

CORS networks today and tomorrow – latest improvements and applications

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Keywords: GNSS, Global Navigation Satellite System, GPS, Global Positioning System; CORS, Continuously Operating Reference Station, VRS, RTK corrections, Trimble VRS technology

SUMMARY

Satellite positioning technologies such as the Global Positioning System (GPS) have revolutionized the way we realize location and changes of position over a broad range of spatial and temporal scales. This means we are now much more knowledgeable about where they are, when they are and how we communicate that information to our friends, colleagues, clients etc... This paradigm shift has been particularly visible in the surveying, mapping and construction industries where locating something quickly and precisely saves time and money. Trimble Navigation Limited started in 1978 with the launch of the first GPS satellites by the United States Department of Defence. Since then, Trimble has focused on providing industry-leading positioning technology. GNSS (Global Navigation Satellite System) Infrastructure such as CORS (Continuously Operating Reference Station) networks providing high accuracy RTK (Real-time Kinematic) correction data for users of GNSS Rover have become an important part in Surveying, Construction and Mapping/GIS projects. The presentation will give an overview of the Trimble VRS technology for providing high accuracy network RTK corrections to users based on CORS network data. An overview of the latest improvements for software and hardware of CORS networks will be given. Last but not least new applications for CORS networks such as deformation monitoring are presented.

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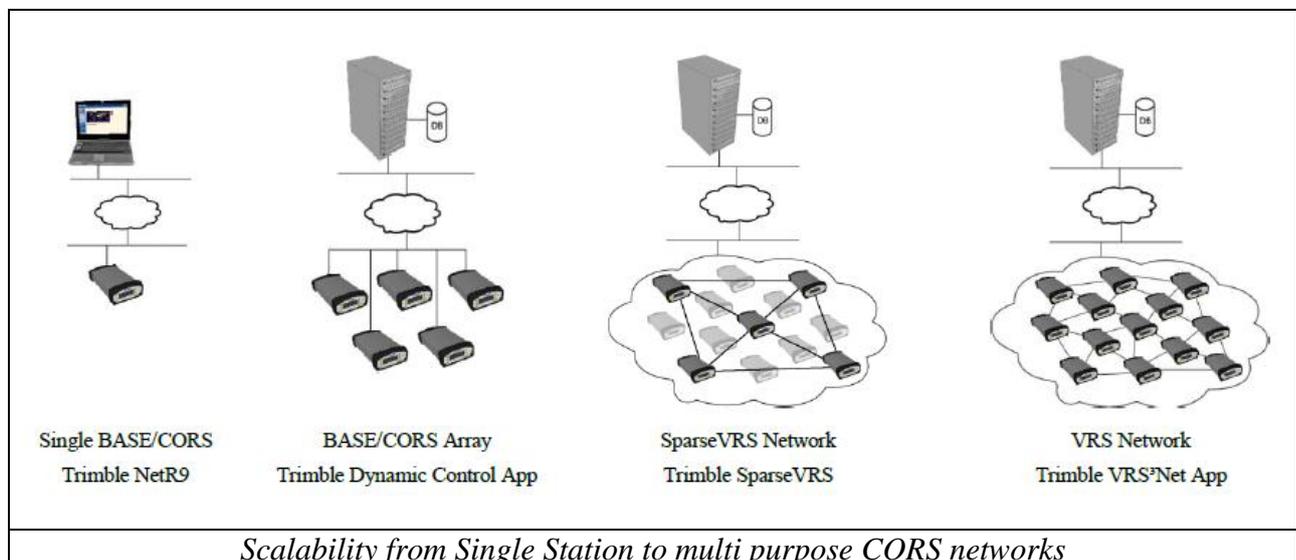
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1. INTRODUCTION

Reflecting on past experience and evolution of CORS network technology one clearly sees a dramatic shift in the adoption rate within the geodetic community quickly expanding both geographically and across new customers.

While the “western world” adoption of CORS networks is fait accompli, barrier to entry remains high in the Emerging Economies around the world, based on many factors – namely absence of modern communication infrastructure, technology adoption status & experience, initial & operating cost of CORS networks and a relatively small market audience who has other higher social priorities to tackle.

A new 3rd generation CORS network solution is now coming to market to enable more simultaneous users and applications across a broader community of users, so as to increase adoption rate in all regions, but specifically for the Emerging Economies markets.



The 3rd Generation solution: More accuracy-based users and more application based users = More Users

The very origin of the CORS network technology/solutions may be to blame as it relates to its limited scalable flexibility to adapt to various users needs as it relates to accuracy. But then again, Germany developed the best and most accurate solution it could think of and pushed the envelope several times faster than any prior generation had done in the field of modern geodesy.

But a square meter (m^2) of land in Munich (Germany) is exponentially more valuable than the same square meter (m^2) in Western Africa or many other regions of the developing

economies of the globe, and the end user would be more than satisfied by a rough sub-meter accuracy, particularly if at the same time, the solution implemented can be – at a later date and seamlessly – regionally and incrementally scaled up to the higher accuracy, as the need arises and the economy permits.

The 3rd Generation CORS network technology does exactly that – not only from an accuracy point of view, but also by allowing a greater number of users to share the same platform, thus decreasing the per-user cost footprint.

2. ACCURACY

Recent advances in the development of yet another order of computer performance based on 64-bit distributed architecture on the “.Net” platform have enabled the full use of the new multi-core computer servers.

In turn, a better understanding of the IONO modeling and more exhaustive mathematical model have been developed supported by this technology, which can now provide a more flexible and scalable “accuracy” solution.

Whereas in the past, only higher cm-level accuracy were possible under the RTK technique, one can now provide different accuracy RTK-based solution as a function of the interstation spacing of the network, the local IONO gradient, the type of RTK solution running in the rover, and of course, the 2 basic conditions remain: Reliable electrical supply and low-latency Internet, LAN and wireless communication for the interconnectivity of the CORS with the Control Center (CC) and for the ability of the rovers to wirelessly reach the computed corrections at the CC via a NTRIP connection.

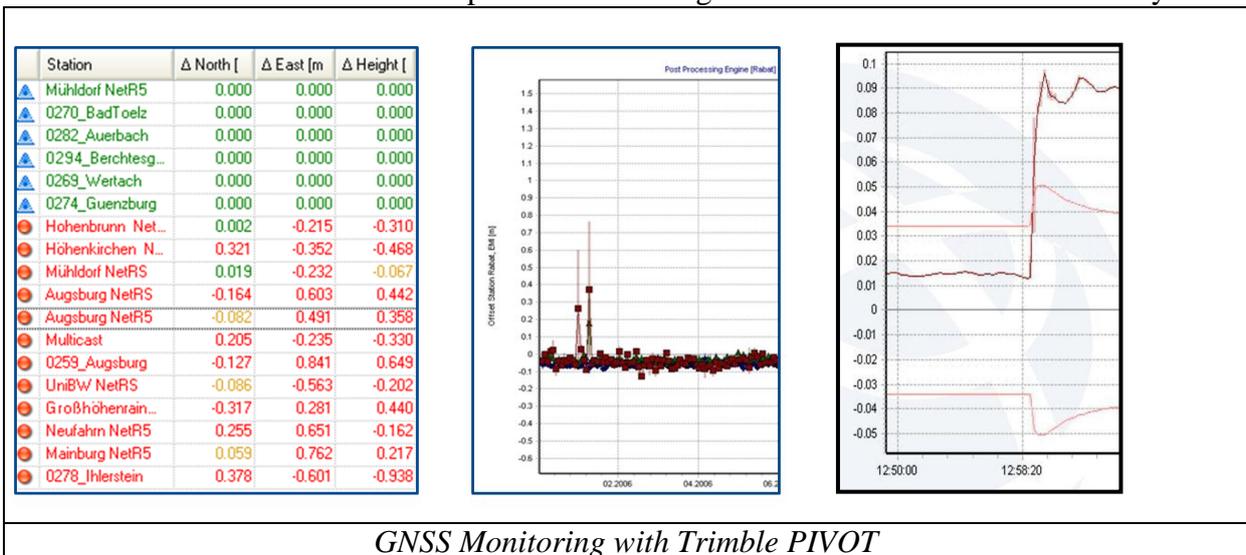
The interstation spacing can be derived empirically and as the ionospheric conditions worsen until the solar max of 2013, one must be careful to plan the grid accordingly. The relationship between the cost of CORS network and the distance between the stations is not proportional – it is an exponential relationship. Going from 50 Km to 100 Km means only ¼ of the CORS are now required.

3. NEW APPLICATIONS

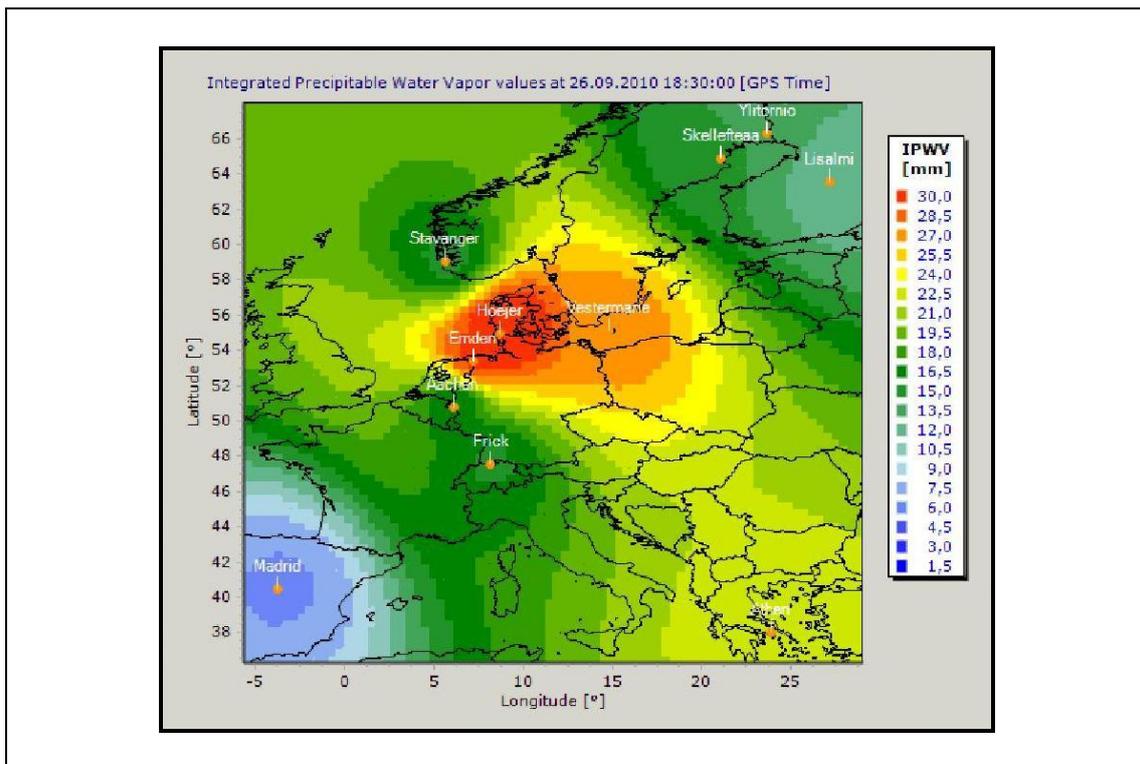
Ever since the beginning of the RTK CORS network development, the focus has been to serve the geodesists, and to replace conventional national geodetic networks with a real-time solution to serve essentially one class of users: The surveyors.

Nothing wrong with that, provided the community of users can afford both the initial technology and its on-going maintenance. A first glance at adding application came at the end of the 2nd generation with the implementation of precise Integrity Monitoring (Trimble Integrity ManagerTM) for network administrators. This tool – again based on high-accuracy positioning – was even more accurate and acted as a mean to monitor and detect in both real-time or in post-processed mode any minute variation in coordinates of the CORS location – independent of their spatial positional shift happening over seconds or over long period of times (months).

This application lead to offering GNSS-based Deformation monitoring based on CORS networks; a tool particularly appreciated for large and very large objects – from a large bridge, a water dam, a valley’s subsidence or even the drift of a continent. So CORS networks had made the first step towards reaching additional users besides the surveyors.



Today CORS networks are used for many different applications such as the computation of the IPWV (Integrated Precipitable Water Vapor) expressing the content of water vapor contained in the atmosphere. The meteorological community uses the Integrated Water Vapor values for instance as input to numerical weather models in order to increase the accuracy of the model.



Beside the computation of the water vapor content, TEC (Total Electron Content) computation as another atmospherical application will become more and more important during the next years. Being an excellent indicator for RTK (Real Time Kinematic) performance the TEC values will be of interest for Surveyors and network operators looking for best possible positioning performance.

The community of real-time users has grown not only including Surveyors using RTK but also providing real-time and post-processing data for Mapping and GIS users and applications, provide RTK corrections to construction machines equipped with machine control equipment for automatic guidance or to farmers using automatic guidance to improve their row guidance while planting and spraying. For all those users CORS networks have become the GNSS positioning backbone for their daily work.

4. CONCLUSION

Looking at the past evolution of CORS networks and recent developments we see IT Infrastructure and knowledge becoming more important. While the user community grows the demands to technical IT components, software and their administrators is growing aswell. While being only important for surveyors in the past CORS networks have become the positioning backbone for many other users in different working areas from construction to farming. Being a technology that facilitates the development of new technologies in the end-user segment the growth of the user community for CORS network could be expected to continue during the next years.

LITERATURE

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