

1. How do I connect to the new Tennessee Department of Transportation GNSS Reference Network

- a. In addition to multiple reference frames being offered and to support the widest variety of GNSS rovers, TDOT will offer different correction formats and network correction types. Be it a VRS, iMac or Nearest RTK solution, TDOT will support these common correction types to assure compatibility.
- b. TDOT recommends that users connect using the MSM mount points below, due to the inclusion of multiple constellations in these mount points, however, please consult with your rover manufacturer to understand which correction format and network correction type works best with your specific rover.
- c. The TDOT GNSS Reference Network Source Table can be found at:

i. Server Address: **TDOTCORS.TN.GOV:8002**

Mountpoint Name	Correction Type	Constellations	Reference Frame	Epoch
MSM_iMAX	GNSS (Network)	GPS, GLO, GAL, BDS	NAD83(NA2011)(MYCS2)	2010.00
MSM_VRS	GNSS (Network)	GPS, GLO, GAL, BDS	NAD83(NA2011)(MYCS2)	2010.00
MSM_NEAR	GNSS (Single Base)	GPS, GLO, GAL, BDS	NAD83(NA2011)(MYCS2)	2010.00
MSM_iMAX_CORS96	GNSS (Network)	GPS, GLO, GAL, BDS	NAD83(CORS96)	1996.00
MSM_VRS_CORS96	GNSS (Network)	GPS, GLO, GAL, BDS	NAD83(CORS96)	1996.00
MSM_NEAR_CORS96	GNSS (Single Base)	GPS, GLO, GAL, BDS	NAD83(CORS96)	1996.00

Mountpoint Name	Correction Type	Constellations	Reference Frame	Epoch
RTCM3_iMAX	GNSS (Network)	GPS, GLO	NAD83(NA2011)(MYCS2)	2010.00
RTCM3_VRS	GNSS (Network)	GPS, GLO	NAD83(NA2011)(MYCS2)	2010.00
RTCM3_NEAR	GNSS (Single Base)	GPS, GLO	NAD83(NA2011)(MYCS2)	2010.00
RTCM3_iMAX_CORS96	GNSS (Network)	GPS, GLO	NAD83(CORS96)	2010.00
RTCM3_VRS_CORS96	GNSS (Network)	GPS, GLO	NAD83(CORS962)	1996.00
RTCM3_NEAR_CORS96	GNSS (Single Base)	GPS, GLO	NAD83(CORS96)	1996.00
CMRP_VRS_CORS96	GNSS (Network)	GPS	NAD83(CORS96)	1996.00
CMRP_NEAR_CORS96	GNSS (Single Base)	GPS	NAD83(CORS96)	1996.00

2. What reference frames or coordinates are the foundation of the Tennessee Department of Transportation GNSS Reference Network?

- a. When TDOT launched its network in 2007, the CORS96 reference frame was the National Spatial Reference System (NSRS) and with our software package we were limited in our ability to seamless transition to the newer NAD83(2011) Epoch 2010.00 reference frame when it was introduced in 2012.
- b. With our software modernization we will be able to offer both CORS96 and NAD83(2011) Epoch 2010.00 reference frames in parallel, as well as provide future reference frames such as the new NATRF2022 reference frame when and if it becomes available from NGS.
- c. New mountpoints have been created to allow our users to use CORS96 on legacy projects and to easily transition to the more modern NAD83(2011) Epoch 2010.00 for new projects and field operations.
- d. It is highly recommended that you transition to the more modern NAD83(2011) Epoch 2010.00 reference frame whenever possible to assure compatibility with other industry tools and networks.
 - i. More information about the NAD83(NA2011)(MYCS2) reference frame can be found on the NGS Website -> [NA2011 FAQs](#)

3. How do I contact the Tennessee Department of Transportation GNSS Reference Network team?

- a. If you have any questions or experience any issues, please reach out to us by email at TDOT.GNSSNetwork@tn.gov.

4. Are there other post processing tools available outside of the RINEX Project Tool available on the TDOT GNSS Reference Network Portal?

- a. Yes. The new TDOT GNSS Reference Network subscription service now also includes access to a Coordinate Computation Service and a Virtual RINEX Service.
- b. Access to these advanced features is available through the [TDOT SBC Interface](#). Enter this portal using the same license username and password as provided for access to your RTK Products.
- c. Look for hyperlinks to quick guides once you log into the TDOT SBC Interface.

5. How do I use the information provided in the email activation message I received?

- a. The new TDOT GNSS Portal at <https://portal.tndot.net> is now available, providing users with a streamlined way to manage their account information and licenses. Access to the portal requires the username and password provided in the Activation Email.
- b. Upon logging in for the first time, users will be prompted to review and update their contact information to ensure accuracy. Additionally, acceptance of the TDOT Terms and Conditions is required to proceed.
- c. Within the portal's Account Management page, licenses are listed at the bottom of the page. This section provides the usernames and passwords necessary for configuring Rovers to access RTK services, ensuring seamless integration with the system.

6. How do I renew my existing licenses?

- a. At this point in time, you cannot renew your existing licenses outside of 30 days from your current expiration date.
- b. To support the transition from our paper-based license renewal system to the new electronic payment platform, we have implemented several updates to ensure a smooth process for all end-users.
- c. As part of this transition, end-users with recently expired or soon-to-expire licenses will be granted a grace period to complete their renewal. These users will receive an automated email reminder on December 15, 2024, notifying them that it is time to renew. A 30-day grace period will be provided for license renewals, ensuring uninterrupted access during this transition period.
- d. For all end-users, automated renewal reminders will be sent 30 days prior to the license expiration date. If the renewal is not completed, a follow-up email will be sent 15 days before the expiration.
- e. To simplify the renewal process, a RENEW button will be available in the user portal starting 30 days before the expiration date. This button allows users to complete their renewal directly through the secure WorldPay payment service. Additionally, each reminder email will include a direct link to the account and payment platform, offering users the flexibility to renew either via email or through the portal.

7. How do I add more rover licenses to my account?

- a. To purchase additional licenses, users can access the new TDOT GNSS Portal at <https://portal.tndot.net> using the username and password provided in their activation email.
- b. After logging into the portal, users can select the 'Add a License' option. This will redirect them to the WorldPay payment service, where they can securely complete the purchase of additional licenses.
- c. The system automatically calculates a prorated cost for the new licenses, aligning their expiration dates with those of existing licenses for streamlined management.

8. Can I change my Passwords?

- a. A user can change their TDOT GNSS Portal password by accessing their "View Account" settings while logged into the portal.
- b. The account holder can click on the "Change Password" link to modify their portal password.

- c. If a user needs to change their email address, they must send a request to TDOT at TDOT.GNSSNetwork@tn.gov as their account is tied to the email address and updates must be made by TDOT.
- d. A user can change their TDOT rover passwords by clicking the “Reset Password” under “License Action” in the “License Management” section of the “View Account” page.
- e. A user is unable to change the “Rover Name” provided by the system.
- f. System generated passwords:
 - i. Be very cautious when entering your username and password.
 - 1. The characters sometimes are difficult to determine. For example, sometimes the lower-case L (l) is mistaken for a capital i (I) in the passwords.

9. I need to change the email address tied to our account. I can't do that in the TDOT GNSS Portal. What do I do?

- a. If the primary contact is no longer the main contact due to retirement, job change, etc., you cannot change the email information through the TDOT GNSS Portal.
- b. If you need this change, you must email TDOT.GNSSNetwork@tn.gov with the following information:
 - i. Company Name: ii. Old Email information: iii. New Email information:
 - iv. Other contact changes, such as name, phone, etc.:

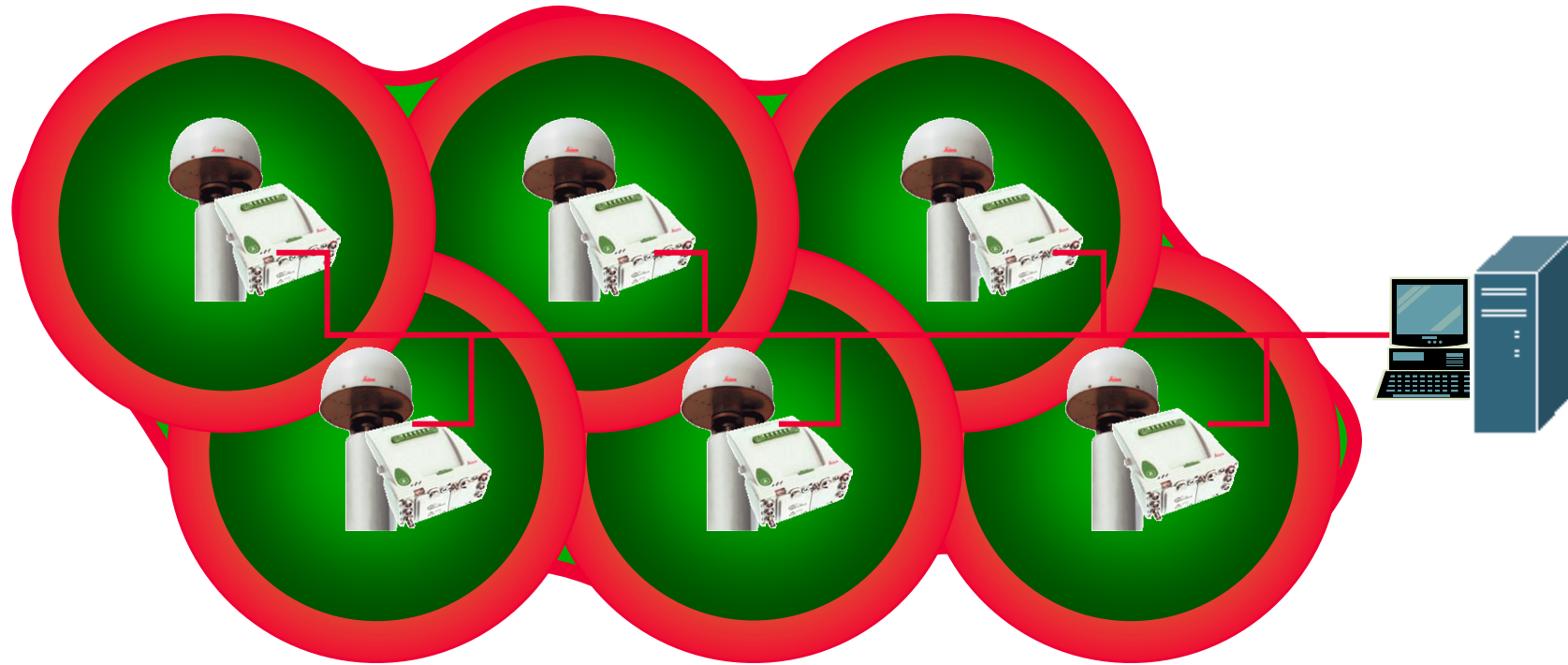
10. What are the costs for TDOT GNSS Access?

- a. The required fees for each USER account for an individual Access Point are as follows:
 - i. Access Point Fee (for each simultaneous Access Point) to include network account administration support:
 - 1. Fifty dollars (\$50.00) per month for each simultaneous Access Point.
 - 2. A convenience charge of 2.35% of the total cost is added to pay for the use of the credit card system.

11. What is the difference between iMAX, VRS, and Closest network mountpoints?

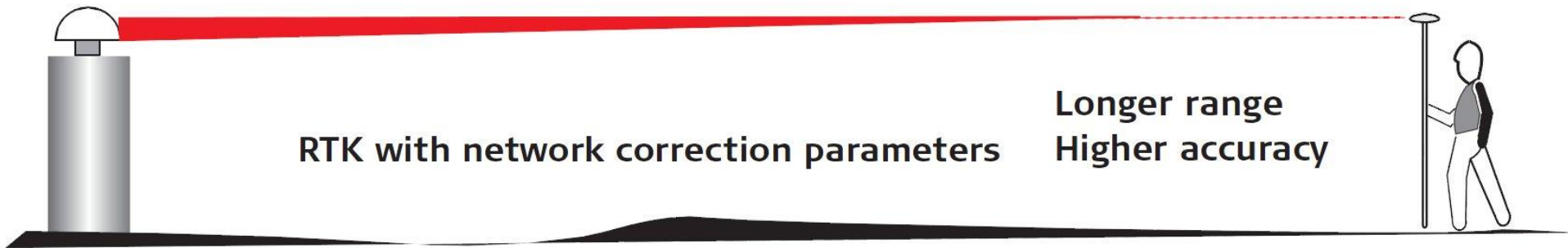
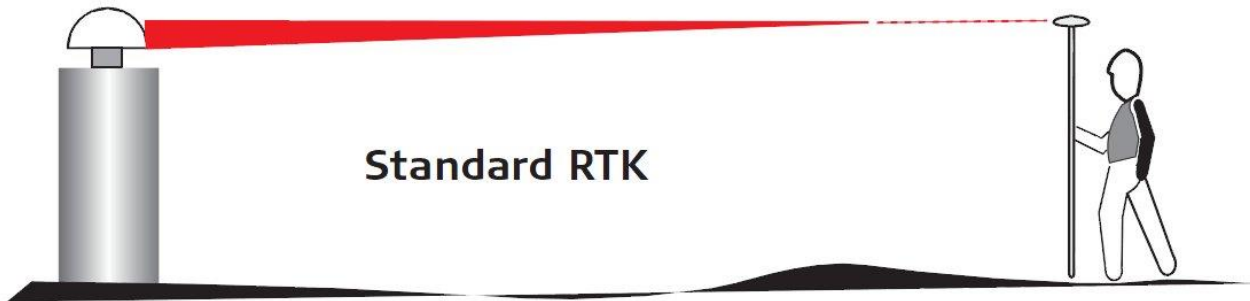
Motivation for Network RTK

- Model and estimate distance-dependent errors
 - Main error sources: ionosphere, troposphere and satellite orbits
- Provide network correction information to rover users



Accuracy, Reliability, Availability
Good  Poor

What does it mean to the end-user?



Example Rover Technical Specification

MEASUREMENT PERFORMANCE & ACCURACY¹

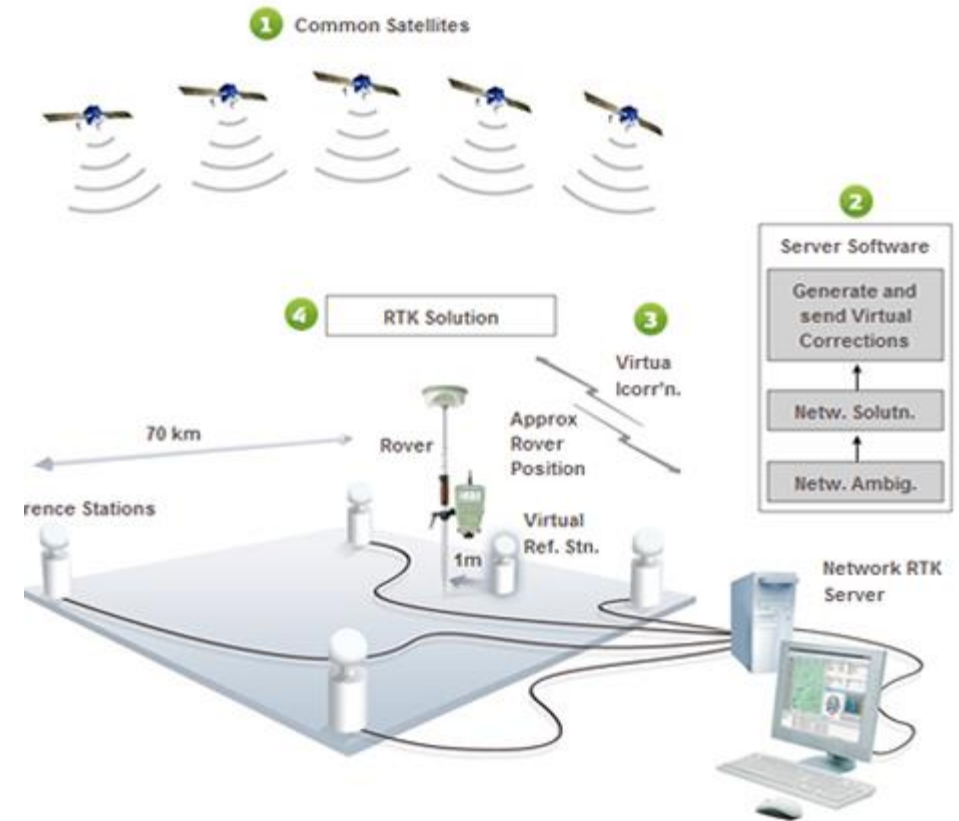
Time for initialisation		Typically 4 s
Real-time kinematic (Compliant to ISO17123-8 standard)	Single baseline Network RTK	Hz 8 mm + 1 ppm / V 15 mm + 1 ppm Hz 8 mm + 0.5 ppm / V 15 mm + 0.5 ppm
Real-time kinematic tilt compensated	Topographic points (not for static control points)	Additional Hz pole tip uncertainty typically less than 8 mm + 0.4 mm/° tilt down to 30° tilt
Post processing	Static (phase) with long observations Static and rapid static (phase)	Hz 3 mm + 0.1 ppm / V 3.5 mm + 0.4 ppm Hz 3 mm + 0.5 ppm / V 5 mm + 0.5 ppm
Code differential	DGPS / RTCM	Typically 25 cm

For example, a 20km baseline under favorable GPS conditions, per specification, will provide the following performance and accuracy results:

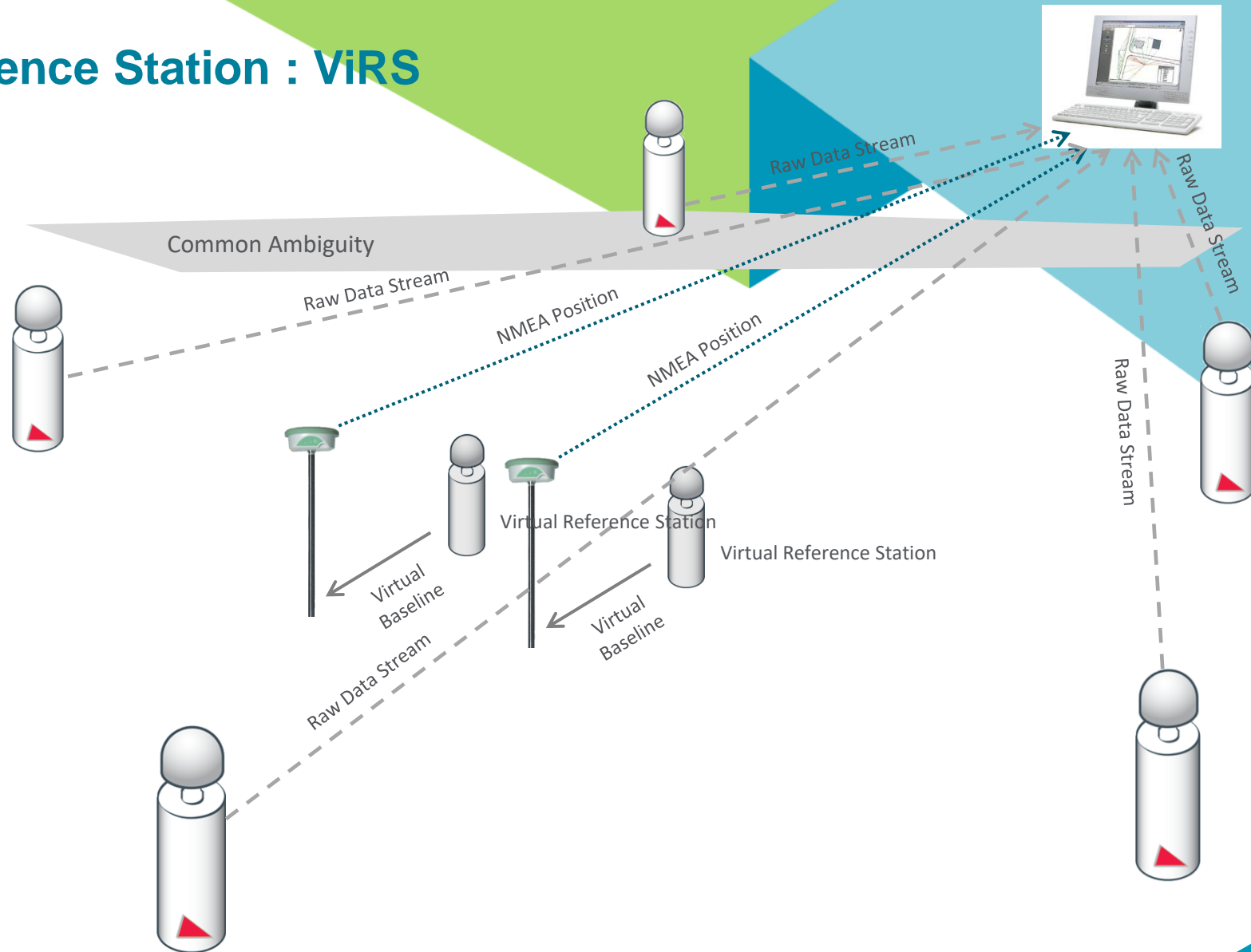
Single Baseline RTK :	8 mm + 1ppm (20km)	= 2.8 cm horizontal
Network RTK:	8mm + 0.5ppm (20 km)	= 1.8 cm horizontal

Virtual Reference Station : ViRS

- ✓ Transmits computed data that is referenced to an **arbitrary point** near to the rover user
- ✓ Uses commonly understood single base formats
- ✓ Compact data transmission
- ✓ Compatible with RTCM 3.2 MSM (GNSS Messages)
- ✗ Content of messages not standardised (in particular use of *a priori* troposphere model)
- ✗ Network information is lost (not all relevant information is available to the rover)

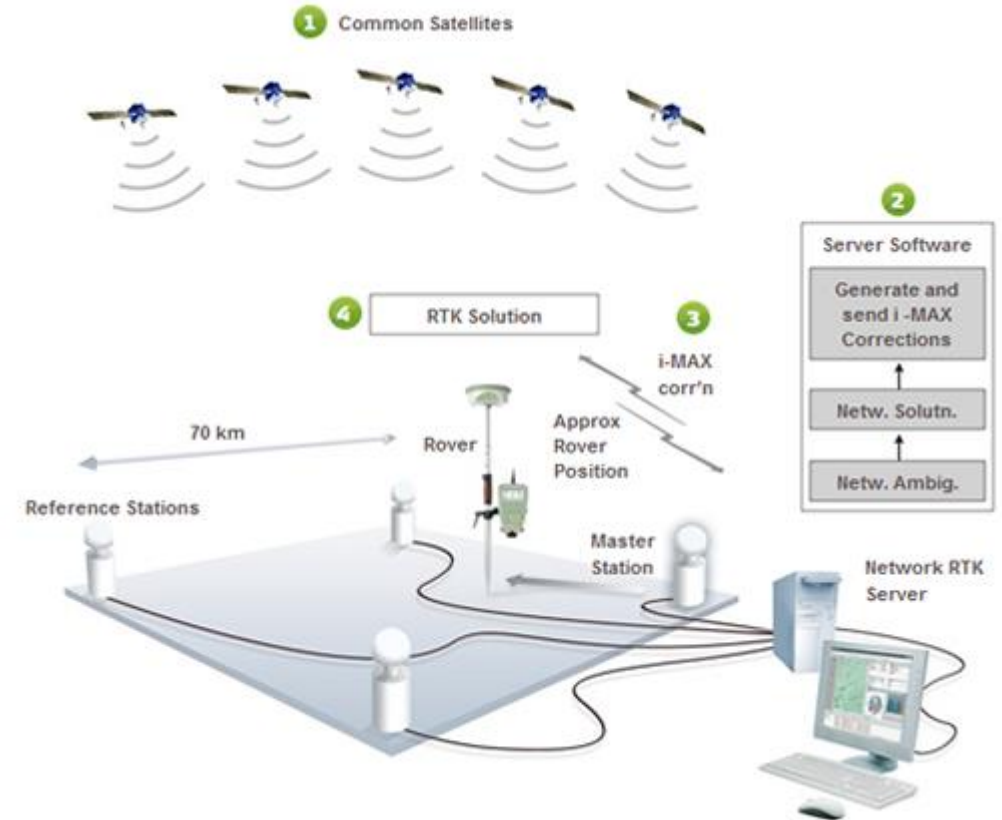


Virtual Reference Station : ViRS

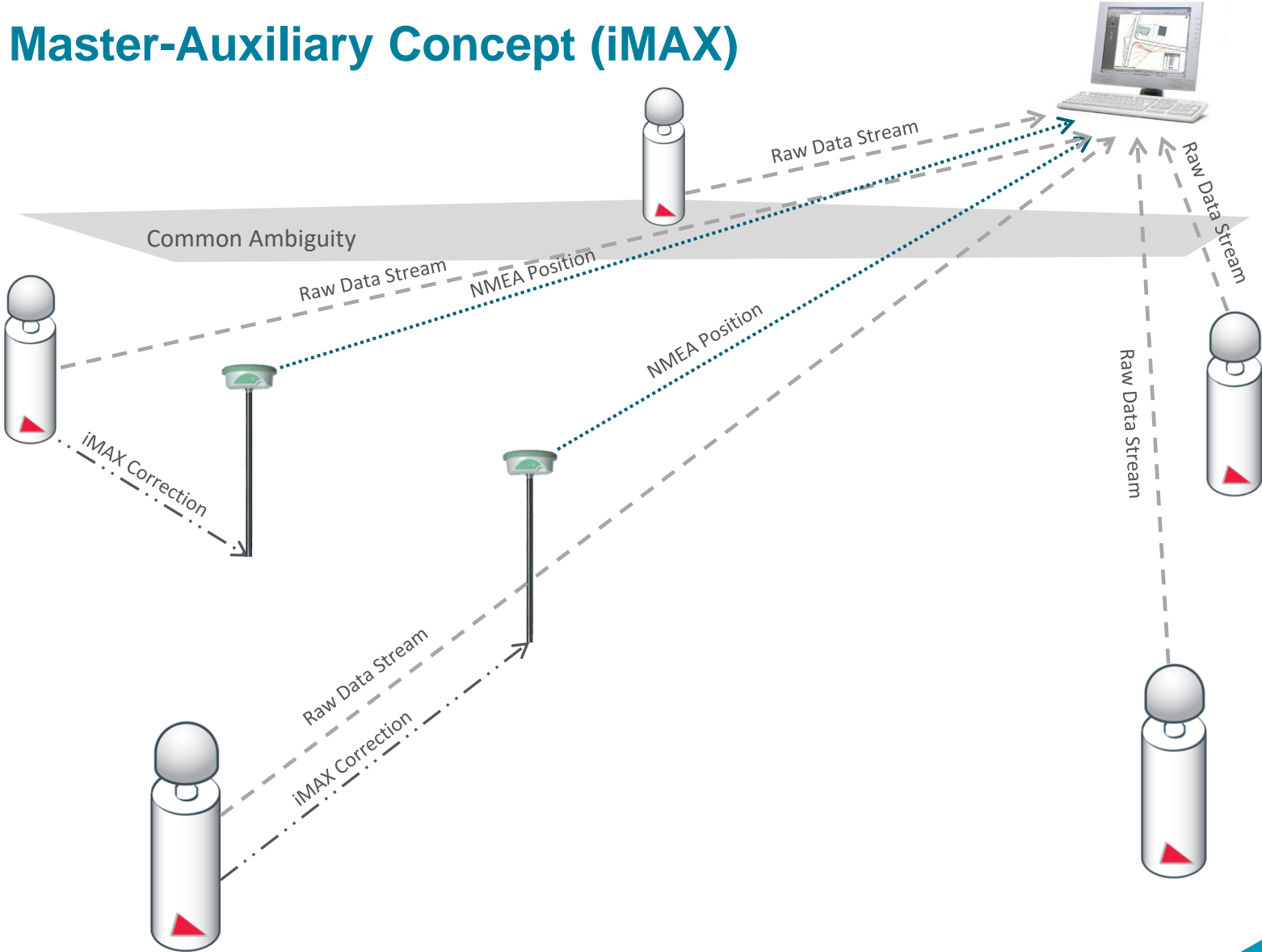


Individualized Master-Auxiliary Concept (iMAX)

- Transmits computed data that is referenced to a **physical** reference station
- Uses commonly understood single base formats
- Compact data transmission
- Compatible with RTCM 3.2 MSM (GNSS Messages)
- Content of messages not standardised (in particular use of *a priori* troposphere model)



Individualized Master-Auxiliary Concept (iMAX)



TDOT GNSS Network RTCM ID Tables

For those using a "NEAR" mountpoint and needing realtime connection information refer the following table for TDOT Site Codes and corresponding RTCM ID#.

Site Code	RTCM ID	Location
TN10	10	Sevierville TN
TN11	11	Johnson City TN
TN12	12	Morristown TN
TN13	13	Newport TN
TN14	14	Lafollette TN
TN15	15	Knoxville TN
TN16	16	Harriman TN
TN17	17	McGhee Tyson AP
TN18	18	Elizabethton TN
TN19	19	Huntsville TN
TN1A	100	Pellissippi St. CC
TN1B	101	Surgoisville TN
TN1C	102	Harrogate TN
TN1D	103	Mountain City TN
TN1E	104	Blountville TN
TN1F	105	Greeneville TN
TN1G	106	Madisonville TN
TN1I	108	Knoxville TN

Site Code	RTCM ID	Location
TN21	21	Chattanooga TN
TN22	22	Dunlap TN
TN23	23	Crossville TN
TN24	24	Cookeville TN
TN25	25	Tullahoma TN
TN26	26	Athens TN
TN27	27	Livingston TN
TN28	28	McMinnville TN
TN29	29	Delano TN
TN2A	200	Cleveland TN
TN2C	202	Coalmont TN
TN2D	203	Spencer TN
TN2E	204	Jamestown TN
TN2F	205	Moss TN
TN2G	206	Winchester TN
TN2H	207	Smithville TN
TN2I	208	Whitwell TN
TN2J	209	Woodbury TN

Site Code	RTCM ID	Location
TN30	30	Hohenwald TN
TN31	31	Nashville TN
TN32	32	Gallatin TN
TN33	33	Clarksville TN
TN34	34	Belfast TN
TN35	35	McEwan TN
TN36	36	Lawrenceburg TN
TN37	37	Columbia TN
TN39	39	Pulaski TN
TN3A	300	Murfreesboro TN
TN3B	301	Brentwood TN
TN3C	302	Mt. Juliet TN
TN3D	303	Springfield TN
TN3E	304	Fayetteville TN
TN3F	305	Franklin TN
TN3G	306	Dickson TN
TN3H	307	Gordonsville TN
TN3I	308	Lafayette TN
TN3J	309	Waynesboro TN
TN3K	310	Dover TN

Site Code	RTCM ID	Location
TN40	40	Lexington TN
TN41	41	McKenzie TN
TN42	42	Newbern TN
TN43	43	Bethel Springs TN
TN44	44	Jackson TN
TN45	45	Arlington TN
TN46	46	Crump TN
TN48	48	Paris TN
TN49	49	Ripley TN
TN4B	401	Martin TN
TN4C	402	Memphis TN
TN4D	403	Whiteville TN
TN4E	404	Camden TN
TN4F	405	Milan TN
TN4G	406	Parsons TN
TN4H	407	Memphis TN
TN4I	408	Wynnborg TN
TN4J	409	Counce TN
TN4K	410	Memphis TN
TN4L	411	Covington TN

TDOT GNSS Network RTCM ID Tables

For those using a "NEAR" mountpoint and needing realtime connection information refer the following table for TDOT Partner Site Codes and corresponding RTCM ID#.

Site Code	RTCM ID	Location
AL10	500	Guntersville AL
AL13	501	Dutton AL
ALFL	502	Florence AL
ALNC	503	North Court AL
GTAC	504	Huntsville AL

Site Code	RTCM ID	Location
KYCG	506	Middlesboro KY
KYDH	507	Dale Hollow KY
KYHK	508	Hopkinsville KY
KYHL	509	Harlan KY
KYHM	510	Hickman KY
KYMU	511	Murray KY
KYMY	512	Mayfield KY
KYSV	513	Scottsville KY
KYTC	514	Bowling Green KY
KYWC	515	Whitley City KY

Site Code	RTCM ID	Location
MSCR	519	Corinth MS
MSHS	520	Holly Springs MS
MSNS	521	Nesbit MS
MSSN	522	Senatobia MS
MSTU	523	Tunica MS
AROC	541	Osceola AR
ARWM	542	West Memphis AR
MOHT	543	Hayti MO

Site Code	RTCM ID	Location
NCBC	525	Bryson City NC
NCMU	527	Murphy NC
NCNE	528	Newland NC
NCRB	529	Robbinsville NC
NCSY	530	Sylva NC
NCWJ	531	W Jefferson NC
ASUB	537	Boone NC
NCM2	544	Marshall NC