

RTCM 3.1 Decoder in SurvCE

Manual and White Paper on Messages 1021-1027

(SurvCE/SurvPC beta 2.80.52. December, 2012)

Note: This feature is under beta testing and could suffer corrections and improvements in the future.

Index

[Introduction](#)

[How does it work?](#)

[RTCM 3.1 standard for Transformation Messages](#)

[Preparation](#)

[RTCM messages 1021-1027 availability and User Activation](#)

[RTCM messages Alert](#)

[Real Time Check for NTV2 and Geoid Corrections \(monitor Screens\)](#)

[Sample cases. A few NTRIP Networks in Europe](#)

Introduction

RTCM 3.1 messages 1021-1027 have been designed to provide Transformation Parameters for the GNSS measurements that can be applied in order to get a more accurate positioning in some of the Local Coordinate System within the network coverage.

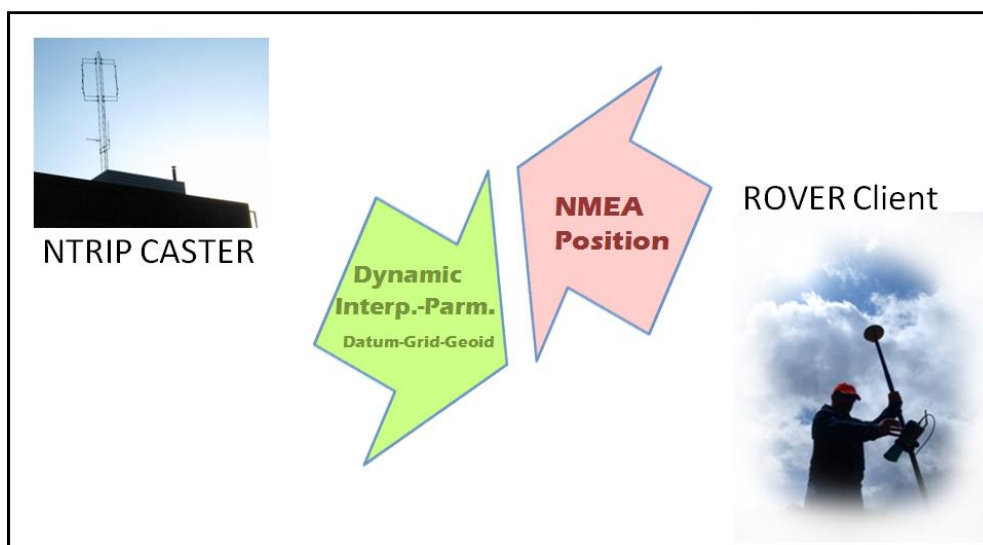
The use of these messages is independent of the rest of messages broadcasted from the NTRIP server. Whichever case these messages get implemented in the mount-point stream, from a SurvCE/ SurvPC point of view, it is the user choice to apply for these messages or not. This means, the user can link to the mount point, in the traditional way, just for an RTK-wise solution (getting GNSS reference differential information for an accurate RTK Fix), but also having an extra possibility to use or not use these messages which are addressed to a different purpose that is only related to the Data Collection Software to incorporate the transformations suggested by the network to conclude in a good final set of Local Coordinates.

There is nothing new on this but a more automated way and new technology to collect and apply transformations. Almost the same results could be acquired by using pre-defined transformation models in SurvCE, previously set in the system, this including Datum Transformation and Map Projection definitions, Geoid Undulation models and NTV2 type models for correcting E/N distortions on a grid. The benefits are for a more automated procedure, simpler setup on transformations and more safe against user mistakes and at the same time having a great potential for getting any updates on local transformation models in a more direct and more independent way from the regular updates of Data Collection Software.

In order to understand how to use this technology in SurvCE, next are some explanations from the RTCM standard.

How does it work?

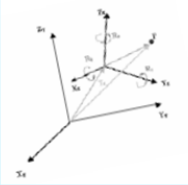
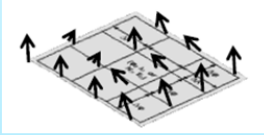
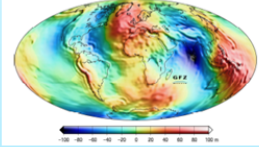

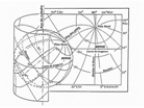
It is important to clarify; the caster always needs to know the position of the rover, because some of the transformation parameters are customized depending on that. In order to make this possible, the Controller Software needs to periodically upgrade the position of the receiver and it does by sending a GGA (NEMA) position stream to the caster. There is nothing to concern the user on this, as SurvCE will automatically detect and provide this information when required.



RTCM 3.1 standard for Transformation Messages

The standard provides three main sets of transformation messages:

messages 1021-1027:

- 1021-1022 Datum Transformation Parameters
 - 1021 Helmert-Molodensky 7par
 - 1022 Molodensky-Badekas 10par 7+XYZ of M-B Rotation Point)
- 1023-1024 Grid Residuals and/or Geoid undulation
 - 1023 $\delta\phi, \delta\lambda, \delta N_{\text{geoid}}$
 - 1024 $\delta\text{East}, \delta\text{North}, \delta N_{\text{geoid}}$

- 1025, 1026, 1027 Projection Information
 - 1025 All projection types excepting LCC-2SP and OM
 - 1026 Lambert Conic Conformal 2SP
 - 1027 Oblique Mercator


- **1021 and 1022 messages.** These are the very basic Datum Transformation that needs to be provided. Only one of the two will be in the same set, depending on the transformation type being a 7 parameter one or a 10 parameter one. SurvCE only supports message 1021 by now as not yet found a network with 1022 implemented. 1022 support could be added in the future if required.
All 1021-1027 compliant mount points tested until now by SurvCE team are including message 1021, so we have not found any case where the datum should be “preset” by the user (more details in “Preparation” chapter)
- **1023 and 1024 messages.** The information provided by these two messages is about the **Horizontal** (EN model) **and Vertical** (Geoid model) corrections to apply. Again, only one of the two messages applies.
 - 1023 does for latitude and longitude residuals (in target datum) + Geoid undulation (in source datum). SurvCE supports this message and takes care for doing the right transformations, considering 1021 and 1023 together. We have found that some mount-points only provide the Vertical-part of these corrections for Geoid, whenever the datum does not require EN distortions modeling (like those using GRS-80 datum in target system). Nothing needs to be pre-defined in SurvCE in relation to this message (more details in “Preparation” chapter)
 - 1024 does for Northing and Easting residuals (in target datum). SurvCE is NOT supporting this until now. We have not yet found a Caster using this message, and any future requirement will have to be studied first, as it could decrease in our opinion the potential for traceability and re-calculation in the software.
- **1025, 1026 and 1027 messages.** Only one or none of these messages can be supplied from the caster. They are all related to the Map projection parameters and the one that fits the local projection type is used. 1025 is design for most of the projection types (like Travers Mercator) while 1026 and 1027 would be the ones to define Lambert Conic Conformal 2P and Oblique Mercator respectively. SurvCE only supports type 1025 by now, as we have just found implementations on this one to test. But it won’t be any problem in the future to support the other two projection types.
We have found few casters including any of these three messages, so it is the user responsibility to predefine the right projection parameters in SurvCE, before connecting to the caster. (More details in “Preparation” chapter)

Preparation

Not all required information for a complete transformation is always coming from the server. This means that SurvCE will need to complete, from the understanding of the user in some of the cases, whatever is required to get the final expected positions in the local grid. Next are the basics rules that SurvCE will apply depending on the provided messages from the caster.

- First is to explain that the current “Pre-Set” System in the job will be the support for any missing information in the messages 1021-1027. In order to set this, the operator can use the regular commands in SurvCE/ Localization before connecting to the caster. Under “Localization/System”, any of the Regional or World-Generic Pre-defined Systems can be used, as well as any new “User-Defined System” where the case could require it.
- Datum parameters are not necessary to be correct in the pre-set System, whenever the mount-point is providing such information through message 1021. We have not yet found any mount point, compliant with these messages, not providing 1021. In order to know if the mount-point supplies 1021, please check the “RTCM messages Alert” below.
- Any NTV2 Grid model (.grd) or Geoid Model (.gsf), previously set by the user before connecting to the caster will be ignored and will be replaced by the included corrections for Lat, Long and Elevation coming within message 1023 if available.
- If a 1025 message is broadcasted, SurvCE will “Pick” and Apply the projection parameters as coming from RTCM3, this is removing whichever System information was pre-set from the user. In order to know if the mount-point supplies 1025, please check the “RTCM messages Alert” below.
- Very few Casters we have tested by now are providing 1025-1027. So the normal case is for the user pre-sets a good System in SurvCE/ Localization/ System Tab.
- If the caster is providing Projection Parameters through messages 1026 or 1027, SurvCE will advise in the “RTCM messages Alert” dialog for these messages are not yet supported. Attending these cases, the user can preset the required projections on a previous setting on System Tab in order to get the right Map projection.

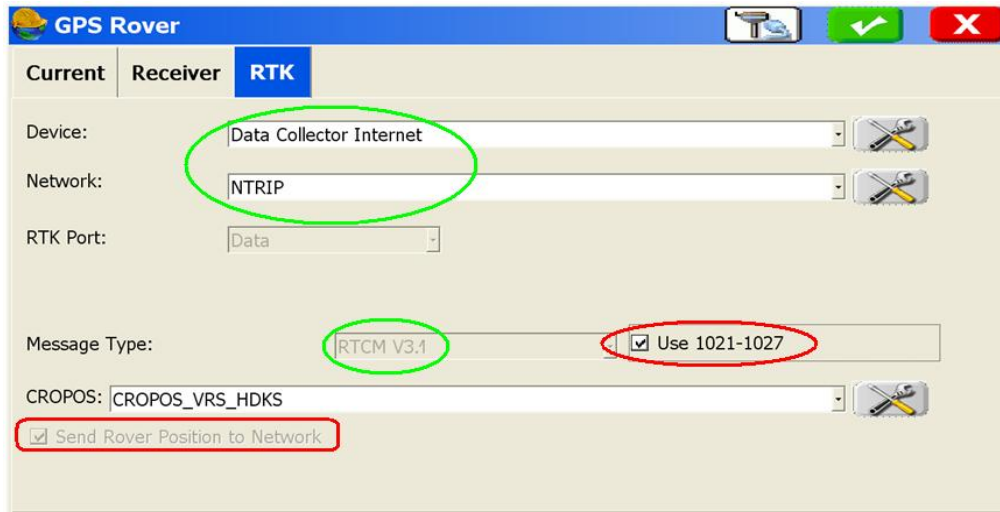
RTCM messages 1021-1027 availability and User Activation

RTCM Decoder in SurvCE is design to work on NTRIP connection, for those mount points, broadcasting RTCM 3.1 that have implemented any of the 1021, 1023 and 1025 messages defined in the RTCM standard. This doesn't mean that you might be expecting the benefit of these messages coming from any RTCM 3.1 caster, but just from those that have really done the implementation work to support them.

Also you might consider, the initial implementation for SurvCE RTCM decoder is ONLY compatible by now with the next RTK methods and devices:

1. Any GNSS receiver compatible with SurvCE DCI (Data Collector Internet) RTK method. This mean for those able to make an NTRIP connection using a network device in the Data Collector, like internal GPRS modem, Ethernet, WiFi, etc
2. Only by now; Using the Internal GSM Modem in ALTUS APS 3 or PENTAX SMT888 (both on v2 versions) GNSS rover receivers

If the user is interested in applying these messages, whether he knows or ignores if they are implemented in the caster, it is required his manual activation of the SurvCE real-time RTCM decoder. This step is easy to do and can be found in the RTK tab in Rover Receiver Setup. It is a new toggle tagged as “Use 1021-1027” that will only show up under the conditions explained above (NTRIP connections, 1021-1027 compliant caster, DCI method or Altus-Pentax internal modem)

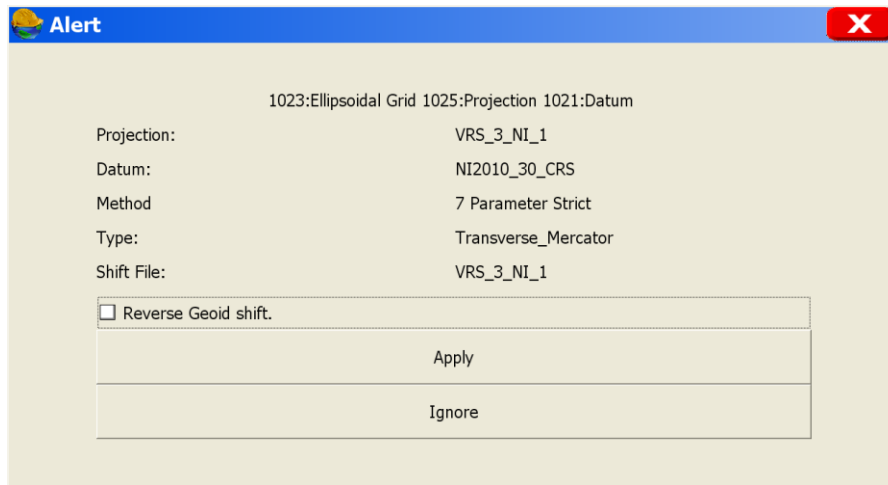


By checking ON the “Use 1021-1027” command, the user can activate the RTCM decoder in SurvCE. The messages coming from the caster will be analyzed from the very first connection to the mount-point. If the mount point is providing 1021, 1023 or 1025 messages, SurvCE will prompt the user, within the next few seconds after linked to the caster using Rover Setup, with the “RTCM messages Alert” dialog explained in the next chapter.

By checking OFF the “Use 1021-1027” command, SurvCE RTCM decoder will be disabled. No action at all will be taken from SurvCE in order to seek, read or apply any of the 1021-1027 messages embedded in the RTCM streaming, whether they are implemented or not. RTCM information will just be used for RTK-engine in the receiver to perform a regular RTK fix, and the user needs to set manually any of the Transformation procedures in SurvCE in order to get the required Final Local coordinates.

RTCM messages Alert

Only in the case that the user checked ON the “Use 1021-1027” command and connected to a mount point that is supporting these messages, a new dialog will show up within the first few seconds after connecting to the caster.



First row in the “Alert” dialog is reporting the messages found in the NTRIP Caster stream. Options are:

- 1021 Datum
- 1023 Ellipsoidal Grid
- 1025 Projection

Central lines reporting the new “User Defined” CSL that will be applied in SurvCE for Projection, Datum and Shift Models in the case the user taps on “Apply”. The name of the new projection and shift models are taken from the mount-point name (VRS_3_NI_1 in this case), and the name of the datum is taken from the Datum Parameters provided by 1021 message.

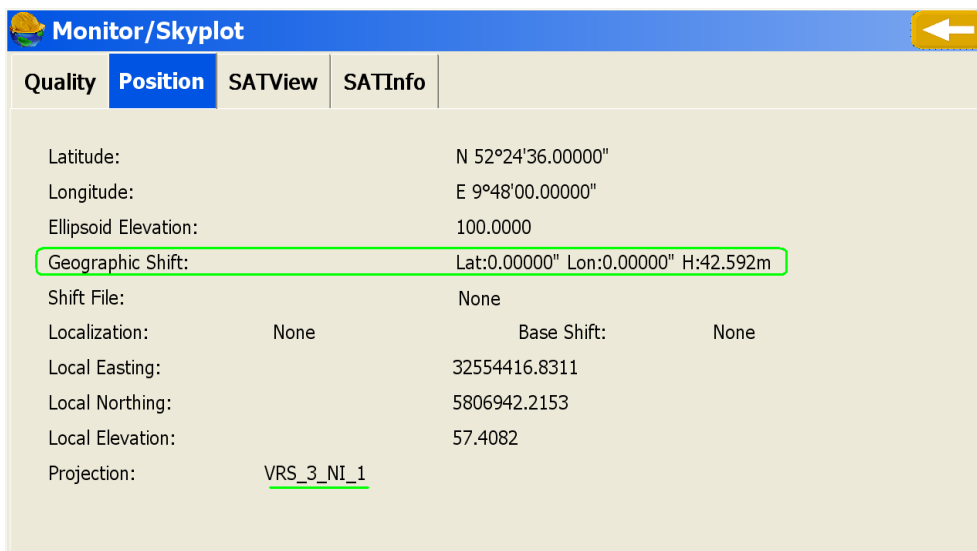
This together with:

- Reverse Geoid Shift. This toggle is NOT to be checked in most of the cases. The purpose is to attend workaround some mount-points using a wrong sign convention to apply Geoid undulation values.
- **Apply / Ignore.** By selecting on one or the other, the user will take his final decision on applying for the transformation parameters coming from NTRIP (use APPLY) or preserving the pre-set System Information from SurvCE/ Localization (use Ignore)

Note: At this time, the user needs to review the first line to make sure his preset parameters are set accordingly with the transformation messages coming from the caster. The normal situation is, if the 1025 message is not mentioned in the first row (only 1021 and 1023 listed), that means as explained in previous paragraphs, that SurvCE will incorporate the user preset System in the Job to complete the Datum Transformation (1021) and potential Lat-Lon-Height corrections (1023) as coming from the network. If the user is not sure at this point, he can always “Ignore” on this step, and revise System settings before reconnecting to the caster (using Rover-setup or network re-connect again)

Real Time Check for NTV2 and Geoid Corrections (monitor Screens)

Any time, after having Applied for RTCM messages as explained in the previous explanations, the user can check real-time the Lat / Lon and Geoid corrections that are being applied in current position of the rover. New report lines (highlighted below) have been added in the Position Tab under Monitor/ Skyplot .



Sample cases. A few NTRIP Networks in Europe

Next is a list of a few European NTRIP Networks that are implementing these transformation messages, at the time this document was written. SurvCE has been tested on this networks and found good results on final coordinates.

| NETWORK NAME | country | region |
|-----------------|---------|--|
| CROPOS | CROATIA | Croatia |
| APOS | AUSTRIA | Austria |
| SAPOS-NI | GERMANY | Niedersachsen-Bremen /Mecklenburg-Vorpommern/ Rheinland-Pfalz und Saarland |
| SAPOS-BW | GERMANY | Baden-Württemberg |
| SAPOS-BY | GERMANY | Bayern-Baveria |
| CPOS | NORWAY | Norway |

In the next page, more detail information on each of these networks, that including:

- NTRIP Caster information for the NTRIP software uses, IP and Port.
- RTCM 1021. Listed the mount points in the caster where 1021 message is used
- RTCM 1023 (Geoid). Listed the mount points in the caster where 1023 message is used and is including Geoid undulation.
- RTCM 1023 (NTV2-Grid). Listed the mount points in the caster where 1023 message is used and is including Lat-Lon corrections from an NTV2 model.
- From the specific mount-points using RTCM transformation messages, the suggested Projection Systems that might be selected from the Pre-Defined list in SurvCE, before connecting to the caster.

| NETWORK NAME | NTRIP-Solution | NTRIP-IP | PORT | RTCM-1021 (datum) | RTCM-1023 (Geoid) | RTCM-1023 (NTV2-Grid) | RTCM-1025 (projection) |
|-----------------|----------------|----------------|-----------|--------------------|-------------------------------|---|------------------------|
| CROPOS | Trimble | 195.29.118.122 | 2101 | HDKS;HTRS96 | HDKS;HTRS96 | HDKS | not used |
| | | | | Mount Point | zone | Suggested SurvCE Preset Projection | |
| | | | | HDKS | 5 | CROATIA/Bessel 1841/Gauss zone 5 | |
| | | | | HDKS | 6 | CROATIA/Bessel 1841/Gauss zone 6 | |
| | | | HTRS96 | 6 | CROATIA/HTRS96/TM | | |
| APOS | Trimble | 195.29.118.122 | 2101 | NET3;VRS3 | NET3;VRS3 | NET3;VRS3 | not used |
| | | | | Mount Point | zone | Suggested SurvCE Preset Projection | |
| | | | | NET3/VRS3 | EAST | AUSTRIA/MGI/Austria East Zone | |
| | | | | NET3/VRS3 | CENTRAL | AUSTRIA/MGI/Austria Central Zone | |
| | | | NET3/VRS3 | WEST | AUSTRIA/MGI/Austria West Zone | | |
| SAPOS-NI | GNSmart | 195.37.202.231 | 2101 | NET3;VRS3 | NET3;VRS3 | not used | NET3;VRS3 |
| | | | | Mount Point | zone | Suggested SurvCE Preset Projection | |
| | | | | NET3/VRS3 | anyone | No needed. Message 1025 supplies | |
| | | | | | | | |
| SAPOS-BW | Trimble | 80.154.101.74 | 2101 | NET3;VRS3 | NET3;VRS3 | NET3;VRS3 | not used |
| | | | | Mount Point | zone | Suggested SurvCE Preset Projection | |
| | | | | NET3/VRS3 | 3 | GERMANY/DHDN/Gauss-Kruger zone 3 | |
| | | | | NET3/VRS3 | 4 | GERMANY/DHDN/Gauss-Kruger zone 4 | |
| SAPOS-BY | Unknown | 195.200.71.81 | 2101 | NET3;VRS3;RTKMon | NET3;VRS3;RTKMon | NET3;VRS3;RTKMon | not used |
| | | | | Mount Point | zone | Suggested SurvCE Preset Projection | |
| | | | | NET3/VRS3 | 4 | GERMANY/DHDN/Gauss-Kruger zone 4 | |
| | | | | NET3/VRS3 | 5 | GERMANY/DHDN/Gauss-Kruger zone 5 | |
| CPOS | Trimble | 193.156.101.72 | 2101 | CPOSHREF | CPOSHREF | not used | not used |
| | | | | Mount Point | zone | Suggested SurvCE Preset Projection | |
| | | | | CPOSHREF | UTM zone | Germany/ETRS89/UTM zone xxN | |