ATSC 3.0 Technical overview

ATSC 3.0 (Advanced Television Systems Committee) is a digital terrestrial broadcasting standard that has been substantially enhanced compared with the ATSC A/53 predecessor standard. ATSC 3.0 is designed to allow network operators more flexibility, greater robustness and more efficient operation. It employs state-of-the-art encoding and modulation technologies, enabling a significantly more effective use of the limited spectrum resources. In this way, capacity is created to transfer UHD video contents and immersive audio contents to the end user via terrestrial networks, using a minimum of resources. The consistent focus on IP technology in the baseband makes it possible to merge cost-effective terrestrial broadcasting with other IP-based services.

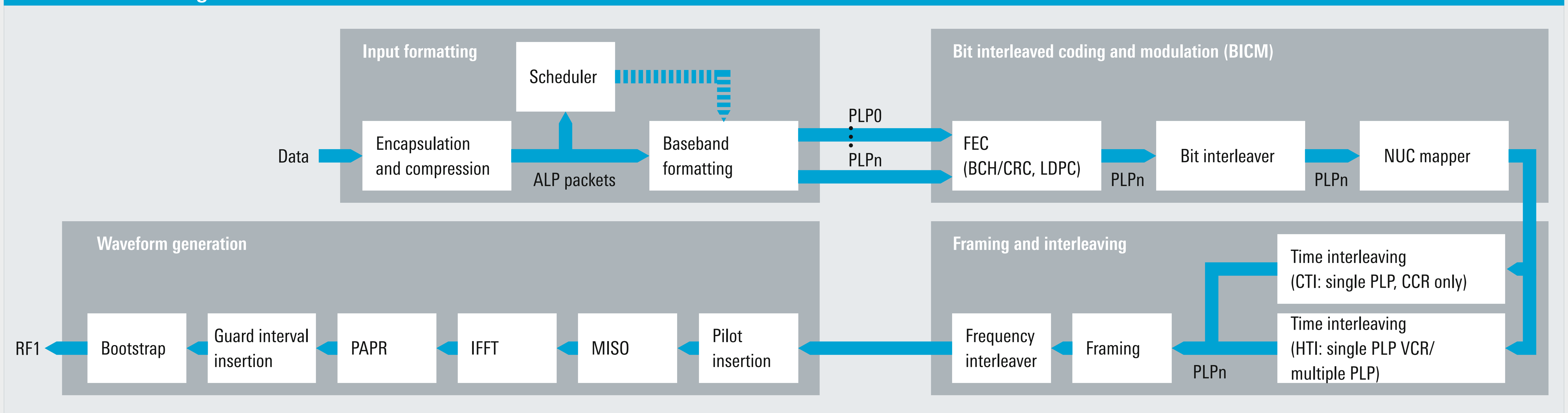
ATSC 3.0 is the first ATSC standard to employ coded orthogonal frequency division multiplexing (COFDM). This modulation method uses a large number of orthogonal carriers, resulting in a signal that is robust against interference. COFDM technology also makes it possible to set up spectrum-efficient ATSC 3.0 single-frequency networks (SFN).

Use of the latest low density parity check (LDPC) codes in combination with Bose-Chaudhuri-Hocquenghem (BCH) codes allows the usable channel capacity to approach the theoretical Shannon limit, as does the use of non-uniform constellations (NUC) for modulation. ATSC 3.0 employs multiple physical layer pipe (multiple PLP) technology, enabling a flexible use of the channel. Using modern technologies such as layer division multiplexing (LDM), it is possible to implement effective, simultaneous transmission to mobile as well as fixed receivers.

Key features

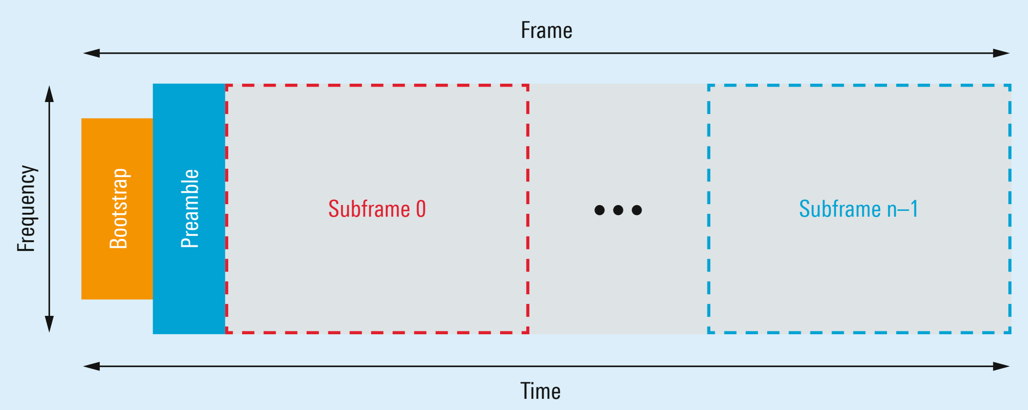
OFDM technology	spectrum-efficient
Layer division multiplexing	flexible coverage of services
IP-based content delivery	designed for UHDTV and HDR

ATSC 3.0 block diagram



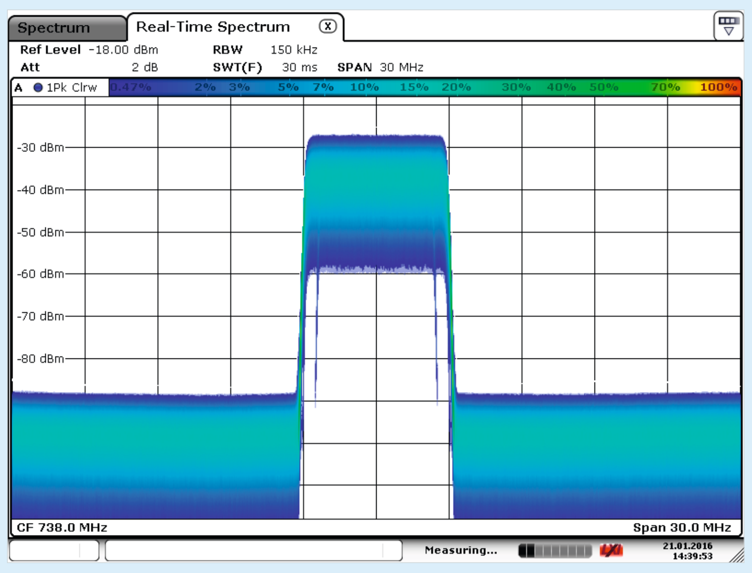
ATSC 3.0 frame structure

An ATSC 3.0 frame consists of a bootstrap, preamble and one or more subframes. The bootstrap and preamble contain the basic signaling information and the L1 signaling data for the frame. One subframe can carry the payload of one or multiple PLPs.

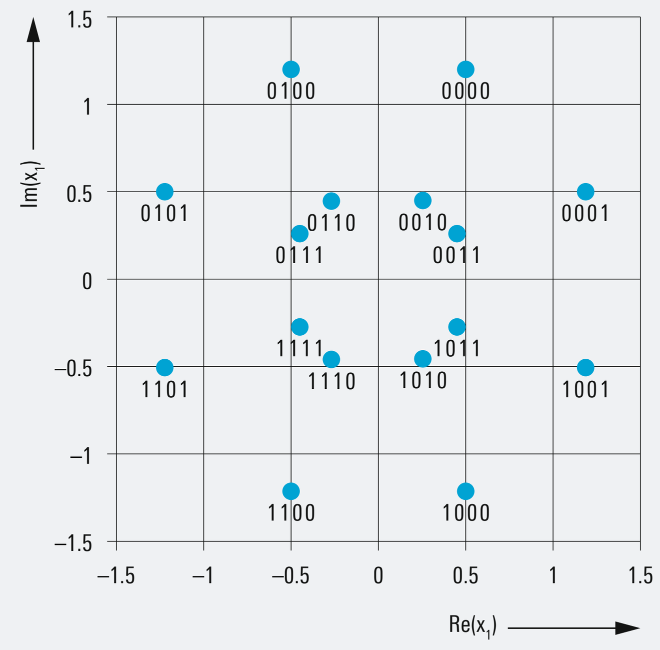


ATSC 3.0 spectrum

Due to the smaller bandwidth, the bootstrap is clearly visible in the ATSC 3.0 spectrum



16QAM non-uniform constellation (NUC) diagram



For non-uniform constellations, the points in a constellation diagram are not equidistant for in-phase and quadrature components. For each LDPC code rate, a specific NUC is defined to maximize spectral efficiency.

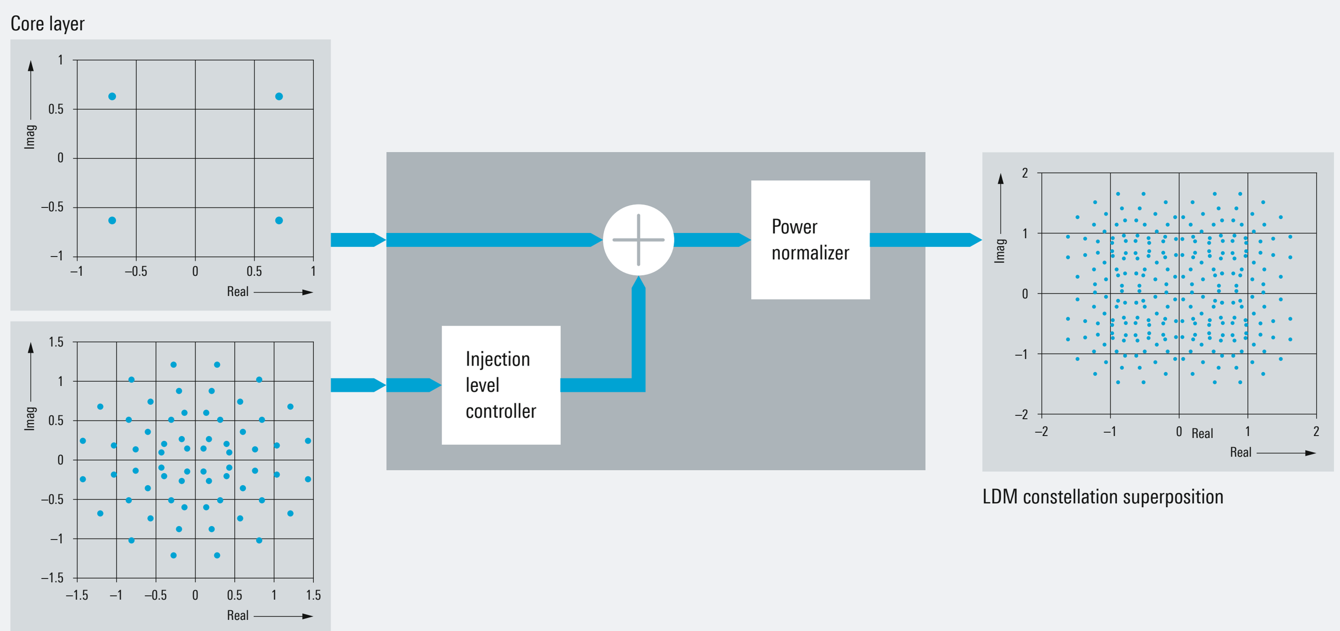
OFDM parameters

Parameter		8K FFT	16K FFT	32K FFT
Number of carriers NoC	$C_{red\_coeff} = 0$	6913	13825	27649
	$C_{red\_coeff} = 1$	6817	13633	27265
	$C_{red\_coeff} = 2$	6721	13441	26881
	$C_{red\_coeff} = 3$	6625	13249	26497
	$C_{red\_coeff} = 4$	6529	13057	26113
Duration T_U		8192 T	16384 T	32768 T
Duration T_U (µs) [1), 2)]		*1185.185*	*2370.370*	*4740.741*
Carrier spacing $1/T_U$ (Hz) [2)]		843.75	421.875	210.9375
Spacing between carriers 0 and NoC – 1 in MHz: $(NoC-1)/T_U$ [2)]	$C_{red\_coeff} = 0$	5.832	5.832	5.832
	$C_{red\_coeff} = 1$	5.751	5.751	5.751
	$C_{red\_coeff} = 2$	5.670	5.670	5.670
	$C_{red\_coeff} = 3$	5.589	5.589	5.589
	$C_{red\_coeff} = 4$	5.508	5.508	5.508

1) Numerical values in italics are approximate values.
2) Values for bsr_coefficient = 2 and system_bandwidth = 6 MHz.

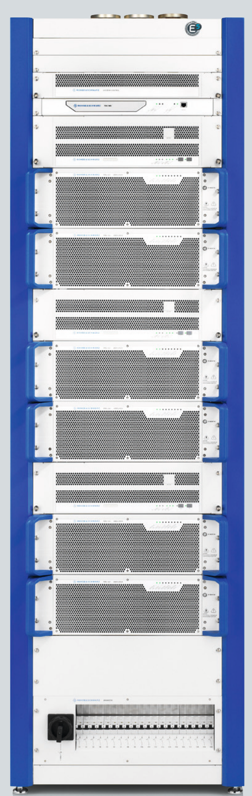
Layer division multiplexing (LDM)

LDM allows for a spectrum-efficent constellation superposition of multiple PLPs at different power levels for transmission in one RF channel. Different PLPs can have different FEC and modulation parameters. This gives flexibility to broadcasters to design the individual layers for robustness and payload capacity as required for different reception conditions.



Rohde & Schwarz solutions for ATSC 3.0

R&S®BTC broadcast test center



R&S®TMU9/R&S®TMV9 TV transmitter

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ATSC 3.0 Technical overview

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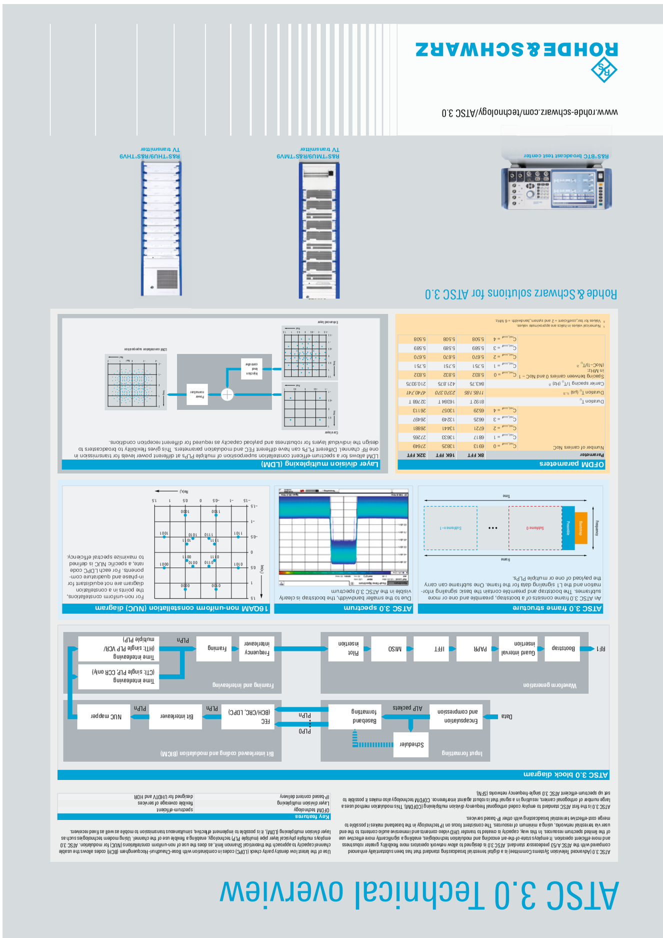

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