



## SmartStation Operating in GPS Network RTK Leica is Setting the Standard

Leica Geosystems has introduced SmartStation, the world's first high performance total station with integrated GPS and GPS SpiderNET, the world's first Network RTK software supporting the RTCM Standard V3.0 based on the Master Auxiliary concept.

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## Surveying History From Theodolite to Global Positioning

Traditionally, surveyors use angle measured with theodolites and distance measured with a steel band or Electronic Distance Measurement (EDM) device to propagate coordinates from one point to another using the technique of traversing.

The **Total Station** simplified the procedure of traversing by integrating the EDM into the theodolite and reading all measurements digitally.

The **introduction of satellite positioning systems** has provided the surveyor with an additional measurement technology to perform survey tasks. GPS, in particular **real-time kinematic (RTK) GPS**, provides surveyors with an efficient tool to conduct their survey activities.

**Although RTK GPS is now widely used, there are still many surveyors who do not benefit from GPS technology because of a perception of complexity and expense.**

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## Total Station vs GPS RTK Advantages and Disadvantages

Despite many advantages, surveying using only total stations or GPS has disadvantages.



Surveying with a total station, unlike GPS surveying, is **not disadvantaged by overhead obstructions**; however, it is restricted to **measurements between inter-visible points**.

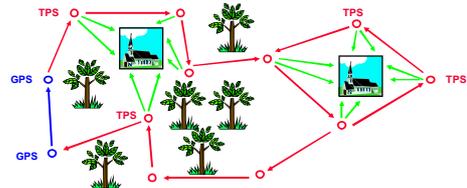
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## Total Station vs GPS RTK A two Steps Approach

GPS is frequently used to bring control to the survey site before continuing the survey with a total station in areas with overhead obstruction that limit the use of GPS.



This procedure is a two steps approach that requires **multiple set-up's on points, one with GPS and then again with a total station.**

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## Integration of GPS and Total Station Technologies



### SURVEYING WITH GPS IN THE YEAR 2000

- GPS PROVIDES 1 CM RELATIVE POSITIONING ACCURACY WITHIN ONE HOUR ON SITE.
- COMBINED WITH CONVENTIONAL OPTICAL AND EDM INSTRUMENTS, GPS IS AN INTEGRAL PART OF EVERY SURVEY JOB.



NOTE: ACCESS TO L<sub>2</sub> IS A MUST FOR LONG DISTANCE SURVEYS. THE C/A CODE OR EVEN A CARRIER ON L<sub>2</sub> WOULD BE EXTREMELY HELPFUL.

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## Editorial in latest issue of Engineering Showcase

Stephen Booth, Editor:



### On the merger path

Looking back ten years ago Showcase predicted the merger of GPS and total station technology by the end of the century. That it did not happen is something of a puzzle. There are few problems in fitting a GPS antenna concentrically with an instrument on a tripod. Communication between the two sensors is even possible without cable although the rate of raw data exchange from GPS receivers is probably too much for current technologies. Almost certainly the reason is cost. While GPS has been getting steadily smaller, optical instruments have not changed much in size and weight during the last decade. However, this will change I believe during the coming decade as production costs continue to tumble and Leica's System 1200 heralds the stirrings of a new era. But I wonder if anyone will ever produce a really miniature total station that will sit atop a camera tripod? Measured building surveyors are itching for such a device.

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## System 1200 – SmartStation

Bringing the best of both worlds together

- World's first total station with GPS
- Introducing a new way to survey
- Measuring without known control points
- Surveying easier, quicker and with fewer set ups.



## Why was it not realized earlier ?

- GPS Reference Station infrastructure must exist, or to be installed at reasonable costs.
- GPS Reference Station must cover long range RTK, requiring advanced data-processing techniques and a standard network corrections format.
- GPS hardware technology must be small enough to package all necessary components into a smart antenna which is small enough to be carried by a TPS without affecting the TPS performance (stability of instrument, endurance of gears, etc.)
- TPS must be prepared to provide communication and power to the smart antenna.
- TPS must be capable of processing and managing differential GPS data .

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## SmartStation - Overview

- New revolutionary surveying system.
- World's first TPS and GPS perfectly combined.
- High performance total station with powerful GPS receiver.
- No need for control points, long traverses or resections.
- Surveying easier, quicker and with fewer set ups.
- All TPS1200 total stations can be upgraded to SmartStation.



## GPS Reference Station Networks Network RTK

In many regions, the availability of a GPS reference station network means that surveyors can utilize RTK GPS without the need to set-up their own local reference station. They simply enter the field, dial-in to a GPS reference station network infrastructure and begin RTK GPS surveying.

GPS Reference station networks are increasing in popularity as many government agencies have found it more economically viable to invest in GPS reference station networks rather than maintaining ground control. In addition, many private companies have seen the opportunities in setting-up reference station networks and selling the data to an increasing number of users.

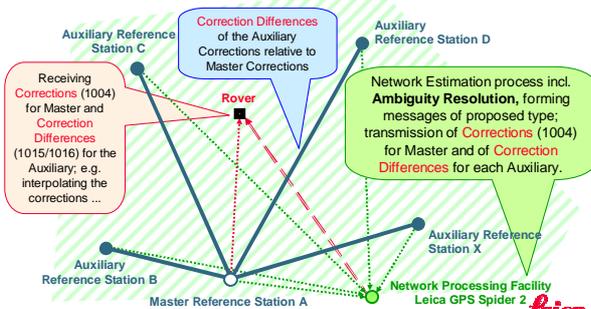
The motivation behind using multiple reference stations for GPS corrections is to model and correct for distance-dependent errors that reduce the accuracy of conventional RTK positions in proportion to the distance from a rover to its nearest reference station.

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## Network RTK Transmission Concept

One Master Reference Station + Several Auxiliary Reference Stations = One Network Cell

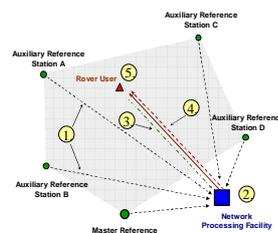


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## MAX Corrections

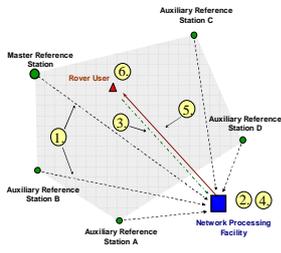


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## i-MAX Corrections



1. Transmission of raw observation data from the reference stations to the network processing facility.
2. Network estimation process including **ambiguity resolution** to reduce the stations to the common ambiguity level.
3. NMEA GGA position received from the rover at the network processing facility. The most appropriate reference stations are chosen for the rover based on its location. The master station is chosen as the reference station closest to the rover.
4. Leica GPS Spider calculates the **network** corrections for the rover and applies them to the observations from the master station.
5. Formation and transmission of RTCM 2.3 or Leica format corrections from the master station.
6. Computation of high accuracy rover position using the reference network.

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## Leica GPS Spider v2.0 Software

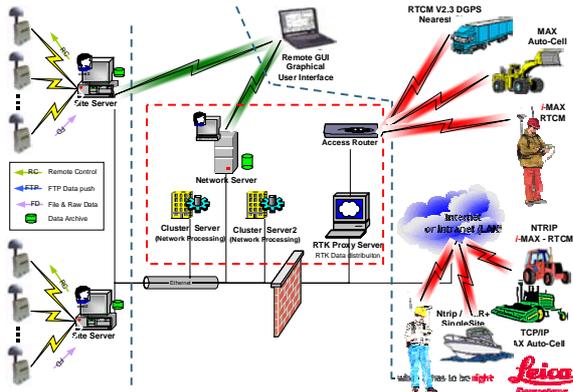
GPS Spider is an integrated suite of software for centrally controlling and operating single reference stations or networks of stations. GPS Spider is modular and scalable with new advanced solutions for long-range high-accuracy Network RTK (SpiderNET), structural monitoring, centralized data distribution, data access management and also supports the charging of data and services. Become a professional service provider using the best solutions for your needs thanks to GPS Spider.



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## GPS SpiderNET – Architecture Overview



## A New Way to Design GPS Network RTK From Local to Global Coverage

The **primary objective** of any surveyor is to survey a project in the most efficient way to increase his profitability and fulfil the increasing request for collecting 3D digital accurate information.

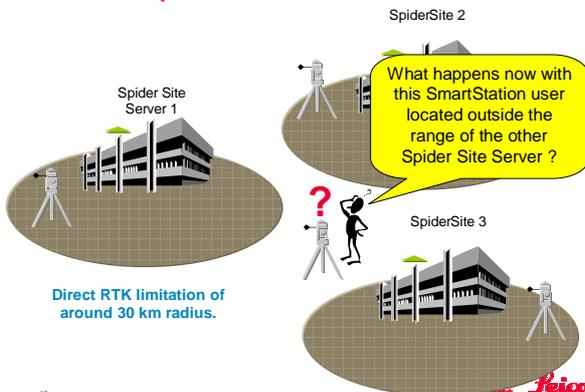
The **SmartStation** introduces a **dramatic shortcut** in field operations by combining GPS and total station advantages into a single instrument. But this advantage supposes that **GPS Reference Station corrections** are available in the vicinity of the equipment.

Instead of setting up a GPS Reference Station network to first cover an entire area like a city, a region or even a country or a nation, the flexibility of the new generation of GPS RTK Network software solution allows the project leader to build himself that infrastructure in a more adaptive, sequential and suitable way.

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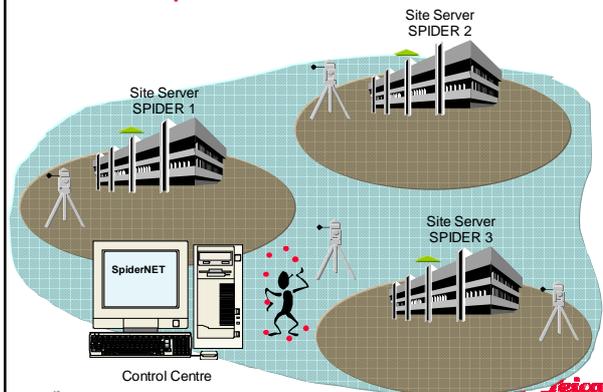
## Cooperative GPS SPIDER Network



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## Cooperative GPS SPIDER Network



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## Join Effort and Cooperation A New Business Model

We can then imagine that some surveying organizations working with or without overlap on the same area will decide to **join their effort and build together a largest Reference Station Network on a cooperative basis.**

**It should also be a third party company** who wishes to generate new services based on that technology that want to take the initiative to provide the RTK corrections service to those surveying organizations by negotiating the access to their existing data streams.

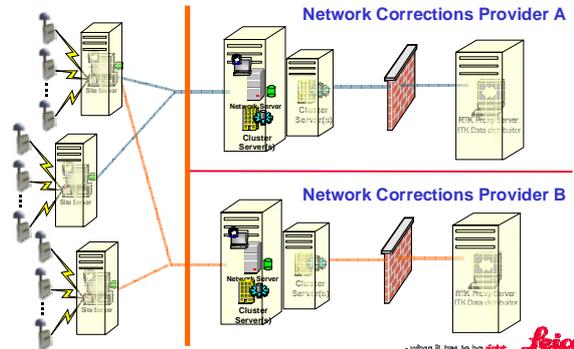


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## A New Business Model



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## Conclusion SmartStation and Network RTK

To use SmartStation, the surveyor does not need any specialist GPS know-how, RTK GPS positioning of the total station is achieved simply by the push of one button in the standard total station set-up application.

The proliferation of GPS reference station networks means that in many cases a surveyor is **within 50km of a reference station** and hence dial-up and use SmartStation to determine accurate RTK GPS positioning of the instrument.

The new Leica GPS Spider v2.0 software and its SpiderNet module provides standard RTCM 3.0 network corrections to both RTK GPS rovers and the new SmartStation, delivering the **ultimate accuracy compatible with centimetre performance allowing the integration of GPS and total station technologies.**

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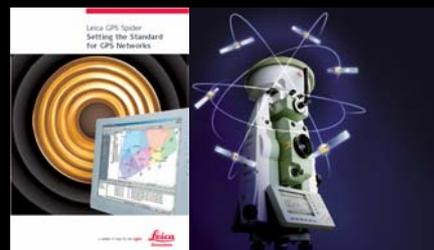


Vice Director Wu Limin of the Surveying and Mapping Institute of Kunming CHINA has named the SmartStation « Tong Zhan Yi ».

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## Introducing a new way to survey



Many Thanks for your Attention