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GPS/GNSS Related Terminology

2D: Term that often refers to determining a position in two dimensions; latitude and longitude, northing and easting, or x and y.

3D: Term that often refers to determining a position in three dimensions---latitude, longitude, and altitude (northing, easting, elevation or x, y, z).

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3G: Cellular-network classification that represents "third-generation" enhancements to cellular hardware or to cellular infrastructure---preceded by 1G and 2G. The differences between each generation pertain to data-stream capacity, data transfer speeds, and overall integrity of the cellular network.

4G: Cellular-network classification that represents "fourth generation" of cellular wireless enhancements to hardware or infrastructure; preceded by 1G, 2G, and 3G. 4G will provide a wide range of data rates up to ultra-broadband (gigabit-speed) internet access to mobile users.

ALDOT: (ALabama Department Of Transportation) - With proper equipment, producers can utilize highly-accurate positioning services maintained by ALDOT (e.g. CORS, RTK network corrections). http://www.dot.state.al.us/Docs/Bureaus/Design/Location/CORS_Opening_Page.htm

Analog: The traditional method of adapting radio signals so they can carry information. AM (Amplitude Modulation) and FM (Frequency Modulation) are the two most common analog systems. Analog has largely been replaced by digital technologies, which are more secure, more efficient, and provide better quality.

Antenna: A device for transmitting and receiving radiofrequency (RF) signals. In terms of guidance devices, a GPS/GNSS antenna merely accepts signals from satellites or base stations. Contrary to a GPS/GNSS receiver, no internal calculations are performed within the antenna.

APC: (Antenna Phase Center) - A theoretical point in the guidance receiver for which a position is derived.

Base Station: A stationary GPS/GNSS receiver that serves as a reference point, providing correction data to a "rover" GPS/GNSS unit. Correction data can be broadcast via radio frequency, cellular signal, or the internet.

Bluetooth: Radio technology that enables devices such as computers, mobile phones and hands-free kits to be connected without cables up to 30 feet away. Bluetooth technology provides wireless mobility.

Broadband: A term used when describing the bandwidth or capacity needed to carry multiple voice, video or data channels simultaneously. Broadband technology was introduced to help deliver increased speeds and advanced capabilities. These advancements now give consumers better access to the internet and related services.

Carrier: Also known as service provider or operator, a carrier is the communications company that provides customers service (including air time) for their cellular phones/modems.

Carrier phase: A method of distance determination between a satellite(s) and a GPS receiver. Code phase distance determination is initially used to determine position to approximately 1-meter accuracy. Carrier phase is a more uniform, higher frequency signal and thus more difficult to synchronize. The pseudo-random code is initially used to obtain a crude position solution, and the carrier signal further refines this solution.

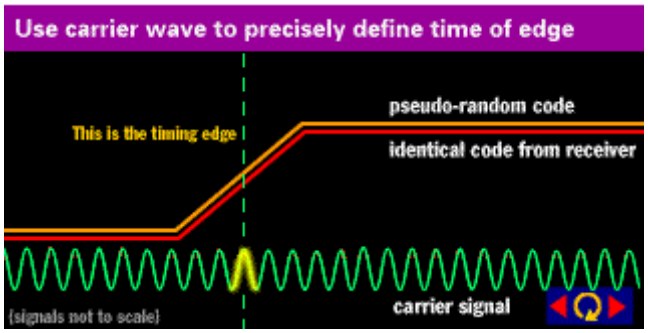

Figure 1. Example of carrier signal being used to refine positional solution. *Courtesy of Trimble™*

CDMA: (Code Division Multiple Access) – Cellular protocol followed by Sprint PCS™, Verizon Wireless™, and Alltel™. Service is mostly isolated to North America. Here are the basics of how a cellular device works … a cellular phone is a short-range radio transmitter and receiver. The phone software converts the sounds from the microphone into small pieces of information (packets) that are transmitted by radio signal to the nearest cellular tower. From the tower, the pieces are digitized and transferred throughout the cellular network by fiber-optic cable. The pieces are then broadcast by the cellular tower to be received by a second phone, wherein the software pieces together the parts in their proper order and translates them into what we hear as a friend's voice. In today's world, wireless data transfer is also possible through many of the cellular phones available in the marketplace. The CDMA protocol involves a certain principle of packet formation and transmission such that information (both voice and data) can be sent over an extended range with less power. CDMA2000 is a "generational overhaul" over the original CDMA service.

CDMA2000 1XRTT: The 1x in 1xRTT stands for one times the number of 1.25MHz channels, while RTT stands for radio transmission technology. The first step in the evolution to 3G is cdma2000 1X, which improves packet data transmission capabilities and speeds in the network, and also boosts voice capacity. (Speed of up to 307 KB per second.) A 3G wireless communications standard evolved from CDMA technology. It has double the voice traffic capacity of CDMA and provides peak data rates of 153 kbps.

CDMA2000 1XEV-DO (Evolution Data-Only): It represents the second step in the evolution of CDMA2000. Commercially launched in 2001, offers data speeds of up to 2.4 Mbps.

CDMA2000 1xEV-DO (and 1xEV-DV): A 3G wireless communications standard further evolved from CDMA2000 technology. It is a standard optimized for data transmission providing a peak data rate of 2.4 Mbps with a typical user experience of 300 - 800 kbps.

CDMA2000 1XEV-DV (Evolution Data-Voice): CDMA2000 1XEV represents the next step in the evolution of CDMA2000. CDMA2000 was approved by the International Telecommunications Union

(ITU), a standards body based in Geneva, as a 3G technology to provide data and voice services together, with data rates of up to 3.09 Mbps.

Cellular amplifier/booster: A cellular amplifier or booster may be useful to boost reception in areas where cellular service is sparse.

CF card: (Compact Flash card) - Removable media platform used for storing data in portable electronic devices. Type I and Type II CF formats are available. CF cards are also commonly used in guidance-system computers to store field records and/or to provide credentials, such as activation codes.

CMR: (Compact Measurement Record) - A survey-grade communication & differential correction protocol that is proprietary to Trimble™. Three formats exist: CMR, CMR+, and CMRx; the difference between the three refers to the amount of correction data that can be obtained from an increasing number of satellite sources. This is one of several corrections offered through ALDOT reference stations. Basically, this protocol is a type of data stream format in which correction messages are transmitted from the base station to the receiver via radio frequency or internet.

CMR+: (Compact Measurement Record Plus) - CMR+ improves the performance of CMR with a correction stream of more consistent length than the traditional CMR format, which facilitates better operation on radio networks.

CMRx: (Compact Measurement Record x) – Refers to a CMR data stream format developed to support modifications in Global Navigation Satellite System (GNSS) constellations. CMRx will allow Real-Time Kinematic (RTK) users to utilize more constellations, satellites, and signals as they become available, with faster initializations and improved performance near obstructions and under canopies. It offers significant compression (around 40%) over the already compact CMR/CMR+ format to help users receive more correction on less bandwidth.

Code phase: A method of distance determination between a satellite(s) and a GPS receiver. Receivers determine their distance from the satellites by comparing the phase shift between an internally generated code (pseudo-random code) and one received from the satellites. The time elapsed between pseudo-random code and satellite code synchronization is proportional to the distance the receiver is from the satellite. However, the bits (or cycles) of the pseudo random code are so wide that even when they are synchronized, there is still considerable ambiguity. This ambiguity results because the frequency of the pseudo-random code is approximately 1 MHz as opposed to the more accurate carrier phase signal at a frequency of approximately 1 GHz.

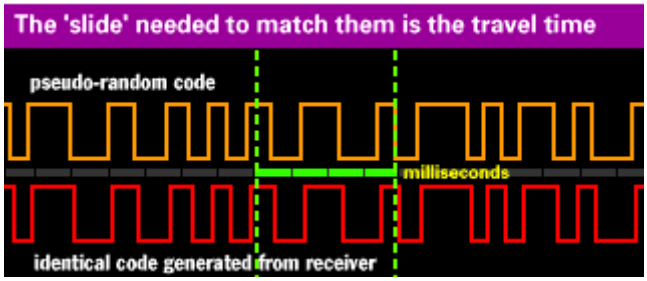

Figure 2. Example of code phase signal synchronization between internally generated and satellite generated signals. *Courtesy of Trimble™*

Coordinate System: A system used in geometry and trigonometry to represent the location of points in two-dimensional or three-dimensional space. Coordinate systems are used in GPS/GNSS navigational systems to provide a receiver's location on Earth. There are many frequently used coordinate systems all of which have different geographic origins including latitude and longitude and US State Plane coordinate systems.

CORS: (Continuously Operating Reference Station, or Service) – As the name implies, this refers to a positioning receiver that is dedicated for the purpose of continuously collecting positions and comparing the solutions to a known, or fixed, answer. Not every dedicated reference station is a CORS station; a CORS station is one that has been certified by the National Geodetic Survey (NGS, a division of the National Oceanographic and Atmospheric Administration) as being reference-worthy, according to their standards. The reference stations maintained by ALDOT are either established CORS stations or pending CORS stations, per NGS approval. In addition to maintaining the upkeep of these stations, ALDOT also provides real-time connectivity to each station for customers; the result is a Real-Time Kinematic (RTK) service whereby the customer does not necessarily have to purchase their own base station. When a user refers to utilizing real-time corrections in this manner, it is often said as "using CORS".

Datum: A Geodetic datum defines a reference system that describes the size and shape of the earth. Datums have evolved from those describing a spherical earth to ellipsoidal models derived from years of satellite measurements. Frequently used datum include: World Geodetic System 1984 (WGS 84), North American Datum of 1983 (NAD 83), and North American Datum of 1927 (NAD 27). Referencing geodetic coordinates to the wrong datum can result in position errors of hundreds of meters.

DEM: (Digital Elevation Model) - A digital representation of a surface, usually for topography calculations. Also, *.dem is a file format defined by the US Geological Survey (USGS) for digital elevation data. DEMs are often utilized in geographic information system (GIS) analyses.

DGPS: (Differential GPS) - refers to techniques used to enhance accuracy, integrity, reliability, and availability of GPS data. The DGPS technique can be implemented in two ways: one based on using a single reference station to generate the correction data, and the other makes use of a network of reference stations. There are a number of services that provide DGPS corrections as opposed to "non-corrected," or autonomous, positions. The signal provided by these services increases GPS accuracy by applying a 'correction' to the computed GPS position solutions. In addition, these correction services minimize, and in some cases eliminate, the potential errors (multi-path, atmospheric interference, orbital errors, clock errors, etc.) which can be introduced when a GPS computes its position. Some correction services available in Alabama include: WAAS, Coast Guard Beacon, John Deere StarFire™ System, OmniSTAR®, and Real-Time Kinematic (RTK) including CORS and Real-Time Kinematic Network (RTKN) solutions.

Digital: Technological approach that converts signals (including voice) into the binary digits '0' and '1'. This data is compressed, and then transformed into electronic pulses for a wired network, optical light waves for fiber optic networks, or radio waves for wireless networks. Digital wireless technology has been replacing analog technology, because digital delivers more voice/data capacity, supports more applications, offers better sound quality, and provides for more secure signals.

DOP: (Dilution Of Precision) - One of many quality measurements to evaluate solutions derived by a positioning receiver. This is a numeric value that relates relative geometries between positioning satellites as well as the geometries between the satellites and the receiver; the lower the value, the higher the probability of accuracy. DOP can be further classified to other variables: GDOP (three-dimensional position plus clock offset), HDOP (horizontal position), PDOP (three-dimensional position), TDOP (clock offset), VDOP (vertical position). A DOP value of 4 or less is typically desired for best accuracy.

Dual frequency: This term refers to a navigational receiver capable of using L1 and L2 satellite frequencies to derive a position. Until recently L2 satellite frequency access was restricted to governmental use only. Dual frequency receivers merely observed L2 frequencies and matched the wave lengths of them to an internally generated pseudo-random code. The time taken to sync the wave lengths was proportional to the distance of the receiver from the satellite and allowed for increased accuracy. With GPS Modernization, a new L2C signal is being broadcast on the L2 frequency from approximately 1/3 of operational satellites; this number will increase. Dual frequency receivers capable of interpreting the L2C signal are considered true dual frequency receivers.

EDGE: (Enhanced Data rates for GSM Evolution; aka **EGPRS**, or Enhanced GPRS) - This cellular-data service is designed for high-speed internet traffic, with speeds and capacities comparable to broadband internet for desktop computers; the availability of this service is not as widespread as GPRS, being confined mostly to heavily urban areas. The cellular providers T-Mobile™ and AT&T Mobility™ utilize this service.

Elevation Mask: Refers to an elevation relative to the horizon in which GPS/GNSS satellites contained within are not used in a positional solution. There is a significant increase in distance between a receiver and a satellite on the edge of the horizon as opposed to a satellite directly above the receiver. This increase in distance allows for more ionospheric error resulting in poor accuracy when used in the positional solution. The satellite will typically not be used for a positional solution until it rises at least 10 degrees above the horizon and is therefore "masked" from the group of satellites used for position determination.

Ellipsoid: In terms of global positioning, a reference ellipsoid is a theoretical, smoothed representation of the earth's surface, not taking into account geophysical undulations. Vertical differences between the reference ellipsoid and the actual surface of the earth are termed "Height Above Ellipsoid" and can be converted to an elevation representative of mean sea level.

EV – DO: (Evolution – Data Only, Evolution – Data Optimized) - Method of cellular data transfer that is faster and more robust than RTT (Radio Transmission Technology), such that streaming video and "high-speed" internet traffic is possible. The availability of this service is not as widespread as RTT. The cellular providers Sprint PCS™, Verizon Wireless™, and Alltel™ utilize this service. **EV – DO Revision A** is a further data enhancement that can accommodate more real-time data streaming than the original version.

Firmware: refers to programs or data structures that internally control electronic products. Navigational systems contain firmware and manufacturers may offer free or purchasable updates to the firmware when system advancements are available.

Geoid: A geoid is a model or "true" representation of the earth's surface. It corresponds with the mean sea level of the Earth. Periodically, new geoid models are developed taking into account changes in Earth's gravity field with the two most recent models being Geoid 2003 and Geoid 2009.

GLONASS: (*GLObal'naya NAvigatsionnaya Sputnikovaya Sistema*) – This is the name of the satellite-navigation network maintained by the Russian government. The English translation of this name is "GLObal NAvigation Satellite System," or more commonly named "GLONASS."

GNSS: (Global Navigation Satellite System) – refers to using multiple satellite navigation systems concurrently by a GPS receiver to compute its position. These navigational systems include the United States network (GPS)

and Russia's (GLONASS). The citizenry of the European Union is developing a system (Galileo), as is the government of China (Compass). What makes a GNSS receiver superior to a GPS receiver is its capabilities of receiving signals from navigation satellites other than, and in addition to, those that are of the GPS network. As a result, GNSS users can utilize more satellites to compute a position with increased *position accuracy* and *reliability*.

GPRS: (General Packet Radio Service) – Cellular data transfer method that allows for simple internet browsing, e-mail, and improved text messaging. The cellular providers T-Mobile™ and AT&T Mobility™ utilize this service. Cellular providers will often charge per megabyte of data traffic or offer a flat fee for "unlimited" traffic.

GPS: (Global Positioning System) – This is the name of the satellite-navigation network maintained by the United States Department of Defense (USDoD). Also, the term "GPS" is often treated more generically to refer to any device that depends on navigation satellites for functionality or for any coordinate values derived from such a device.

GPS Modernization: The US Congress initiated legislation, termed "GPS Modernization," in 2000 to upgrade the GPS system. Objectives for the project included creating additional monitoring stations, new satellites, additional navigation signals for both civilian and military users, and processes to improve the accuracy and availability of GPS. For the end user, the largest impact of this project will be new civilian signals L2C, L5, and L1C.

GSM: (Global System for Mobile communications) – This term refers to a worldwide cellular protocol which was originally developed for voice transmissions. A cellular device that utilizes GSM often has a range limit of around 23 miles from device to a cellular tower. A device that utilizes GSM will often require a SIM (Subscriber Identity Module) card. Cellular carriers such as T-Mobile™ and AT&T Mobility™ utilize this cellular communication protocol.

HAE: (Height Above Ellipsoid) – Vertical difference between a reference ellipsoid model and the known, or derived, elevation at a given spatial location (typically in meters). The reference ellipsoid is a theoretical, smoothed representation of the earth's surface; however, the earth's surface undulates higher than or lower than the "surface" of the ellipsoid depending on location. If the given spatial location happens to be "under" the ellipsoid surface, the HAE is expressed as a negative value.

IP Address: (Internet Protocol Address) – This is an address that distinguishes a computer (or a network server) from all other computers connected within a network, similar to how someone may find a particular book within a library. The address is represented by a series of numbers and periods that may look like "123.456.789.012". From a precision-agriculture standpoint, the importance of this term is illustrated by the example that, if a farmer wants to utilize the real-time correction service offered by ALDOT, then the farmer's device must be able to access and maintain a stable data-streaming connection with the ALDOT server, represented by its own IP address. This is analogous to a website address.

L Band: This refers to a group of radio frequencies from 390 MHz to 1550 MHz. GPS/GNSS satellites output their signals on three carrier frequencies within this range---L1 (1575.42 MHz), L2 (1217.60 MHz), and L5 (1176.45 MHz).

L1 / L1C: A frequency (1575.42 MHz) broadcast by GPS/GNSS satellites that is equipped with two super-imposed codes, the Coarse Acquisition (C/A) code for civilian use and the Precision code (P-Code) for military use only. Single frequency navigational receivers utilize the L1 frequency to derive a positional solution. The final signal upgrade as part of GPS Modernization will be L1C. The L1C signal will be super-imposed onto the L1 frequency, and it will be backwards-compatible with the current C/A-code. L1C will be established in order to overcome the deficiencies of the L1 C/A code. L1C will be interoperable with the Galileo (European Satellite Navigation System) L1 Open Service signal and possibly with the modernized GLONASS (Russian Satellite Navigation System), producing a truly international signal. Like L2C and L5, L1C has been designed with unique and innovative features to enhance its robustness for all users, especially in difficult operating environments. The projected launch of the first GPS satellite transmitting L1C could be as soon as 2013.

L2 / L2C: refers to a frequency (1227.60 MHz) broadcast by GPS satellites that until recently contained only a super imposed P-code for government access only. Through GPS Modernization, a new L2C signal is being broadcast on the L2 frequency. This signal is accessible to civilians and approximately 8 satellites are equipped to broadcast the L2C signal currently; the full constellation of satellites (24 satellites) is expected to broadcast L2C by 2016. The benefit of the L2C for the end user is a stronger signal because it is broadcast at 1227.60 MHz (in the radio-frequency world, a smaller frequency number generally represents a more powerful frequency.) The stronger signal will minimize error due to obstructions and multipath as well as reducing the amount of power needed by the GPS unit to receive the signal, thereby increasing GPS reliability. In fact, a "GPS fix" may be determined in some indoor environments by utilizing L2C.

L5: refers to a new signal frequency of 1176.45 MHz beginning to be broadcast from satellites. This frequency is even lower than L2 and will provide further improved accuracy, reliability, and performance within vegetative canopies and around obstructions. Therefore, accurate and reliable operation under forest canopy may be possible with L5. This signal will also be more impervious to radio-frequency interference (RFI). L5, also referred to as the Safety-of-Life signal due to its maritime and aviation implications, will only transmit the C/A code. Like the L2C-compatible equipment, some manufacturers of high-end GPS surveying and mapping equipment are currently making products capable of interpreting the L5 signal. Availability of this frequency will depend on government funding and timing, but 24 satellites broadcasting the L5 frequency are expected to be online around 2018.

MAX: (Master Auxiliary Correction) - A method of RTK Network (RTKN) correction proprietary to Leica Geosystems™ in which multiple base stations are used to determine an RTK correction. MAX requires the use of RTCM 3.x data stream format and the user must determine which cell (predefined group of base stations established by the network administrator) the rover is operating within as well as which base station is closest to the rover (master station). Correction differences are determined for the auxiliary stations (base stations located in the predefined cell) and sent to the rover along with raw data from the master station. The rover unit utilizes the correction data from these stations to compute the positional error then applies this differential correction to the final positional solution.

> **Auto-MAX:** (Auto Master Auxiliary Correction) - A derivation of Leica Geosystems™ MAX correction that uses two way communications, the rover sends its location to the server, and Leica GPS SpiderNET™ determines which cell and which master station is most appropriate for the rover unit to utilize. The user does not have to know the correct mount point prior to initiating the navigational operation.

iMAX: (individual Master Auxiliary Correction) – A derivation of Leica Geosystems™ MAX correction in which the correction is performed at the server and then broadcasted to the rover unit. This type of correction supports earlier rover models not capable of handling RTCM 3.x format. Leica GPS SpiderNET™ produces an individual correction that can be broadcast on RTCM 2.3 or RTCM 3.0 formats as a network correction and applies it to network observations from the master station.

MHz (Megahertz): a unit of frequency equal to one million hertz or cycles per second. Wireless mobile communications within the United States generally occur in the 800 MHz, 900MHz and 1900MHz spectrum frequency bands. Radio transmissions from base stations generally occur in the 450MHz and 900MHz bands.

Modem: (modulator-demodulator) - A device that enables computers to exchange data through wires (telephone, cable, etc.) or wirelessly. Cellular modems are typically used to access Real-Time Kinematic Network (RTKN) or CORS data via the internet.

Mount point: This refers to a directory in a computer system from which data can be accessed. Mount points are used to determine a particular data stream to access; the data streams are usually configured according to equipment compatibility. In the case of ALDOT, mount points currently available include: AutoMAX, CMR+, CMR+ Near, Leica MAX, Near_Leica_GG, and Near_RTCMv3_GG.

MSL: (Mean Sea Level) – This is a common frame of reference for positions with a vertical component. The average location at which the ocean meets the beach is considered “mean sea level”.

NAD83: (North American Datum 1983) – This is one of many different mathematical projection models upon which satellite-derived positions can be translated into a coordinate system that corresponds to positions derived through standard maps. For the sake of simplicity, each datum has mathematical parameters that define it, including the predicted center of the Earth and the mathematical shape of the Earth. Because the Earth is not perfectly spherical or ellipsoidal, the mathematical parameters may provide a model that is accurate on one portion of the planet, while being horribly inaccurate on another. NAD83 is a best-fit model for North America, Canada, Mexico, and Central America, while the previous model (NAD27) was designed for a central portion of North America only. Neither datum is wrong; however, errors may be introduced into positioning if one operates outside of the datum’s range or if coordinates from one datum are compared to coordinates from another datum.

NTRIP: (Network Transmission of RTCM via Internet Protocol) – This is a password protected method of RTCM (a corrections protocol) data stream acquisition. As the name implies, this protocol can only occur through an internet connection. This protocol offers greater usage statistics, security, and controlled access for the signal provider and requires a username and password issued by the network administrator. A fee may be associated with NTRIP usage, however ALDOT does not currently charge for NTRIP use.

PPM: (Parts Per Million) – In positioning terms, ppm is a representation of position error as a function of distance between two communicating devices. For instance, if a user was operating a guidance system that depended on a single base station, a one-inch ppm error would occur if the user was 15.78 miles (one million inches) away from the base station, in addition to random error and other systematic error sources.

Packet Data: Information that is reduced into digital pieces or ‘packets’, so it can be transmitted more efficiently and quickly across networks, including radio airwaves and wireless networks.

PDA: (Personal Digital Assistant) - A portable, handheld computing device which runs its own operating system and is capable of running programs and transmitting and storing data. These devices offer services such as paging, data messaging, e-mail, computing, faxes, date books and other information management capabilities. Often, it is used as a means to collect data when connected to sensors such as a DGPS receiver for many agricultural operations.

Port Number: This number is a gateway, or "link," to a more particular source of information on a networked computer or server. A port number will typically be associated with an IP address and represent an application specific number for identifying different applications communicating from the same IP address. An example of this term, from a precision-agriculture standpoint, would be when a farmer wants to utilize the real-time correction service offered by ALDOT, then the farmer's device must be able to access and maintain a stable data-streaming connection of compatible data with the ALDOT server, represented by its own IP address and port number.

Projection: Typically referred to as a map projection which represents projecting all or part of the earth's surface (3-D) onto a 2-D plane. In terms of navigational systems, points and lines are projected from an ellipsoidal model (3-D), representing the earth, to a flat plane (2-D) for analysis. Projected data is required to conduct dimensional analysis such as measuring lengths and areas.

Receiver: Refers to a GPS/GNSS receiver in which computations are performed internally to derive a positional solution. The GPS/GNSS receiver and antenna could be located within the same housing while other GPS/GNSS units may have a separate receiver and antenna.

Repeater: A device that receives, amplifies, and re-transmits a radio or cellular signal. It is used in wireless networks to extend the range of base station signals and to expand coverage. Repeaters are typically mounted on structures or vehicle (e.g. truck) in order to expand the broadcast range in varying terrain or locations with obstacles (e.g. buildings, trees, etc.).

Rover: Refers to the mobile GPS/GNSS receiver which can include navigational and mapping units, a single GPS/GNSS receiver, or RTK technology.

RTK: (Real Time Kinematic) – refers to highly-accurate, highly-repeatable positioning. With RTK, a base station receiver is placed on a stable (ideally immobile) mount, allowing multiple GPS rover receivers to utilize this type of correction within a limited range of the base station. The premise behind the service is simple: as the base station continually collects static position information under local field conditions, the positioning errors computed at the base station (the differences between "observed" values and "truth") are assumed to be the same errors occurring at the mobile receiver (rover). The base-station errors are transmitted to the mobile receiver, usually via a short-range radio or other communication device, allowing the rover unit to use this information to calculate a highly accurate, corrected position. Radios operate best within line of sight or with a repeater. RTK utilizes two dual-frequency receivers---necessary for highly accurate operations, such as precision guidance for row crop production or collecting GPS elevation data for topography mapping. The Alabama Department of Transportation (ALDOT) has established many CORS-rated stations throughout Alabama. They also provide real-time connectivity to each station for customers; the result is an RTK service whereby the customer does not necessarily have to purchase their own base station.

RTCM: (numerous versions and types) - refers to an International communication/corrections format (not manufacturer specific), developed by the Radio Technical Commission for Maritime Services; earlier versions were designed for DGPS uses (code-differential), and RTCM v.2 Type 1.8/1.9 was first to offer uncorrected carrier-phase and pseudorange information in the datastream (for RTK use); currently up to version 3.1 with expected advancements in the future. Basically, this is a type of data stream format in which correction messages are transmitted from the base station to the receiver via radio frequency or internet.

RTN / RTKN: (Real-Time Network or Real-Time Kinematic Network) – A generic term for a correction service offering greater reliability than single-station RTK Correction by using data from a "mesh" of multiple surrounding base stations in an attempt to model exact error at the rovers location. Increased accuracy and reliability over longer baseline distances can be expected. If a receiver is located "under the mesh," typical RTK accuracy can be expected. A subscription fee would most likely be associated with using this service, due to infrastructure costs. Examples include Virtual Reference Stations™ (VRS), eGPS™, and Master Auxiliary Correction (MAX).

RTT: (Radio Transmission Technology) - This is the "voice" protocol for CDMA-enabled cellular devices, usually abbreviated as "1X". However, modifications have allowed basic internet traffic over this service as well. Cellular providers such as Sprint PCS™, Verizon Wireless™, and Alltel™ utilize this type of communication protocol.

SD card: (secure digital card) – Removable-media format used in mobile devices such as digital cameras, PDAs, and GPS receivers.

SIM: (Subscriber Identity Module) – If you have a cellular device that requires GSM, GPRS, or EDGE services, then you will also require a SIM card. As the name implies, this is a media storage device (available from the service provider) that identifies your cellular device to the network, in addition to storing personal information, such as the user's contact list. A SIM card is about the size of a postage stamp. If you have a cellular device that functions despite not having a SIM card installed, then that device is likely a CDMA-enabled device.

Smartphone: refers to a cellular phone with advanced capabilities, often with PC-like functionality, internet capability, and a complete operating system.

SMS: (Short Message Service) - Essentially, this is basic "text messaging" that accommodates 140 - 160 characters. This service was originally designed for mobile-to-mobile communications via GSM, but SMS is also available under CDMA.

SNR: (Signal to Noise Ratio) – In analog and digital communications, it refers to a measure of signal strength relative to background noise. The greater the ratio, the more reliable the observation.

SV: (Satellite Vehicle or Space Vehicle) – This abbreviation is used to refer to satellites orbiting Earth.

TCP/IP: (Transmission Control Protocol/Internet Protocol) - A protocol permitting communications over and between networks, the TCP/IP protocol is the basis for the Internet communications.

TIN: (Triangulated Irregular Network) – A TIN is a mathematical model of a surface defined by triangles where each vertex is a measured point.

UMTS: (Universal Mobile Telecommunications Systems) - This is third generation (3G) technology generally based on W-CDMA (Wideband Code Division Multiple Access). UMTS promises a communications speed between 384 KB per second and up to about 2 MB per second.

UTM: (Universal Transverse Mercator) – This is one of many different mathematical projection models upon which satellite-derived positions can be translated into a coordinate system that corresponds to positions derived through standard maps. For the sake of simplicity, each datum has mathematical parameters that define it, including the predicted center of the Earth and the mathematical shape of the Earth. Because the Earth is not perfectly spherical, the mathematical parameters may provide a model that is accurate on one portion of the planet, while being horribly inaccurate on another. UTM, is a world standard for topographic mapping and digital exchange. Therefore, it is a global model that has been divided into numerous zones (60 total zones, 6° each) that represent certain sections of the globe. Coordinates collected using UTM map projection are identified as Easting (x) and Northing (y) with units measured and reported in meters, unlike NAD-83 coordinates (conventionally presented in survey feet).

VRS: (Virtual Reference Station) – Represents a network correction method in which multiple base stations are used to derive correction data specific to an individual rover but it is unique in that a "virtual" base station is created for the rover at the autonomous point of initiation. This method of network GPS/GNSS correction is proprietary to Trimble™. The rover uses correction data from this VRS as if it were working off of a "real" station. However, the correction algorithms received from the VRS more closely model the error experienced by the rover than a "real" station's single baseline solution from some miles away. This correction approach can allow for increased accuracy and reliability for RTK and similar based systems. The reliability comes into play when considering the multiple base stations used as opposed to a single baseline solution. With a VRS, the operator has *multiple* stations from which data is being pulled; however, a single baseline solution is dependent upon the "health" of *one* station. Because the VRS has the ability to seamlessly pick up or select another base station in the event one of its base stations goes down during the receiver operation, it lends itself to continuous operation and is not dependent on any one station's functionality.

WAAS: (Wide-Area Augmentation System) – This correction service, developed by the Federal Aviation Administration (FAA), is free to use and provides coverage across the US along with part of Canada and Mexico. Many GPS receivers (especially mapping and navigational units) produced today utilize WAAS correction signals. Through a network of ground-based reference stations and two geostationary satellites, the corrections are broadcast to an L1-capable, DGPS-enabled receiver. Some manufacturers that utilize WAAS for their guidance systems report pass-to-pass dynamic accuracies of 6 – 8 inches; however, static accuracy is typically under 10-ft.

WGS-84: (World Geodetic System 1984) – A mathematical ellipsoid, comprised of a standard coordinate frame, ellipsoidal reference surface, and nominal sea level, to best represent the planet Earth. WGS-84 has been used by the GPS community since January 1987.

WiFi: (Wireless Fidelity) - provides wireless connectivity over unlicensed spectrum (using the IEEE 802.11a or 802.11b standards), generally in the 2.4 and 5 GHz radio bands. Wi-Fi offers local area connectivity to WiFi-enabled computers.

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