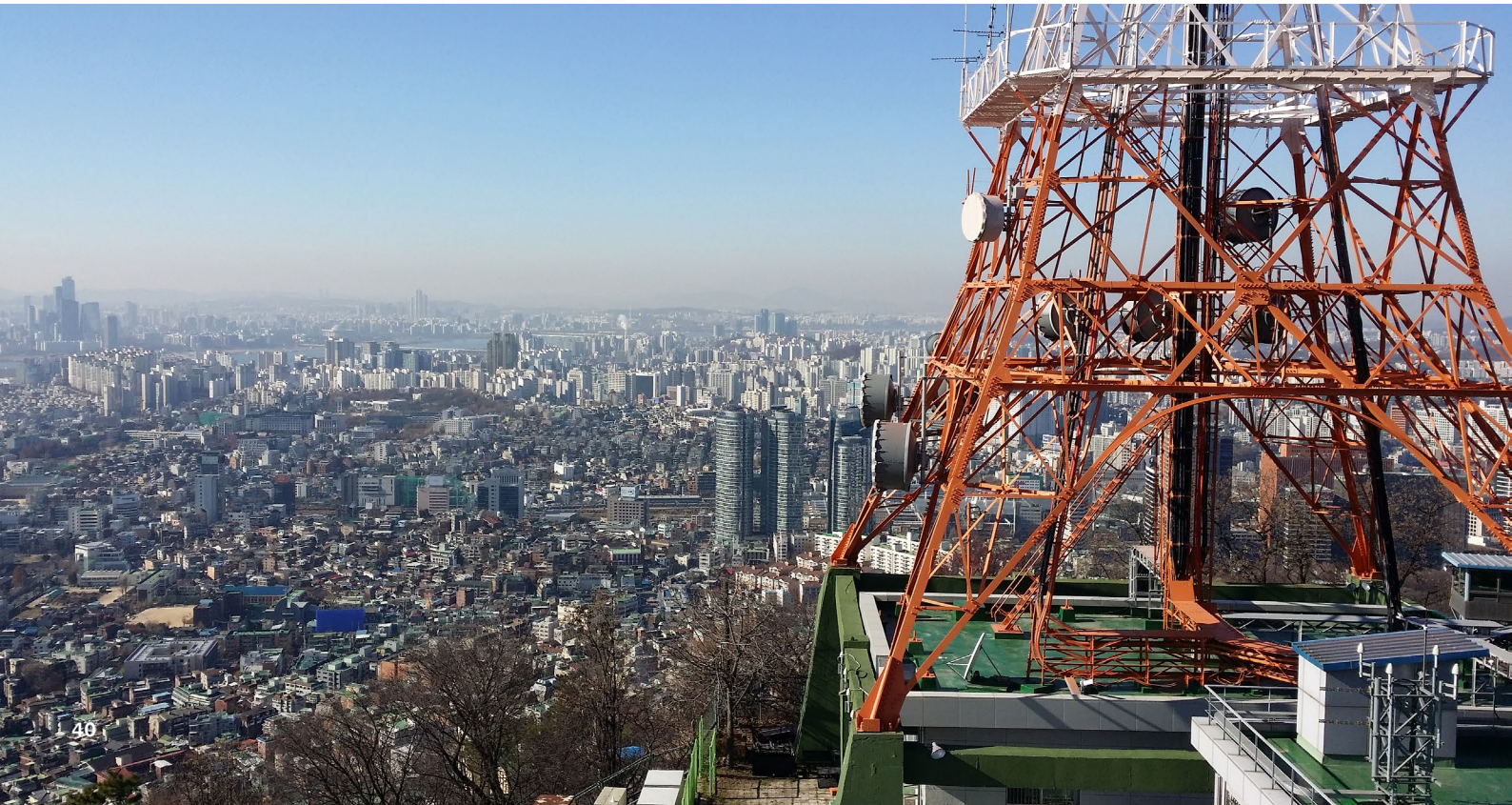
UHDTV and the Olympics

All large-format TVs sold in recent years are UHD-ready, but 4K program content is still hard to find. As the host country of the Olympic Winter Games 2018, South Korea is taking advantage of the occasion to launch a UHD campaign – and relying on transmitters from Rohde & Schwarz.

Like most countries, South Korea discontinued analog terrestrial television several years ago, and in late 2012 they migrated to digital broadcasting based on the ATSC standard. Since there were already signs of a UHD technology breakthrough back then, initially at the TV end (in large part due to the efforts of Korean manufacturers), the three terrestrial broadcast network operators – public broadcaster KBS and private broadcasters MBC and SBS – started transmitting trial UHD programs as early as 2014 in order to get acquainted with the technology and to see how well it worked in practice. Market surveys indicated that the tech-savvy Korean viewers definitely appeared to be ready for it. At that time, the only UHD-capable technology for terrestrial broadcasting was the DVB-T2 standard, which was already available in Rohde & Schwarz transmitters. These transmitters were therefore used for the trials. In the meantime, however, the ATSC standardization committees had defined version 3.0 to the point that implementation in products was imminent. The Korean state organizations that address this topic – the Next Generation Broadcasting Forum (NGBF) and the Telecommunications Technology Association (TTA) – ultimately opted for nationwide adherence to the ATSC family of standards and to implement an ATSC 3.0 network. From a performance perspective, there is not much difference between the ATSC 3.0 and DVB-T2 standards. They have similar spectral efficiency and allow the use of advanced video encoding. With a consistent focus on the Internet protocol (IP) in the baseband, however, ATSC 3.0 is the first IP-native broadcasting standard. Rohde & Schwarz has broken new ground in signal processing by developing the R&S®SDE 900, the world's first IT server-based exciter (see box). It allows the full scope of the standard's flexibility to be utilized.

Fig. 1: Together with three other stations, the Namsan broadcasting station provides UHDTV coverage for the Seoul metropolitan area.



Seoul Broadcasting System (SBS) was not only the first South Korean broadcaster to employ the new broadcasting technology, it was the very first broadcaster ever to do so. At the kickoff, in December 2016 viewers could follow a short track speed skating World Cup competition via terrestrial reception in UHD quality, broadcast by an R&S®THU9 high-power transmitter located on Gwanak Mountain. Together with the three stations Namsan (Fig. 1), Yongmoon and Gwanggyo, which are also equipped with Rohde & Schwarz transmitters, the Gwanak transmitter provides single-frequency network (SFN) coverage in the Seoul region.

Whereas the first phase of the Korean UHD project focused on the Seoul capital region where about half of the fifty million residents live, the second phase aims to achieve 77 % coverage by the end of 2017, including the metropolitan areas of Busan, Gwangyu, Daegu, Daejeon and Ulsan and also the Olympic site. The goal is 90 % coverage by 2020. All three network operators are participating in this expansion and have opted for Rohde & Schwarz transmitters. The second phase is the installation of 27 transmitter systems in the 5 kW and 2 kW power classes in a customer-specific backup configuration. Everything has to be delivered quickly and put into operation by the end of 2017. There can be no delays, since the Olympic Winter Games will start promptly on February 9 in Pyeongchang city – and with them a new era of television.

The world's first server-based exciter

For ATSC 3.0 broadcasting, Rohde & Schwarz launched the world's first server-based exciter solution – an ingenious choice since ATSC 3.0 was developed with the aim of integrating IP technologies (Fig. 2). Broadcast network operators benefit from the high flexibility of this approach because it not only ensures future-proof solutions with regard to the evolution of ATSC, but also potentially allows the integration of other standards.

The flat plug-in makes it easy to upgrade the current R&S®Tx9 transmitter generation to the new standard. A purely software-based encoder generates the I/Q modulation data and feeds it to the R&S®TCE90x exciter, which in turn generates the COFDM waveform using the most powerful precorrection on the market. The entire solution offers the high level of signal quality expected from Rohde & Schwarz.

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From ATSC 1.0 to ATSC 3.0

Advanced Television Systems Committee (ATSC) standards are a set of standards for digital terrestrial television. The ATSC is an international, non-profit organization based in the U.S. The first ATSC standard was drafted in the mid-1990s, at the same time as the first DVB standard. ATSC 1.0 provided for exclusively MPEG-2 coded video content and a fixed data rate of 19.39 Mbit/s. It was later amended slightly to support MPEG-4 video (H.264) as well. The physical layer is based on eight-level vestigial sideband modulation (8VSB*) on a single carrier. The RF channel bandwidth is specified as 6 MHz. Due to the single-carrier modulation, the possibility of implementing single-frequency networks (SFN) is very limited. In contrast, the new ATSC 3.0 standard (version 2.0 was never officially approved) is based on modern orthogonal frequency division multiplexing (OFDM), so it can also be used to set up single-frequency networks.

The general design goals for ATSC 3.0 were reliable transmission of high-resolution broadcast formats for reception by both fixed and mobile devices as well as more efficient and flexible spectrum utilization. Higher spectral efficiency is primarily achieved by means of non-uniform modulation and forward error correction (FEC).

Thanks to the consistent use of IP in the baseband and in the protocol layers, the standard allows the broadcasting service to be augmented with other IP sources. For example, it is theoretically possible to combine the picture content of an ATSC 3.0 broadcast with a sound track that reaches the user over the Internet via unicast.

* The digit 8 stands for the eight possible digital symbols that can be transmitted using this modulation method.

Fig. 2: A pioneering approach in a deceptively simple package: the server-based R&S®SDE900 baseband unit utilizes standard IT components instead of special hardware.