IEEE 802.16m/WiMAX™ Rel. 2.0

Technology Overview

The goal of IEEE 802.16m is to develop an advanced air interface (AAI) to meet the requirements for IMT-Advanced next generation networks while being backward-compatible with legacy WiMAX™ Release 1.0 devices. IEEE 802.16m is an amendment to the released IEEE 802.16-2009 standard.

To achieve data rates up to 1 Gbit/s for low mobility scenarios, as requested by IMT-Advanced, several enhanced features have been introduced including multi-carrier aggregation, enhanced MIMO scheme support and a superframe to reduce control overhead.

In addition, the overall performance will be improved with multi-user MIMO (MU-MIMO), multi-BS MIMO, relay station support, self-organizing networks (SON) and Femtocells.

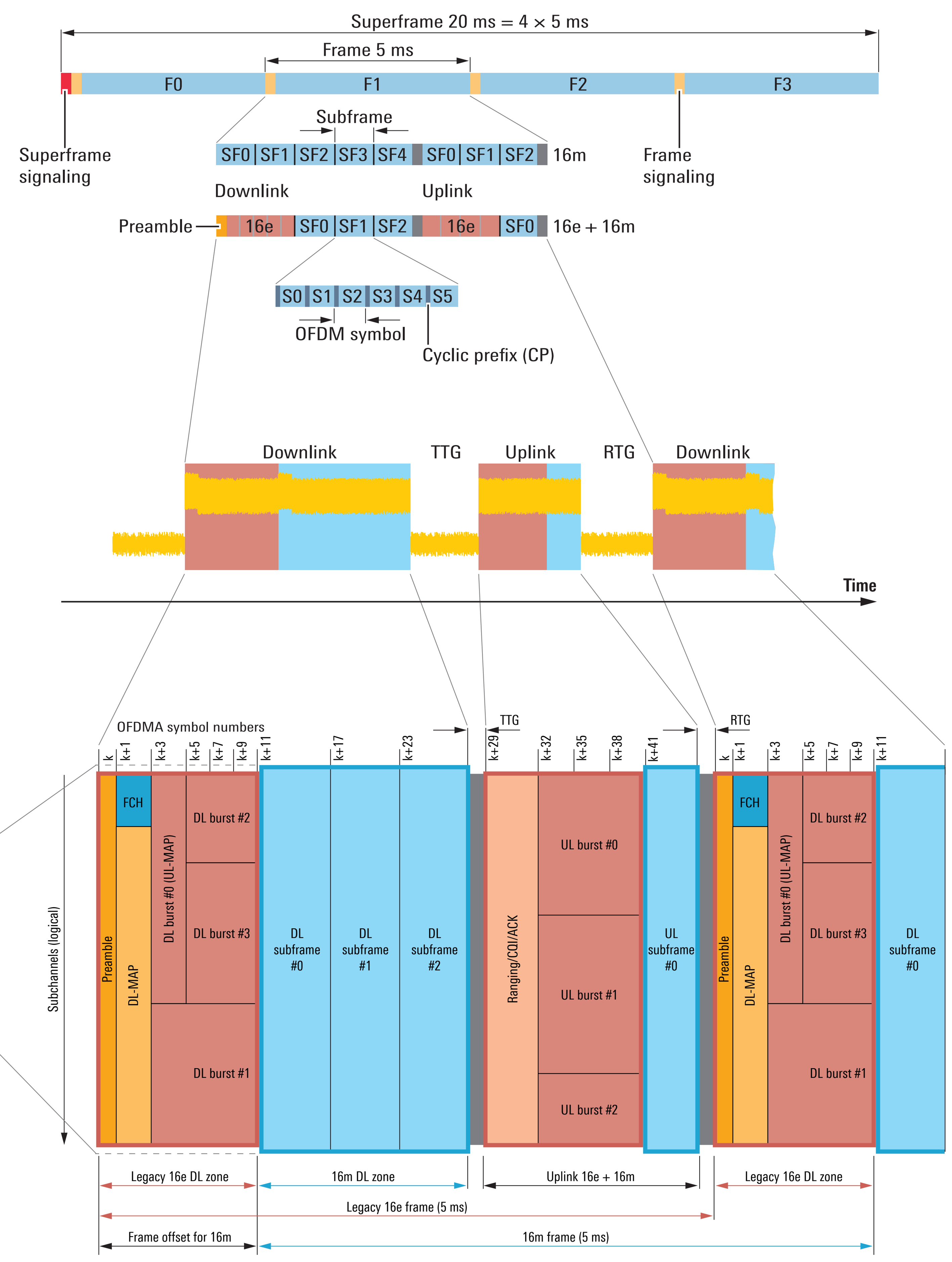
Rohde & Schwarz provides leading test solutions for IEEE 802.16-2009. These include the R&S®SMU200A and R&S®AMU200A signal generators and fading simulators offering a unique two-path concept and the high-performance R&S®FSQ and R&S®FSV signal and spectrum analyzers. Featuring a MIMO base station emulator for IP application testing and dual-tester configuration for high-speed RF and baseband alignment, the R&S®CMW270 and R&S®CMW500 wireless communication testers are the ideal choice for all stages of mobile equipment testing. The R&S®TS8970 radio conformance tester (RCT) and the R&S®TSMW radio network analyzer for drive tests round off the test and measurement solutions, which are applicable from R&D through to production and network deployment.

Already today test solutions from Rohde & Schwarz can be used to generate and analyze signals for carrier aggregation as specified in IEEE 802.16m.

Release 2.0 Enhancements

	WiMAX™ Release 1.0 IEEE 802.16e	WiMAX™ Release 2.0 IEEE 802.16m
Duplexing mode	TDD	TDD, FDD
Channel bandwidth	3.5/5/7/8.75/10 MHz	5/10/20 MHz per carrier, multi-carrier support
MIMO scheme typical / typical / standardized	DL: 2×2 UL: 1×2 8×8	DL: 2×2, 2×4, 4×2, 4×4 UL: 1×2, 1×4, 2×2, 2×4 8×8
Latency Link layer access Handoff	 approx. 20 ms approx. 35 to 50 ms	 < 10 ms < 30 ms
Spectral efficiency (per sector)	peak: DL: 6.4 bit/s/Hz UL: 2.8 bit/s/Hz sustained: DL: 1.55 bit/s/Hz UL: 0.9 bit/s/Hz	peak: DL: 15 bit/s/Hz UL: 6.75 bit/s/Hz sustained: DL: 2.6 bit/s/Hz UL: 1.3 bit/s/Hz
Average sector throughput TDD (DL:UL = 2:1)	DL: 25 Mbit/s (AMC) UL: 6 Mbit/s at 10 MHz	DL: > 35 Mbit/s UL: 8.7 Mbit/s at 20 MHz
Peak data rate (DL)	128 Mbit/s (20 MHz, 2×2 MIMO, TDD)	1 Gbit/s (3 × 20 MHz multi-carrier, 4×4 MIMO, TDD)
Number of active VoIP users	approx. 25 users/sector/MHz	> 60 users/sector/MHz
Maximum coverage	30 km (optimum at 5 km)	30 km (optimum at 5 km)

Release 2.0 Frame Structure



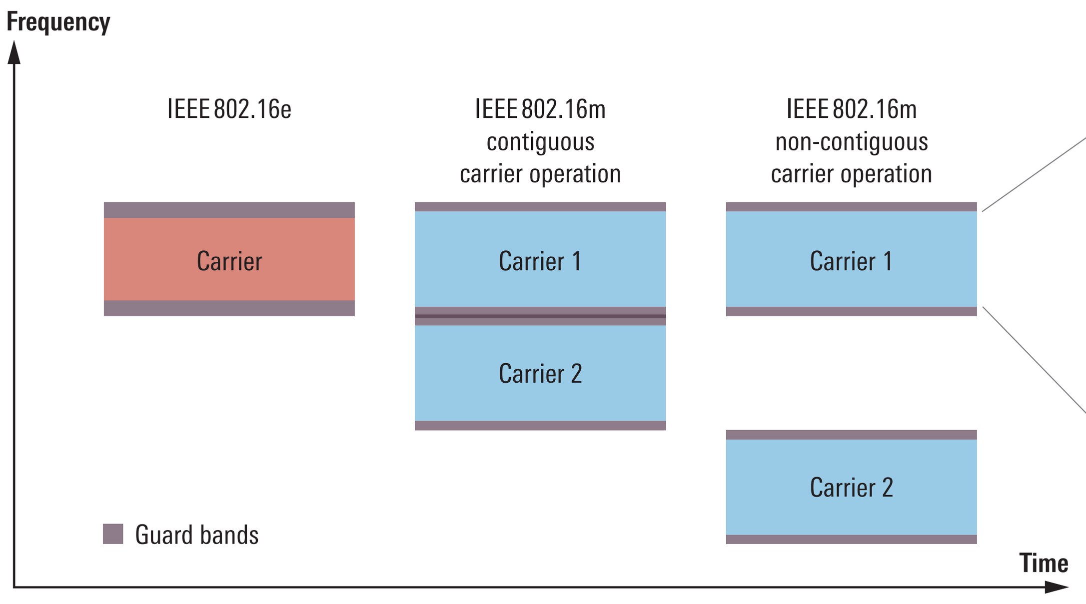
Frame structure

IEEE 802.16m introduces a superframe consisting of four frames with a total length of 20 ms. Control information with larger repetition times, such as the system configuration of a BS, is combined in the superframe signaling and is valid for multiple consecutive frames. This reduces overhead and increases the effective data rate.

One frame has a fixed frame length of 5 ms and contains 5 to 8 subframes. A subframe consists of 5, 6, 7 or 9 OFDM symbols. IEEE 802.16m supports cyclic prefixes of 1/4, 1/8 and 1/16.

Multi-carrier aggregation

To increase the data rate, WiMAX™ IEEE 802.16m features carrier aggregation, the combination of two or more carriers. The carriers can be allocated contiguous or non-contiguous in the same or different frequency bands. In addition, by reducing the guard band of a carrier, more subcarriers are available for data. The guard bands between contiguous carriers can also be used for data transmission.



Legacy support

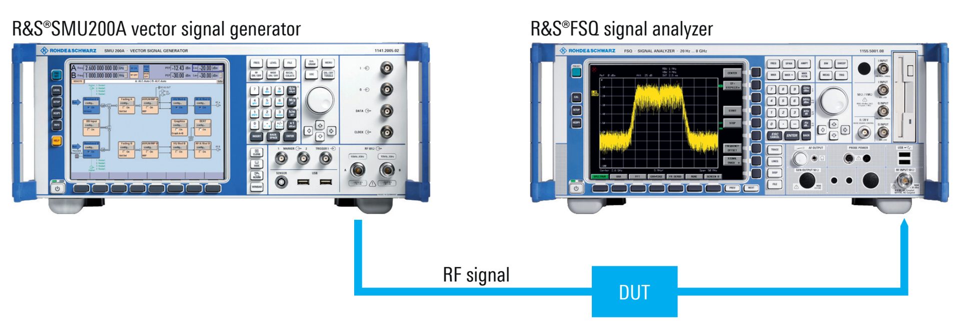
The IEEE 802.16m frame structure supports IEEE 802.16e terminals by allocating a variable area based on the number of terminals and data services. This ensures backward compatibility.

Three different modes are available for the frame structure: the Greenfield mode for IEEE 802.16m, the Brownfield or legacy mode for IEEE 802.16e and the mixed mode for both IEEE 802.16m and IEEE 802.16e.

In mixed mode, both standards apply their own signaling procedures, such as preamble and MAP, and operate independently from each other. The IEEE 802.16e frame starts with the legacy frame, the IEEE 802.16m frame starts delayed, with the first IEEE 802.16m DL subframe.

Multi-carrier Aggregation

Test setup for two carriers



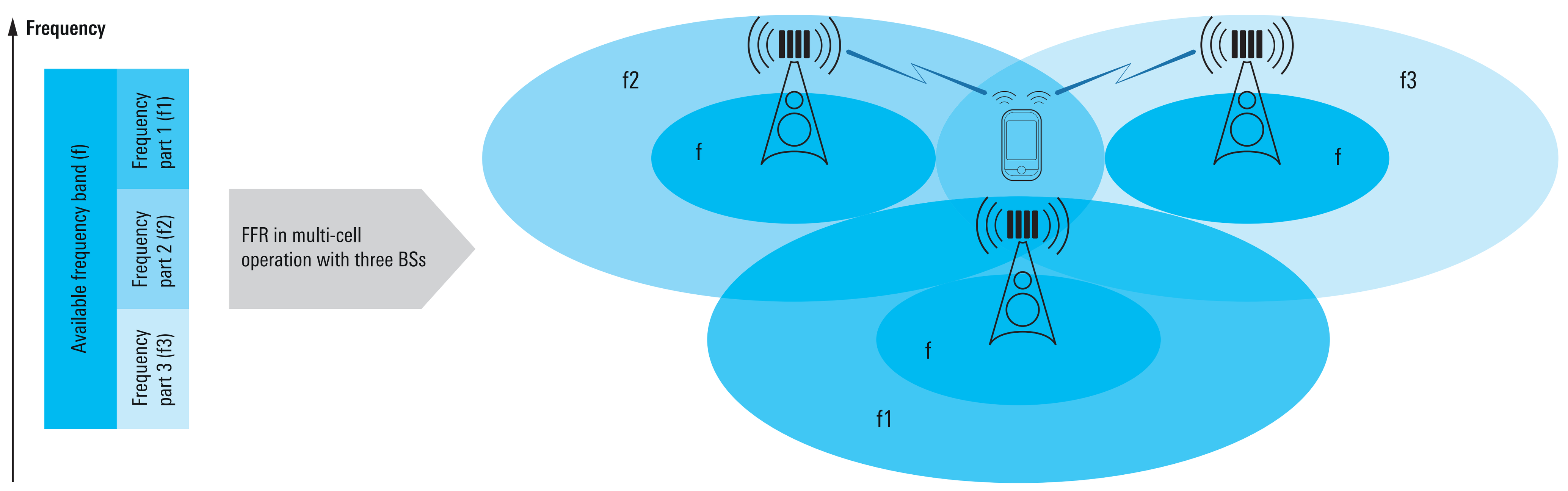
Multi-carrier signals with up to four carriers can easily be generated with the R&S®SMU200A, R&S®SMBV100A and R&S®AMU200A signal generators. The test setup supports carriers with different bandwidths, as well as contiguous and distributed frequency allocation, even in different frequency bands.

Current discussions favor an initial deployment of two carriers with 2 × 10 MHz and 2 × 20 MHz. The unique two-path concept of the R&S®SMU200A and R&S®AMU200A enables aggregation of two carriers with one instrument.

Signal analyzers from Rohde & Schwarz support multi-carrier signal testing. Each individual carrier can be demodulated and analyzed with the high-performance R&S®FSQ or R&S®FSV signal and spectrum analyzer.

Fractional Frequency Reuse

FFR and multi-BS MIMO deployment scenario



For better frequency spectrum usage, WiMAX™ IEEE 802.16m applies fractional frequency reuse (FFR). In FFR, adjacent base stations use the whole available frequency spectrum in non-overlapping areas. In overlapping areas, the frequency band is divided among the base stations. This reduces interference and also enables a mobile terminal located in an overlapping area to connect to more than one base station, which is referred to as multi-BS MIMO.

Glossary:
AAI = Advanced Air Interface, **ACK** = Acknowledgment, **AMC** = Adaptive Modulation and Coding, **BS** = Base Station, **BSE** = Base Station Emulator, **CP** = Cyclic Prefix, **CQI** = Channel Quality Indicator, **DL** = Downlink, **DUT** = Device Under Test, **f** = Frequency, **FCH** = Frame Control Header, **FDD** = Frequency Division Duplex, **FFR** = Fractional Frequency Reuse, **MIMO** = Multiple Input Multiple Output, **MU-MIMO** = Multi-user MIMO, **OFDM** = Orthogonal Frequency Division Multiplex, **OFDMA** = Orthogonal Frequency Division Multiple Access, **RCT** = Radio Conformance Test, **RTG** = Receive Transition Gap, **SF** = Subframe, **SON** = Self-Organizing Network, **TDD** = Time Division Duplex, **TTG** = Transmit Transition Gap, **UL** = Uplink, **VoIP** = Voice over IP, **WiMAX™** = Worldwide Interoperability for Microwave Access

PD 5213.9992.82 V01.00 (sv)

www.rohde-schwarz.com/technology/wimax

ROHDE & SCHWARZ