

# 5G

## TERMS AND ACRONYMS



# Common Terms & Acronyms

The promise of 5G is faster and more reliable communications. 5G opens doors to exciting new connections to Internet of Things (IoT) networks, autonomous driving, broadband wireless, and interruption-free video viewing. Whatever you develop 5G technology for, it will be imperative to understand design and test concepts and solutions across multiple dimensions. There are a lot of 5G terms and more on the way. We've got you covered – here's a list of what's out there today.

## 2G

Second-generation digital cellular networks used by mobile phones, designed as a replacement for analog first-generation radio (1G). Designed primarily for voice using digital standards.

## 3G

Third-generation wireless mobile telecommunications technology, required by International Mobile Telecommunications for the year 2000 (IMT-2000) standard from International Telecommunication Union (ITU) to support at least 200 kbps at peak rate. First mobile broadband utilizing IP protocols added text and image messaging to voice phone calls.

## 3GPP – 3rd Generation Partnership Project

A mobile communications industry collaboration that organizes the development and management of mobile communications standards. With respect to 5G, 3GPP is managing the evolving 5G standards.

## 4G

Fourth-generation mobile telecommunications technology, designed to succeed 3G. A mobile broadband standard designed to support an all Internet Protocol (IP) network for calls, video, data, and web access. The performance goals of 4G are 100 Mbps for high-speed mobile applications such as automobiles, and 1 Gbps for low-mobility use cases including pedestrians and fixed-location access.

## 5G

Fifth-generation of mobile telecommunications technology, required by International Mobile Telecommunications for the year 2020 (IMT-2020) standard to support an all Internet Protocol (IP) network. Supports faster data rates, higher connection density, and much lower latency.

## AAT – Antenna array tool

Software tool for embedding antenna parameters and radiation patterns in test scenarios.

## ACP – Adjacent channel power

The power contained in a frequency channel next to the specified channel.

## ACPR – Adjacent channel power ratio

The ratio of the power contained in a specified frequency channel bandwidth relative to the total carrier power.

## ACLR – Adjacent channel leakage ratio

The ratio of the transmitted power on the assigned channel to the power received on the adjacent channel after passing through a root raised-cosine filter.

## AM distortion

Undesirable distortion caused by amplitude variation in a communications system.

## **AMF – Access and mobility management function**

A component of the 3GPP core network architecture that manages user equipment registration, authentication, identification, and mobility. AMF also terminates non-access stratum signaling.

## **AM/PM distortion**

Undesirable distortion that causes signal degradation in a communications system, typically as the result of the interaction between an amplifier's phase response and the power level (or amplitude) of the input signal.

## **Antenna reciprocity**

A theory that states that the transmit properties of an antenna will be identical to the receive properties of that antenna in a given medium.

## **AUSF – Authentication server function**

A major component of the 5G core network used to facilitate security processes. The AUSF authenticates UEs and stores authentication keys.

## **AWG – Arbitrary waveform generator**

Electronic equipment used to generate signals for injection into a device under test (DUT) to characterize its performance.

## **Backhaul**

The part of the network responsible for transporting communication data between the baseband unit (BBU) and the core network. Connects smaller outlying networks with the core network. Backhaul was often proprietary in earlier cellular generations but is moving to ethernet in 5G.

## **Base station network emulator**

A tool for simulating protocol and network traffic in a test environment. Works in concert with UE emulation and channel emulation to provide an end-to-end system for testing and measuring 5G network performance at scale.

## **BBU – Baseband unit**

A component of the base station. Equipment which handles radio communications and radio control processing functions. The baseband unit converts data into a digital signal and sends

it on to the remote radio head (RRH), which then converts it into an analog signal. In a C-RAN architecture, the baseband unit is usually geographically separated from the radio head.

## **Beam acquisition**

The process of discovering and connecting with UEs. This process is substantially changing in 5G with the deployment of highly directional antenna arrays and beamforming techniques.

## **Beamforming**

The method of applying relative phase and amplitude shifts to each antenna element to shape and provide discrete control of the direction of a transmitted beam. Beamforming requires communication channel feedback to implement real-time control of the beam.

## **Beam steering**

A set of techniques used to focus the direction and shape of a radiation pattern. In wireless communications, beam steering changes the direction of the signal and narrows the width of the transmitted signal, typically by manipulating relative phase and amplitude shifts of the signal through an array of multiple antenna elements.

## **Carrier aggregation**

A major feature introduced with LTE-Advanced, enabling mobile network operators to combine multiple carriers in fragmented spectrum bands to increase peak user data rates and overall capacity of the network.

## **CATR – Compact antenna test range**

Equipment for testing of antennas at frequencies when difficult to obtain far-field spacing. The CATR uses the 3GPP-approved indirect far-field (IFF) test method to overcome the path loss and excessive far-field distance issues associated with 5G cellular communications.

## **CE – Channel emulator**

Electronic equipment that enables real-time performance testing of wireless devices and base stations. Channel emulators simulate the impairments of real-world radio channel conditions to validate the performance of base stations, chipsets, and devices.

## **Cell tower**

Physical location of electronic communications equipment, including antennas to support cellular communication in a network.

## **CIR – Channel impulse response**

The correlation of the received signal against the transmitted signal during testing.

## **CoMP – Coordinated multipoint**

A technique where multiple base stations can coordinate downlink transmission (from base station (BS) to user equipment (UE)) and uplink transmission (UE to BS) to improve the overall reliability and performance.

## **Control plane**

The part of a network that carries information that establishes and controls the network. It controls the flow of user information packets between network interfaces.

## **Core network**

The part of the network that provides services to mobile subscribers through the radio access network (RAN). It is also the gateway to other networks, for instance to the public-switched telephone network or public clouds.

## **CPE – Common phase error**

A measurement of noise in orthogonal frequency division multiplexing (OFDM). CPE describes the average of the phase noise sequence spanning an OFDM symbol.

## **CP-OFDM – Cyclic prefix orthogonal frequency division multiplexing**

An orthogonal frequency division multiplexing (OFDM) technique that uses cyclic prefixes (CP) instead of null guards, protecting OFDM signals from intersymbol interference (ISI).

## **CPRI – Common public radio interface**

An interface specification standard that defines a layer-1 and layer-2 interface for connecting radio equipment such as radio heads on towers to other radio equipment control infrastructure located at the base of the tower or in a centralized facility.

## **C-RAN – Centralized RAN**

A radio access network (RAN) architecture that separates baseband functions from antennas and remote radio heads (RRH) and pools baseband functions in centralized baseband units (BBU). A competing architecture to multi-access edge computing (MEC).

## **CRS – Cell-specific reference signal**

A signal transmitted to estimate the channel between the base station and the user equipment as a reference point for downlink power.

## **CSI – Channel state information**

Refers to known properties of a communication link. 5G NR specifies a new beam management framework for CSI acquisition to reduce coupling between measurements and reporting to control different beams dynamically.

## **CUPS – Control user plane separation**

Foundational concept for 5G networks that enables operators to independently scale the control plane and user plane of the mobile network as needed.

## **Data plane**

The part of a network through which user packets are transmitted. It is often included in diagrams and illustrations to give a visual representation of user traffic. Also known as the user plane, forwarding plane, or carrier plane.

## **DFF – Direct far field**

An over-the-air (OTA) test method used in 5G that involves mounting the device under test (DUT) on a positioner that rotates in azimuth and elevation. This process enables measurement of the DUT at any angle on the full 3D sphere. The DFF method can perform the most comprehensive tests measuring multiple signals and requires a larger test chamber for mmWave devices.

## **DFT-s-OFDM – Discrete Fourier transform spread orthogonal frequency division multiplexing**

An optional modulation format used in the uplink in 5G NR. DFT-s-OFDM uses the mathematical concept of discrete Fourier transform to encode digital data on multiple frequency

channels in a frequency division multiplexing scheme, increasing bandwidth, and decreasing response time.

## DL – Downlink

The path of transmission from the base station to the user equipment (UE). In 5G, the DL waveform is orthogonal frequency division multiplexing (OFDM).

## DUT – Device under test

Device under test (DUT), equipment under test (EUT), system under test (SUT) and unit under test (UUT) are terms used to refer to a device undergoing measurement procedures.

## EIRP – Effective isotropic radiated power

An IEEE standardized definition for the measurement of the radiated power of an antenna in a specific direction.

## eLTE eNB

An evolved 4G eNodeB (or eNB) that can support connectivity to the 4G evolved packet core (EPC) as well as the 5G next-generation core network (NGC or NGCN).

## eMBB – Enhanced mobile broadband

One of three primary use cases defined in the IMT-2020 vision. Enhanced Mobile Broadband refers to target 5G peak and average data rates, capacity, and coverage as compared to conventional mobile broadband (MBB). eMBB specifies a 5G design capable of supporting up to 20 Gbps in the downlink, and 10 Gbps in the uplink.

## eNB – Evolved Node B or eNodeB

Base stations connected to the network that communicate wirelessly with mobile handsets in a 4G LTE network or 5G non-standalone (NSA) mode.

## EN-DC – E-UTRAN New Radio – dual connectivity

A term for the simultaneous 4G LTE and 5G NR connectivity prescribed by 3GPP Release 15. EN-DC enables user equipment to connect simultaneously to an LTE base station and a 5G base station.

## EPC – Evolved packet core

The core network of the 4G LTE system, the EPC features a flat architecture to handle voice and data efficiently. It requires

a few network nodes to be involved in the handling of traffic. EPC serves as an anchor in initial implementations of 5G fixed wireless access (FWA).

## EPS – Evolved packet system

Evolved end-to-end-architecture composed of the base station and evolved packet core (EPC) that enables 4G mobile communication.

## ERTA – Extended range transmission analysis

A technique used to measure the scalar transmission gain or loss of an RF system.

## E-UTRAN – Evolved UMTS terrestrial radio access network

A new radio interface specified by the 3GPP consortium and introduced with LTE in 2008. It was designed to meet ever-increasing data transfer rates while reducing the radio operation latency.

## EVM – Error vector magnitude

Error vector magnitude is a measurement used to quantify the quality of a digital radio signal. The measurement is a representation of how far the actual signal deviates from an ideal representation of that same signal.

## FBMC – Filter bank multicarrier

A form of multicarrier modulation that deploys without synchronization of mobile user nodes signals. It offers better usage of available channel capacity, higher data rates within a given spectrum bandwidth, and higher spectrum efficiency. FBMC is considered inferior to orthogonal frequency division multiplexing (OFDM) in handling multiple-input / multiple-output (MIMO) channels.

## FDD – Frequency division duplex

Using two different radio frequencies for transmitter and receiver operation to establish a full-duplex communications link.

## FD-MIMO – Full dimension MIMO

A MIMO technique added to the 3GPP specification with LTE-Advanced Pro (Release 13). FD-MIMO extends MIMO concepts to work in three dimensions: azimuth (horizontal), control (range), and elevation (vertical).

## **FPY – First pass yield**

Metric describing the number of finished units compared to the number of units that went into the manufacturing process. FPY is a critical metric for device makers and is likely to decline with the complexities of 5G.

## **FR1 – Frequency range 1**

One of two frequency ranges prescribed by 5G NR. FR1 covers sub-6 GHz frequency bands, including some used by previous standards. FR1 also covers potential new spectrum offerings between 410 MHz and 7125 MHz.

## **FR2 – Frequency range 2**

The second of two frequency ranges prescribed by 5G NR; FR2 includes the millimeter wave (mmWave) frequencies between 24.25 GHz and 52.6 GHz. Bands in FR2 have a shorter range and higher available bandwidth compared to bands in FR1.

## **Fronthaul**

Refers to links in the C-RAN that connect radio equipment at the tower with centralized radio controllers (radio equipment control). Fronthaul data is generally transported over fiber optics using the CPRI (common public radio interface) standard. Each manufacturer has a proprietary overlay to CPRI that exclusively requires that vendor's equipment on both ends of the link.

## **FWA – Fixed wireless access**

A type of wireless broadband data communication between two fixed locations and connected through wireless access points and equipment.

## **GCF – Global Certification Forum**

An independent organization that provides certification for mobile phones and wireless devices that use 3GPP standards.

## **gNB – gNodeB**

5G wireless base stations that transmit and receive communications between the user equipment and the mobile network.

## **GPRS – General packet radio services**

A packet-based wireless communication standard for delivering data to mobile devices via a cellular connection.

## **HD – Half duplex**

A two-party communication system for exchanging voice or data, where only one node can speak at a time.

## **Harmonic**

A signal at a frequency that is an integer multiple of another reference signal. The respective harmonic signal can be termed as 2f, 3f and so on where f is the frequency of the reference signal.

## **HSS – Home subscriber server**

Common database of subscriber information, keeps authentication information as well as permissions (e.g., authentication, authorization, and accounting (AAA) server).

## **ICI – Intercarrier interference**

Channel variations during an orthogonal frequency division multiplexing (OFDM) sequence caused by carrier frequency offsets, channel time variation, and sampling frequency offsets. ICI degrades the performance of OFDM transmissions.

## **IFBW – Intermediate frequency bandwidth**

The bandwidth of the frequency that a carrier wave shifts to as an intermediate step in transmission or reception.

## **IFF – Indirect far field**

A test method approved by 3GPP to overcome path loss and excessive far-field distance involved in 5G cellular communications.

## **IMEI – International mobile equipment identity**

A number that uniquely identifies 3GPP mobile devices. Used by the telecommunications network to identify valid devices in case of loss or theft.

## **IMSI – International mobile subscriber identity**

A unique number that identifies the subscriber identification module (SIM) card present in the device belonging to a subscriber.

## **IMT-2020 – International Mobile Telecommunications-2020**

A standard that sets the requirements for 5G networks, devices, and services. IMT-2020 was developed by the International Telecommunications Union (ITU) Radiocommunication Sector in 2015. The ITU is a United Nations agency responsible for information and communications technologies.

## **ISI – Intersymbol interference**

Signal distortion caused when one or more symbols interfere with other symbols. Caused by amplitude and phase dispersion in the channel due to multipath propagation or non-linear frequency response.

## **ITU – International Telecommunication Union**

A United Nations agency responsible for information and communications technologies. The ITU — formerly called the International Telegraph Union — is the oldest global international organization, established in 1865. The ITU created the standard that sets forth the requirements for 5G networks, devices, and services known as IMT-2020.

## **KPIs – Key performance indicators**

Metrics that quantify how mobile phones and other user equipment performs on a network.

### **Layer 1**

The Open Systems Interconnect (OSI) model has seven layers: Layer-1 is the Physical Layer and governs the transmission of data in a point to point or broadcast connection, with a focus on electrical, optical, or RF transmission properties.

### **Layers 2/3**

The Open Systems Interconnect (OSI) model has seven layers: Layer-2 is the Data Link layer and Layer-3 is the Network layer. Together they are responsible for setting up connectivity between hosts, framing the information, and routing information to the right destination. Each layer serves the layer above it and is served by the layer below it.

### **Layers 4-7**

The Open Systems Interconnect (OSI) model has seven layers: Layers 4-7 implement data exchange between relatively distant systems. Layer-4 is the Transport, Layer 5 is the Session layer, Layer-6 is the Presentation layer, and Layer-7 is the Application layer. Each layer serves the layer above it and is served by the layer below it.

## **LO – Local oscillator**

An electronic component used for changing the frequency of a signal.

## **LoS – Line of sight**

Refers to a system where transmitter and receiver are in view of each other without any obstruction. AM/FM radio, satellite transmission, and police radar are examples of line-of-sight communication.

## **LTE-Advanced – Long-term Evolution Advanced**

Also known as “LTE Release 10,” LTE-A is one of the two mobile communication platforms officially designated by the International Telecommunication Union (ITU) as the first 4G technology (the other is LTE-Advanced Pro). It specifies data rates of 500 Mbps maximum upload speed and 1 Gbps maximum download speed with a latency (round-trip) of 5 ms.

## **LTE-Advanced Pro**

Also known as 4.5G, 4.5G Pro, 4.9G, pre-5G, its feature functionality is defined in 3GPP Release 13 and 14. An evolution of Long Term Evolution (LTE) with speeds up to 1 Gbps. LTE-Advanced Pro incorporates new functionality including 256 QAM, FD-MIMO, LTE-Unlicensed, LTE IoT, and other technologies to evolve existing networks towards the 5G standard.

## **LTE-LAA – Long-term Evolution Licensed Assisted Access**

Part of 3GPP Release 13 and a feature of LTE Advanced Pro. It uses carrier aggregation in both the unlicensed (5 GHz) and licensed spectrums to increase peak user data rates and overall capacity of the network.

## **Massive MIMO**

An extension of MIMO, using more transmit and receive antennas to increase transmission gain and spectral efficiency. There is currently no set minimum scale, though a system with greater than 8 transmit and 8 receive antenna is generally considered the threshold for massive.

## **MC – Multicarrier**

Process of splitting data into multiple components and transmitting via separate carrier signals. This method offers reduced susceptibility to several effects that can degrade signal integrity, including multipath fading, interference caused by impulse noise, and inter-symbol interference.

## **MCC – Mobile country code**

A unique identifier used in conjunction with a mobile network code (MNC) to identify a mobile network operator.

## **MEC – Multi-access edge computing**

A network architecture where more processing, especially for latency-sensitive applications, stays closer to the edge of the mobile network. A competing architecture to Centralized RAN (C-RAN).

## **MIMO – Multiple-input / multiple-output**

An antenna diversity technique using multiple antennas on both the transmit side and receive side to take advantage of multi-path propagation and improve the quality and reliability of wireless communication.

## **MIPI – Mobile industry processor interface**

A collection of more than 45 standard mobile industry specifications designed to accelerate development of mobile and mobile-influenced products, most commonly used in mobile handsets.

## **mMTC – Massive machine-type communications**

One of three primary 5G use cases defined in the IMT-2020 vision, massive machine-type communications supports 5G IoT use cases with billions of connected devices and sensors. The use case is characterized by low bandwidth and infrequent bursts of data, requiring long-life batteries.

## **mmWave – Millimeter wave**

The band of spectrum between 30 GHz and 300 GHz where the wavelength is on the order of millimeters. Between the microwave and infrared spectrums, mmWave is used for high-speed wireless communications.

## **MNC – Mobile network code**

A unique identifier used in conjunction with a mobile country code (MCC) to identify a mobile network operator.

## **MU – Measurement uncertainty**

A statistical representation of the accuracy of a measurement.

## **MU-MIMO – Multiple user, multiple-input / multiple-output**

An application of multiple-input / multiple-output (MIMO) technologies where the base station communicates with two or more UEs simultaneously.

## **NEF – Network exposure function**

A function of the 3GPP core network architecture that provides a means to securely expose capabilities and events. NEF

stores the received information as structured data and exposes it to other network functions.

## **NEMs – Network equipment manufacturers**

Firms that build network equipment for service providers to manage their networks.

## **NFTF – Near-field to far-field transform**

A method for over-the-air (OTA) mmWave testing that samples the phase and amplitude of the electrical field in the near region and uses math to predict the far-field pattern. While this is a compact, low-cost method, it is subject to transmitter interference that impacts measurement accuracy.

## **NGC/NGCN – Next Generation Core / Next Generation Core Network**

The 5G next generation core network. NGC or NGCN is the part of the network that provides services to mobile subscribers through the radio access network (RAN). It is also the gateway to other networks, for instance to the public-switched telephone or to public clouds.

## **NLOS – Non-line of sight**

An RF signal path that is obscured by obstacles. Common causes for non-line-of-sight include obstacles such as buildings, trees, hills, and mountains.

## **NSA NR – Non-standalone NR**

A 5G network deployment that uses existing 4G LTE radio and evolved packet core network control plane but also allows carriers to begin early trials using 5G UEs and 5G data (or user) plane.

## **NR – New Radio**

Shorthand for “5G NR.” 5G NR is the standard for a new OFDM-based air interface designed to support 5G devices, services, deployments, and spectrum. NR is used to describe 5G in the same way LTE is used to describe 4G. The 3GPP has three areas of focus for 5G NR: Enhanced mobile broadband (eMBB), massive machine-type communications (mMTC), and ultra-reliable low-latency communications (uRLLC).

## **NRF – Network repository function**

A component of the 3GPP architecture that provides service discovery between individual network functions.

## **NSSF – Network slice selection function**

3GPP architecture function that selects the set of network slice instances serving the user equipment and determines which access and mobility management function to use.

## **Numerology**

Refers to how cellular communications waveforms are created based on underlying structures. The 5G NR specification permits flexible numerology, meaning the OFDM frame can have variable subcarrier spacing, symbol timing, and flexible usage of symbol slots. 5G NR permits different numerologies to be transmitted on the same carrier frequency.

## **NV IOT – Network vendor interoperability testing**

Testing among vendors of network hardware and software to verify the interfaces between their network elements prior to software release in operator networks.

## **OBW – Occupied bandwidth**

The bandwidth containing 99% of the total integrated power of the transmitted spectrum, centered on the assigned channel frequency.

## **OFDM – Orthogonal frequency division multiplexing**

A frequency division multiplexing scheme encoding digital data on multiple frequency channels to increase bandwidth and decrease response time. OFDM techniques allow for densely packed sub-carriers without the need for guard bands and filters, increasing spectral efficiency and simplifying electronic design. OFDM is especially good in severe channel conditions where narrowband interference exists.

## **OQAM – Offset quadrature amplitude modulation**

A group of digital modulation schemes that conveys two digital bit streams by modulation the amplitude of carrier waves. The carrier waves are of the same frequency but out of phase with each other by 90 degrees, enabling simple demodulation at the receiver.

## **OTA – Over-the-air**

Testing the RF performance, demodulation, or RRM (radio resource management) through the air interface, versus a cabled connection; often performed in an anechoic chamber.

## **PAPR – Peak to average power ratio**

The ratio of the peak power of a signal to that signal's average power.

## **PCF – Policy control function**

Element of the 3GPP core network architecture that provides policy rules to control plane functions.

## **PGW – Packet data network gateway**

Equipment in the 4G LTE evolved packet core which connects the LTE network to other packet data networks.

## **Phased array antenna**

Phased array antennas are a means of creating narrow beams and dynamically pointing them in the desired direction without mmWave antennas used for 5G base stations and UEs. A phased array antenna is formed by an array of smaller antenna elements, such as individual patches or dipoles. By varying the relative phases and amplitudes of the signals applied to the individual elements, the antenna array can shape and steer a beam in a chosen direction.

## **Picocell**

A small cellular base station that is an alternative to a repeater or distributed antenna system to improve mobile phone reception indoors.

## **P-OFDM – Pulse-shaped orthogonal frequency division multiplex**

An orthogonal frequency division multiplexing scheme that uses pulse-shaped multicarrier waveforms, offering comparatively high waveform robustness with low out-of-band emissions and interference.

## **PSS – Primary synchronization signal**

The second component of the synchronization signal block used for synchronizing user equipment with a base station.

## **PTCRB – PCS Type Certification Review Board**

A certification forum established by major North American service providers.

## **QAM – Quadrature amplitude modulation**

A modulation scheme with both digital and analog components. QAM doubles the effective bandwidth by combining two amplitude-modulated waveforms onto a single carrier.

## **QoE – Quality of experience**

A measure of the overall level of customer satisfaction with the network as measured by various success factors including ease of use, reliability, security, and cost.

## **QoS – Quality of service**

A measure of the network's ability to achieve specific performance thresholds for latency, error rate, and uptime.

## **RACH – Random access channel**

A channel shared among wireless devices to access the mobile network for call setup and data transmission bursts such as text messages.

## **RAN – Radio access network**

The part of the telecommunications network that connects user equipment to other parts of a mobile network via a radio connection. Connects user equipment to the core network.

## **RAT – Radio access technology**

The underlying physical connection method for a radio-based communication network. Modern phones may support several RATs in one device such as Bluetooth, Wi-Fi, NFC (Near-Field Communications), and 3G, 4G or LTE, and 5G.

## **RRH – Remote radio head**

The component of a base station responsible for converting the digital signal into an analog signal for transmission. The remote radio head is usually located on the tower in proximity to the antenna(s) to minimize signal loss.

## **RRM – Radio resource management**

The management of radio resources and transmission characteristics such as modulation scheme, transmit power, beamforming, user allocation, data rates, handover criteria, and error coding scheme.

## **Rx – Receive**

In wireless communications, the process of converting incoming transmissions into perceptible communications.

## **SBA – Service-based architecture**

Type of architecture standardized by 3GPP for 5G core networks. The 3GPP defines an SBA to include service-based interfaces between control plane functions, with user plane functions connecting over point-to-point links.

## **SC – Single carrier**

A transmission that uses a single radio frequency carrier to transmit all data.

## **SDN – Software-defined networking**

An approach using open protocols for remote configuration of network switches and routers.

## **SEM – Spectrum emissions mask**

A relative measurement of the out-of-channel emissions to the in-channel power. SEM measurements calculate the excess emissions that interfere with other channels or systems.

## **SFI – Slot form indicator**

Indicates how each of the orthogonal frequency division multiplexing (OFDM) symbols within a given slot is used. The SFI denotes whether a given OFDM symbol in a slot is used for uplink or downlink, or if it is flexible.

## **SMF – Session management function**

A fundamental element of the 5G service-based architecture (SBA) that establishes and manages sessions. It also selects and controls the user plane function and handles paging.

## **SNIR – Signal-to-noise and interference ratio**

The power of the signal divided by the sum of interference power from competing signals and the power of the background noise present. SINR is used to describe the theoretical upper limit of channel capacity.

## **SNR – Signal-to-noise ratio**

The ratio of the strength of the signal to interference usually expressed in decibels.

## **SS-RSRP – Synchronization signal reference signal received power**

The average of the power of the resource elements that carry the synchronization signal.

## **SS-RSRQ – Synchronization signal reference signal received quality**

A measurement of the received quality of the synchronization signal.

## **SS-SINR – Synchronization signal signal-to-interference-plus-noise ratio**

The power of the synchronization signal divided by the sum of the interference from competing signals and the background noise present.

## **SSS – Secondary synchronization signal**

The second component of the synchronization signal block used for synchronizing user equipment with a base station.

## **Standalone NR**

A 5G network deployment configuration where the gNB does not need any 4G assistance for connectivity to the core network; the 5G UE connects to the 5G next generation core network (NGC or NGCN).

## **SU-MIMO – Single user, multiple-input / multiple-output**

An application of multiple input and multiple output (MIMO) technologies for wireless communication, in which the base station communicates with only one UE during the allotted time slice.

## **TDD – Time division duplex**

Duplex communication where the uplink is separated from downlink by different time slots in the same frequency band.

## **TT – Test tolerance**

The allowable error of a measurement's accuracy.

## **Transmit diversity**

A technique to diminish the effects of fading by transmitting the same information from two or more independent sources.

## **TRX – Transceiver**

A device that can both transmit and receive signals.

## **TTI – Transmission time intervals**

The duration of transmission allowed for a frame on a mobile network. 5G NR allows for different transmission time durations based on the unique requirements of a class of

traffic, creating differentiated classes of service, similar to those found on an IP network.

## **Tx – Transmit**

In wireless communications, the act of sending data through the air from one device to another device or group of devices.

## **UDM – Unified data management**

A significant component of the 5G core network that stores subscriber data and profiles.

## **UE – User equipment**

A subscriber's mobile device, such as a cell phone, tablet, or modem.

## **UE emulation**

The simulation of subscriber user equipment (UE) usage behaviors.

## **UF-OFDM – Universal filtered orthogonal frequency division multiplexing**

A form of orthogonal frequency division multiplexing (OFDM) modulation that improves out-of-band (OOB) characteristics by filtering the frequency band.

## **UL – Uplink**

The path of transmission from the UE to the base station. In 5G, the uplink waveform is CP-OFDM or DFT-s-OFDM.

## **UPCL – Uplink classifier**

Network functionality supported by the user plane function (UPF) that diverts traffic to local data networks based on filters applied to the user equipment traffic.

## **UPF – User plane function**

The 5G equivalent of the packet gateway in a 4G LTE network. The user plane function includes features to support packet routing and forwarding, interconnection to other data networks, and policy enforcement. Also known as the data plane.

## **uRLLC – Ultra-reliable low-latency communications**

One of three key use cases defined in 5G NR. uRLLC focuses on applications that require fail-safe, real-time communications. Examples include remote surgery, industrial internet, smart grids, infrastructure protection, intelligent transportation systems and autonomous vehicles.

## **UW-OFDM – Unique word orthogonal frequency division multiplexing**

An orthogonal frequency division (OFDM) multiplexing technique that uses an arbitrary deterministic sequence as the guard interval rather than the random cyclic prefixes used in cyclic prefix OFDM (CP-OFDM). UW-OFDM provides the same benefits as CP — including protecting the OFDM signals from intersymbol interference (ISI). CP-OFDM offers benefits for synchronization and channel estimation purposes since it uses known sequences.

## **V2X – Vehicle-to-everything**

The passing of information between vehicles and roadway infrastructure to facilitate road safety and traffic efficiency.

## **vEPC – Virtual EPC**

A core network in an LTE system built with SDN-enabled white-box switches and virtual network functions instead of purpose-built hardware.

## **VSG – Vector signal generator**

Electronic equipment that generates digitally modulated signals for testing and measuring digital components and receivers.

## **VSWR – Voltage standing wave ratio**

The ratio of maximum to minimum voltage in a transmission.

## **VVM – Vector voltmeter**

Electronic equipment that measures the phase and voltage of two input signals of the same frequency.

## **WCDMA – Wideband code division multiple access**

A 3G standard for a radio communication system that provides high-speed data and voice communication services.

## **W-OFDM – Windowed orthogonal frequency division multiplexing**

An orthogonal frequency division multiplexing (OFDM) technique where each symbol is windowed and overlapped in the time domain, reducing the spectral sidelobes.

## **Xn Interface**

A logical interface that interconnects RAN nodes. That is, it interconnects gNB to gNB and eLTE eNB to gNB and vice versa.

Learn more at: [www.keysight.com](http://www.keysight.com)

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