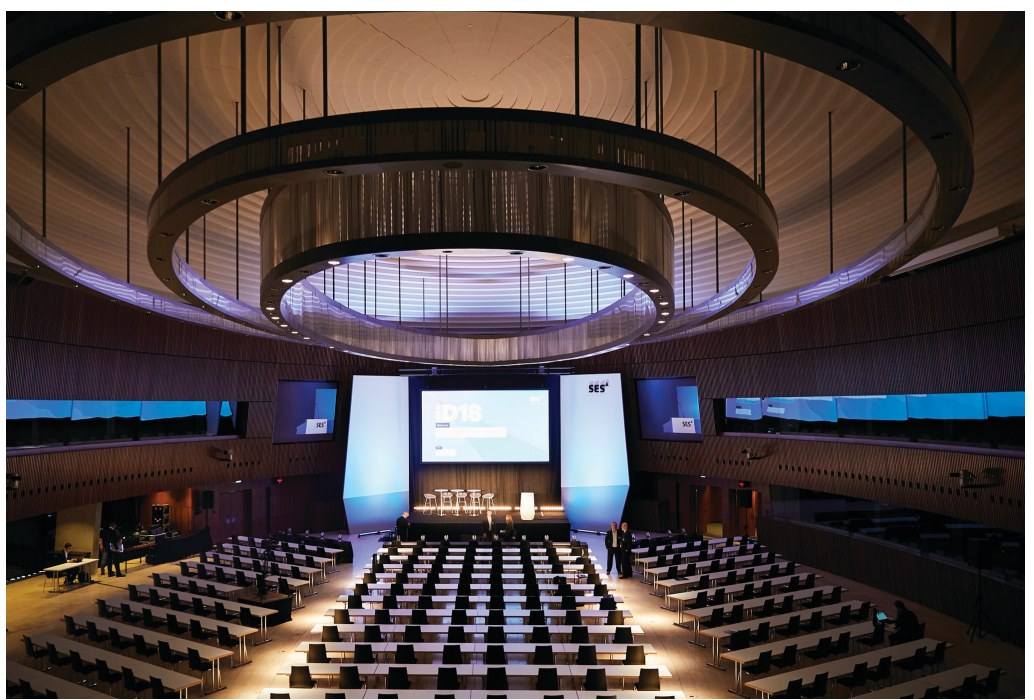
The Rohde & Schwarz R&S PKU100 satellite amplifier was used in the demo broadcast to send the HEVC encoded signal to the satellite. It features adaptive linearization for improved signal quality, enabling network operators to transmit significantly more data using the same signal bandwidth – ideal for 8K transmission.

Thomas Wrede, Vice President, New Technology & Standards at SES Video, comments: "Even though 8K resolution is not yet commercially relevant, we have shown that our satellite network is able to deliver 8K content. We are proud to provide an insight into the future of television. Rohde & Schwarz has made a valuable contribution to this achievement."

Satellite uplink amplifiers

With our rich heritage in broadcast, we are continually seeking for new opportunities where we can leverage on our experience in designing and manufacturing high power transmission equipment for demanding 24/7 applications and new satellite-based markets to establish. One critical area of satellite technology is the amplifiers which are used within ground-based equipment to uplink signals to satellites.

At Rohde & Schwarz, we have a proven track record stretching over more than six decades in the field of high power RF amplifier design. Our products were initially designed for terrestrial transmission applications but the portfolio has been successfully widened to include a diversity of applications including communications, scientific, EMC and design and product validation.



The reason for our entry into the satellite uplink amplifier market today is the opportunity we have to apply significant advances in solid-state transistor technology, which could impact the entire market.

Traditionally, high-power ku-band satellite uplink amplifiers are tube-based devices. The tube-based product is proven technology which is relatively compact and lightweight and offers good operating efficiency. However, there are some long-standing issues with tube-based amplifiers which can make their operation problematic. After first powering up the tube takes a period of time to warm up, thereby delaying system operation, plus when the tubes are subject to failure then the entire system stops operating. An alternative is solid-state amplifiers, however they have only been available in low-power categories so far and just recently, high power solid state amps have become available but are still relatively large and heavy.

At Rohde & Schwarz, our goal is to substitute traditional tube technology with the latest advances in solid state transistors. Working at high frequency, the big challenge is to design a clever heat sink concept to keep the transistors cool which increases their lifetime and performance and to come up with a compact topology for the RF components with as little as possible attenuation caused by the insertion losses of power splitters, combiners, connectors and cables. Also, we sought to develop a product that is easy to integrate within existing satellite systems, is compact, lightweight and efficient in its use of power. After a great deal of in-house R&D, we have succeeded in every respect.

Using the latest transistor technology, we have developed a new family of solid-state amplifiers which combine the best of both worlds and offer users new and radically different functionality. Importantly, if transistors fail during operation, the amplifier continues to operate with reduced output power. With no high voltages used within the product it is easy to maintain and it offers a significantly longer operating lifetime than its tube-based counterpart. Moreover, it is possible to equip the R&S amplifiers with redundant power supplies, both for AC and DC operation, so that a power supply failure does not stop the operation of the amplifier.

We have developed two power classes for our uplink amplifiers: 400W and a 750W models will be available as outdoor and indoor units and for the two frequency bands 12,75 GHz to 13,25 GHz and 13,75 GHz to 14,5 GHz. The amplifier can be used in large scale fixed satellite installations serving customer applications such as broadcasters, telecom & internet service providers, financial institutions, government and non-government organizations. At the same time, the smaller amplifier can also be used for mobile, vehicle-mounted satellite applications.

What is so important about signal linearization?

One of the most important features of the PKU100 is adaptive linearizer, which provides outstanding signal quality and makes the PKU almost 100% linear within 100MHz signal bandwidth. Signal linearization has been a feature found in several tube-based amplifiers but until now it has not been possible within solid-state amplifiers.

The R&S PKU100 comes with optional adaptive linearization. Within satellite uplink amplifiers signal linearization is critical since it produces a significantly cleaner signal from the amplifier.

The linearization has two effects: first it improves the inband signal quality which means better MER (Modulation Error Rate) respectively better EVM (Error Vector Magnitude) or NPR (Noise Power Ratio), which makes the signal easier to receive. Secondly, linearization yields much better out of band performance, i.e. significantly better shoulder attenuation which translates into lower adjacent channel power and therefore less influence on neighboring channels on the satellite.

Conclusion: a new approach for today's drive towards UHD and beyond

A key aspect is the selection of the modulation scheme for transmission. Today, the de-facto standard is DVB-S2, and the trend towards ever higher data rates, required for the transmission of 4K or 8K video for example, compels the use of higher order modulation formats in the future which are already defined in the DVB-S2X standard.

With its built-in signal linearization, the new R&S satellite amplifiers provide much better amplifier performance and offer potential for higher order modulation formats such as 64 APSK or even 256 APSK. It enables the user to extract the most from the available resource in a gallium nitride transistor.

As a consequence, satellite operators will need a significantly less powerful amplifier to transport more data across the same satellite. At a time when energy saving and increased efficiency are key drivers in the satellite communications market this is important news.

Our amplifiers are easy to transport and come in a compact enclosure: an issue which will drive a change in technology replacing tube-based amplifiers with an innovative design of solid state solution.

In many respects the R&S PKU100 family represents a quantum shift in satellite uplink amplifier technology – the world's first solid-state amplifier with automatic adaptive signal linearization offers the best of all worlds.

In the current economic environment where organizations are constantly striving to do more with less resources, the introduction of the R&S PKU100 will be a high-water mark in the international satellite market. The product will be showcased on the Rohde & Schwarz booth (# SL6405) at NAB – come along and see what all the fuss is about!