



Guidelines for Utilizing InCORS

INDIANA'S STATEWIDE GNSS-GPS REAL TIME NETWORK

Presented by

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Land & Aerial Survey Office

2013 ISPLS Convention

January 18, 2013



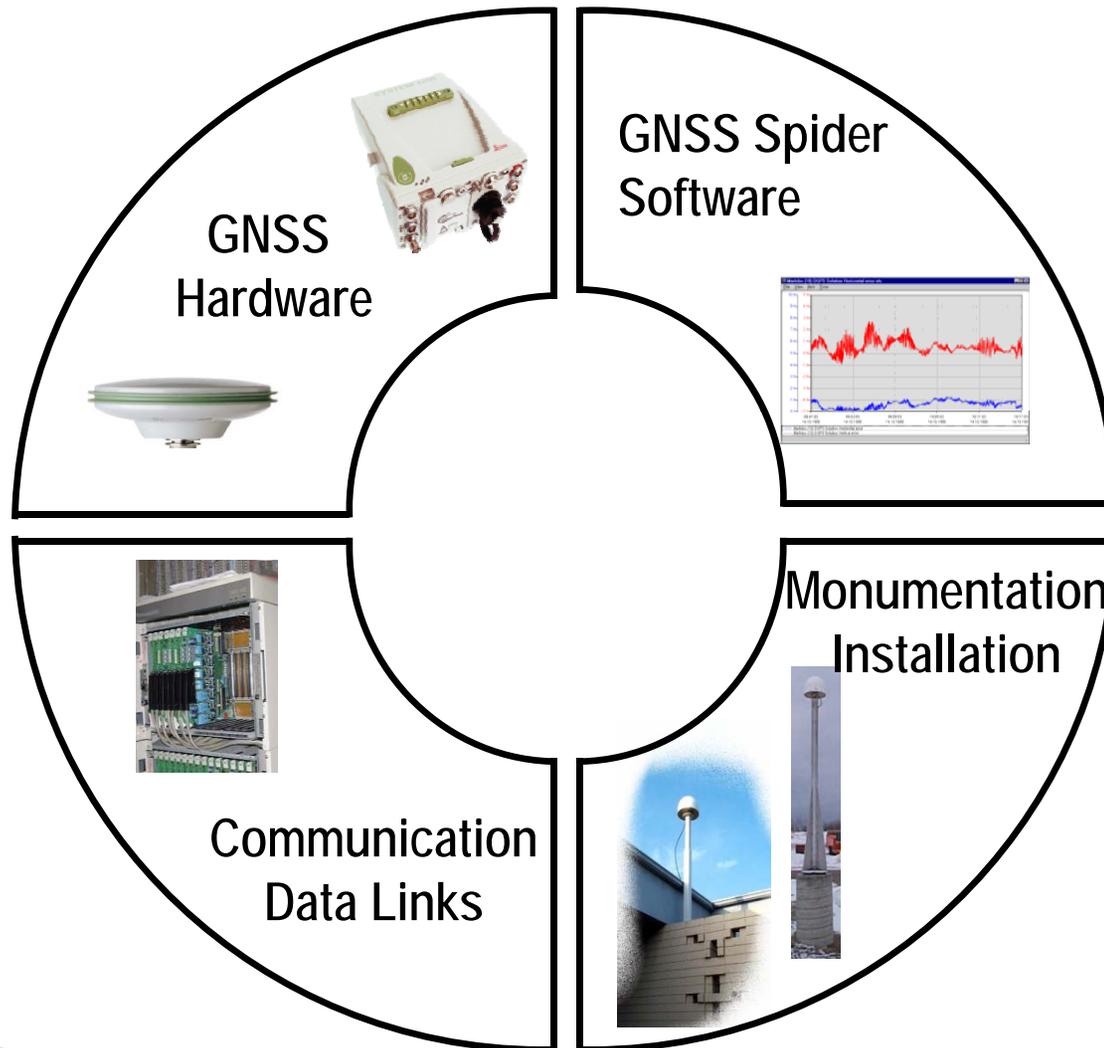
What is the InCORS Network?

Indiana **C**ontinuously **O**perating **R**eference **S**tation Network

- Network of 45 geodetic quality GPS (**GNSS**) receivers and antennas, permanently installed, located across the state – INDOT & ISP sites
- Partnering with KYTC, MDOT, ODOT, Noble Co. and KARA Co.
- Continuously collects GNSS data
- Transmits thru Internet to central servers
- Data archived for future use, available for download by users
- Data processed by server software to generate network corrections- available via internet in real-time



InCORS Components



4 main parts:

GNSS Hardware

GNSS Software

Monumentation

Communication



InCORS Hardware

GNSS Hardware is the key component for functionality in communication, interface with Server Software, Satellite Constellation, Receiver Clock, and Flexibility for remote communications.



1202 GG Leica Antenna
Upgrading antennas
with AS10 Leica
Antenna (triple Freq.)

GRX1200GG PRO Leica Receiver



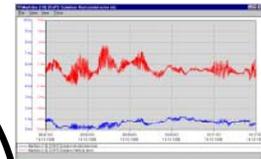
GNSS
Hardware



InCORS Software

- Leica SpiderNet
- Modular and fully scalable
- For single and multiple stations
 - INDOT 45 stations
 - KYTC, MDOT, ODOT & Noble Co. 13 stations
 - Plans for using 2 in Illinois for total of 60 station licenses we currently have
- For small and large networks
- For Post-Processed and RTK Networks
- For all types of GPS receivers
 - Leica, Trimble, Ashtech, Topcon....
- For all communication methods

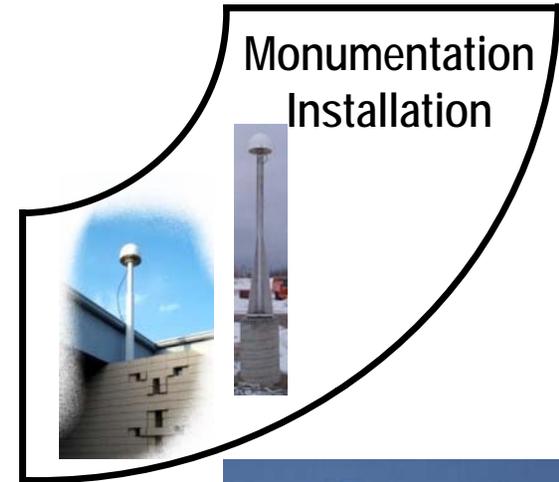
GNSS Spider
Software



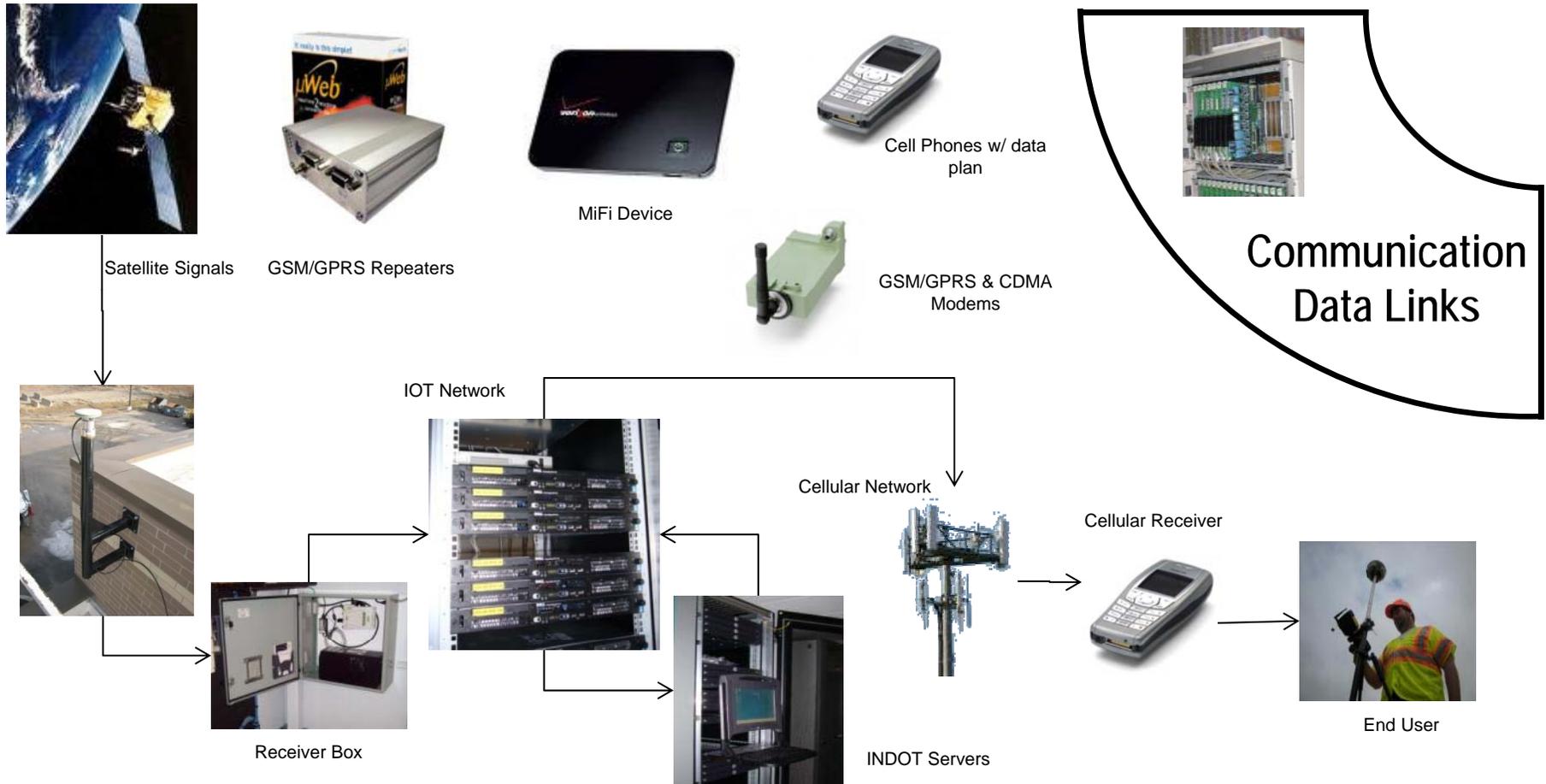
InCORS Monumentation

INDOT Operated Station Monuments

- 3 Concrete Monuments - permanent
- 42 Building Mounts – semi-permanent
- 37 stations have been accepted as National CORS thus far (NGS monitored)



InCORS Communication



InCORS Network Details

- DOT-Owned and Managed
 - Land & Aerial Survey Office (LASO)
- Utilizes state IOT Communications Network
- Utilizes state IOT Server Facility
- Free Access to Public & Private Sector
- Statewide Coverage
- Open Architecture
 - (RTCM 2.3,3.1,CMR,CMR+)
- Base Station Redundancy
- Public use started on February 1, 2010
- Currently have created over 1492 accounts



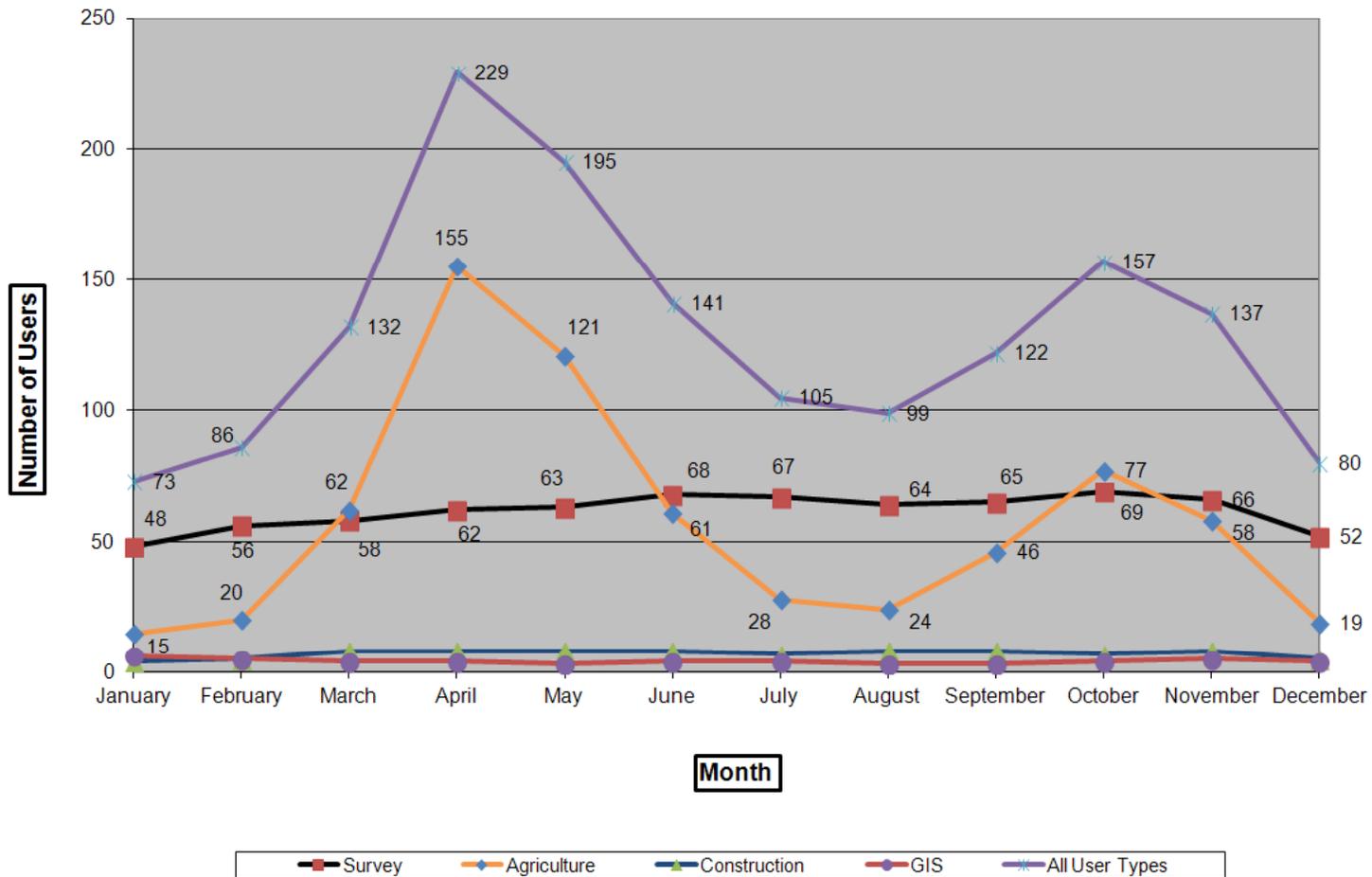
Network Adjustment Summary

- Precision
± 0.5 cm Horiz. & ± 2.0 cm Vert. @ 95% (2-sigma)
- Adjusted vs. Published values
± 0.8 cm Horiz. & ± 2.0 cm Vert.
- Consistent w/ NAD83 (CORS96) (Reference Epoch 2002.0)
± 1 cm Horiz. & ± 2 cm Vert.
- Plans to update to our reference frame to
NAD83 (2011) Epoch 2010.0 Coordinates



Average Usage

Average Usage Per Weekday for Each Month of 2012
(Seperated by User Groups)



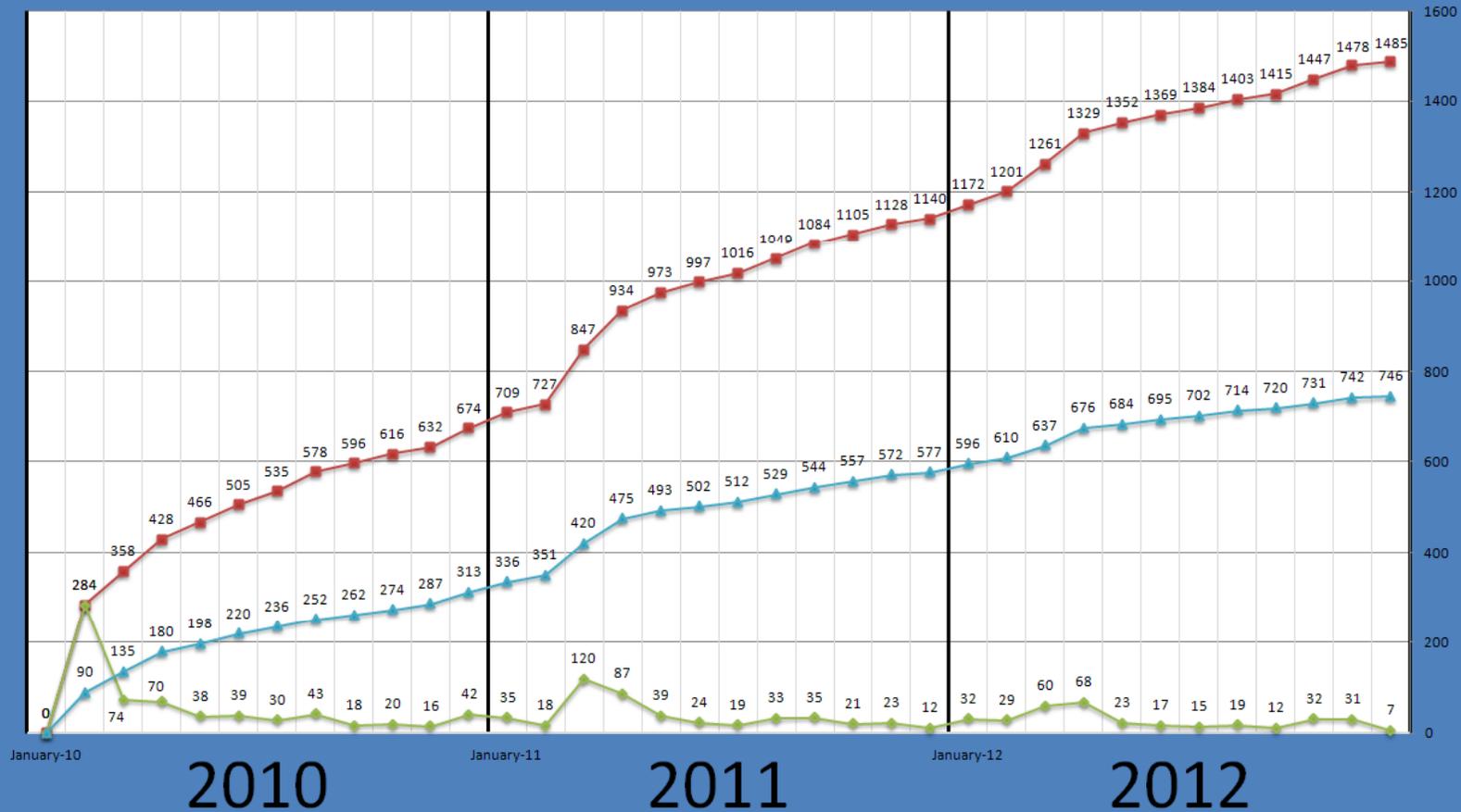
User Growth Over Time



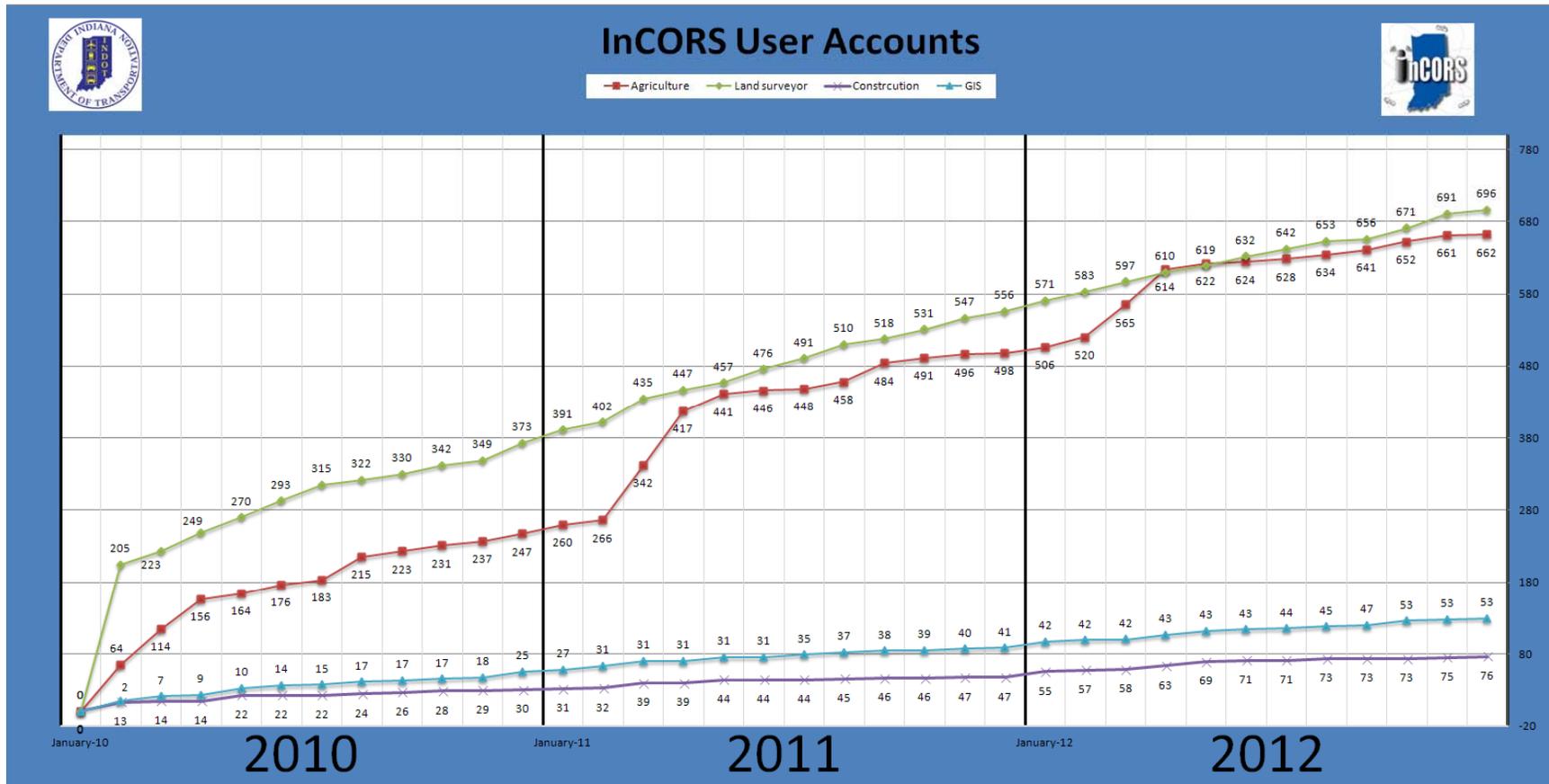
InCORS User Accounts



■ Total # of Accounts
 ▲ # of Accounts per Month
 ▲ Total # of Companies



User Growth by Type



Land and Aerial Survey Office Website

(<http://www.laso.indot.in.gov>)

Indiana Department of Transportation

INDOT > About INDOT > Central Office > Land & Aerial Survey Office

Land & Aerial Survey Office

The Land and Aerial Survey Office has the primary role within the Transportation Engineering Services & Design Support Division of providing support for the design, planning, construction, maintenance and operation of a superior transportation system enhancing safety, mobility and economic growth for the State of Indiana. LASO is committed in its support of INDOT central and district offices, as well as contracted consultants, in delivering quality, environmentally sensitive transportation projects as efficiently as possible, on scope, on schedule and on budget.

LASO is comprised of two primary functional areas: the Land Surveying Section and the Aerial Survey Section. Together they work as a team to provide high quality aerial imaging products and ground survey support. In addition to the two functional areas, LASO is also responsible for the maintenance and administration of the Indiana Statewide GNSS-GPS Real Time Network, known as the InCORS Network.

Land & Aerial Survey Office Operations

Land Survey Section

The Land Survey Section is responsible for establishing project specific geodetic control; placement and location of aerial image ground control; the maintenance and administration of Indiana's statewide GNSS-GPS real time network, known as InCORS, as well as the INDOT benchmark database; providing geodetic and cadastral survey support; establishing survey specific standards, policies and procedures; and providing timely technical expertise, training, and support for all INDOT survey activities. In addition, the Land Survey Section establishes, administers, evaluates and procures new and emerging technologies in field survey equipment and systems for INDOT. Visit the [Land Survey Section](#) for more information about section responsibilities, requirements and standards.

Aerial Survey Section

INDOT's Aerial Survey Section has been providing aerial imagery and performing Aerial Photographic services for Indiana highway related projects since the late 1950s. In 2001 INDOT purchased a state of the art aerial film camera, a digital scanner specifically for the aerial film, and Digital Photogrammetric workstations. As a result the Aerial Survey Section became a state of the art service for our in-house staff as well as the consultants for INDOT. Visit the [Aerial Survey Section](#) for more information about section responsibilities, requirements and standards.

InCORS

INDOT's Land Survey Section of the Indiana Department of Transportation coordinates a network of continuously operating reference stations (CORS). Each CORS site provides Global Navigation Satellite System (GNSS - GPS and GLONASS) carrier phase and code range measurements in support of 3-dimensional positioning activities throughout the state of Indiana. Visit the [InCORS](#) page for more information and to download Rinex data.

Online Services
FIRST IN LINE EVERY TIME

- Traffic Conditions
- Driveway Permit
- Notice of Tort Claim Form
- Indiana GIS Atlas
- Rules.IN.gov

More Online Services »
Subscriber Center »

TRAFFICWISE
Your link to smart travel

Stay Connected

- Twitter
- Facebook
- RSS Feeds
- Mobile

Top FAQs | **I Want To...**

1. Check current traffic conditions
2. Report a road problem or hazard
3. File a claim for property damage and/or personal injury
4. Contact INDOT
5. Check recent news releases
6. Know about public meetings

Request an Indiana State Map

REPORT A CONCERN

INDOT Home

- Travel Conditions
- Current Programs
- Doing Business with INDOT
- Major Projects
- Public Involvement
- Media Room
- Safety
- Resources
- About INDOT
- Accessibility
- Contact INDOT

Sign up to receive e-mail and wireless updates from INDOT





InCORS Website

(<http://incors.in.gov>)

Welcome Page Contains:

- Brief description
- Links to:
 - Station Location Map
 - Data Page
 - RTK info & instructions
 - System Status page

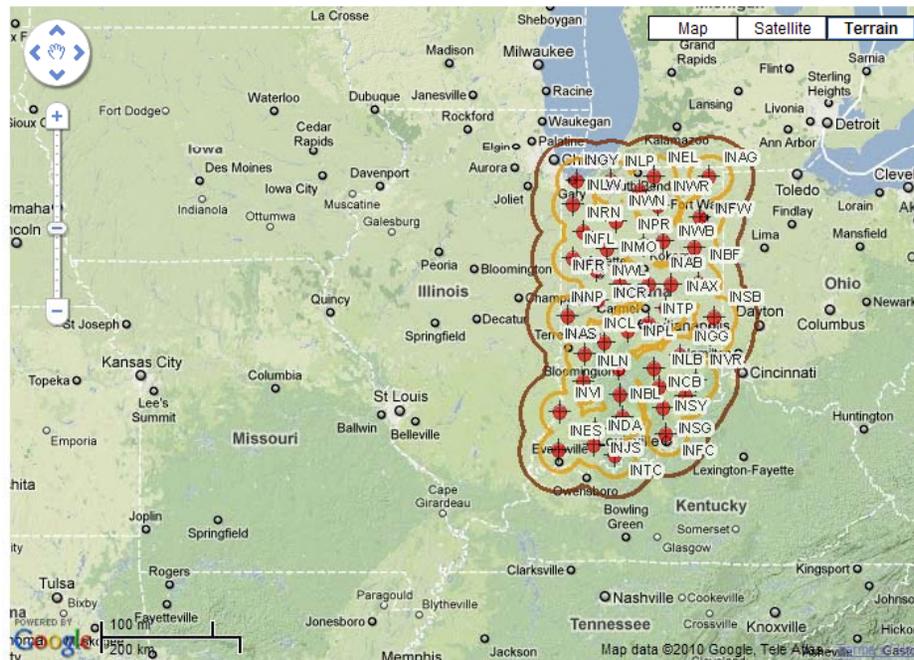
The screenshot shows the InCORS website homepage. At the top, there is a navigation bar with links for various state departments: About Indiana, Agriculture & Environment, Business & Employment, Education & Training, Family & Health, Law & Justice, Public Safety, Taxes & Finance, and Tourism & Transportation. Below this is a search bar and a logo for Governor Mitch Daniels. The main header features the 'IN.gov' logo and the title 'Indiana Department of Transportation'. The page content includes a sidebar with a menu for 'INDOT Home' containing links for Travel Conditions, Current Programs, Doing Business with INDOT, Major Projects, Public Involvement, Media Room, Safety, Resources, About INDOT, Accessibility, and Contact INDOT. The main content area is titled 'INDOT Continuously Operating Reference Stations (InCORS)' and includes a 'Welcome' message, a 'Request an Indiana State Map' button, and a 'REPORT A CONCERN' button. The central image shows a surveyor using a GNSS receiver on a tripod, with a map of Indiana and a close-up of the receiver. Text below the image explains that the Land Survey Department of the Land & Aerial Survey Office of the Indiana Department of Transportation coordinates a network of continuously operating reference stations (CORS). It also provides links for 'Station Location Map', 'Data page', 'Real Time (RTK) page', and 'System Status page'.



InCORS – Station Location Map

InCORS Station Locations

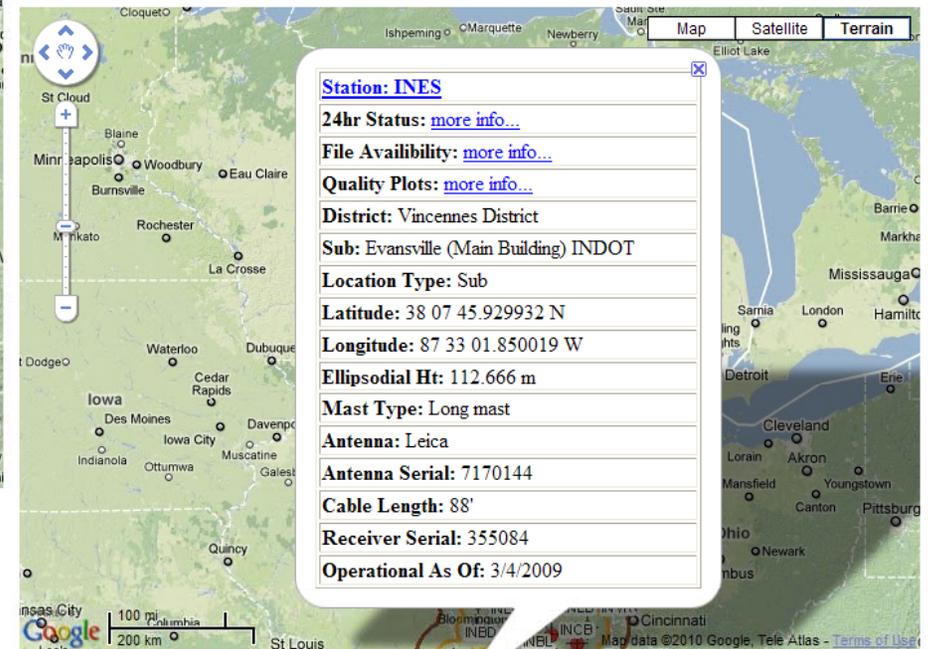
45 Sites across the state. Click on a site for more information.
Orange buffer is 30km from Stations and brown buffer is 60km from stations.
Mouse Click inside the sites for information and status of each location.



✓ Click on station icon to bring up metadata

InCORS Station Locations

45 Sites across the state. Click on a site for more information.
Orange buffer is 30km from Stations and brown buffer is 60km from stations.
Mouse Click inside the sites for information and status of each location.



InCORS – Data Page

Contains:

- Link to the ftp site for Rinex data
- Link to the Data and Website Disclaimer

The screenshot shows the IN.gov website's InCORS Data Page. The page header includes the IN.gov logo and navigation links for various departments. The main content area is titled "INDOT Continuously Operating Reference Stations (InCORS)" and features a navigation menu with links for "Intro", "Data", "Real Time (RTK)", "System Status", "FAQ", "Links", and "LASO". Below the navigation, there is a section titled "Available Data RINEX for Download" which provides information about the data format and availability. A "Folder Browsing" section lists "Rinex Hourly Files" and provides a link to "Data and Website Disclaimer". The page also includes a "Request an Indiana State Map" button, a "REPORT A CONCERN" button, and images of a GPS receiver and a data logger.

IN.gov

About Indiana | Agriculture & Environment | Business & Employment | Education & Training | Family & Health | Law & Justice | Public Safety | Taxes & Finance | Tourism & Transportation

GOVERNOR MITCH DANIELS
Visit his Home Page

Indiana Department of Transportation

INDOT Home

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Sign up to receive e-mail and wireless updates from INDOT

Request an Indiana State Map

REPORT A CONCERN

Available Data RINEX for Download

FTP

RINEX data in the form of navigation, observation and glonass files are available for each of our sites. The data may be browsed via our FTP site found at: <ftp://ftp.incors.in.gov>

Files are available for two months from today's date and are free for download.

Files are organized on our FTP site in the following folder structure:

```
--root
--RINEX or MDS(Leica Format)
--year (4 digit year)
--day of year (1-366)
----site name (4 letter abbreviation)
-----sip file in the file name format of 'site'gps week'gps hour letter'.sip
```

Folder Browsing

Rinex Hourly Files

Hourly Rinex Data Folders Contain two files which are described [here](#).

[Data and Website Disclaimer](#)

[Station Coordinates and RTCM ID Numbers](#)



InCORS – Real Time (RTK) Page

Contains:

- How to get access
- Link to the RTK User Agreement
- Links to RTK documents
- Submittal information for User Agreement
- User tech support note
 - Preferred method of contact: email to incors@indot.in.gov

IN.gov About Indiana Agriculture & Environment Business & Employment Education & Training Family & Health Law & Justice Public Safety Taxes & Finance Tourism & Transportation

GOVERNOR MITCH DANIELS Visit His Home Page

Indiana Department of Transportation

INDOT Continuously Operating Reference Stations (InCORS)

[Intro](#) | [Data](#) | [Real Time \(RTK\)](#) | [System Status](#) | [FAQ](#) | [Links](#) | [LASO](#)

GNSS Reference Solutions

INDOT's GNSS Reference System delivers:

- cm level real-time kinematic corrections
- post-processing solutions
- sub-meter GIS corrections

Providing a real-time kinematic (RTK) correction service over the internet, and RINEX files for post-processing. You don't have to be a Leica user to enjoy the benefits of INDOT's GNSS. If your GPS or GNSS receiver can connect to the internet, INDOT can deliver the data you need. With this service offered by INDOT using Leica's GNSS Technologies you don't need to invest in an extra base station to get accurate positions. You don't need to setup a base station first and worry about its safety. Just start your GNSS rover and connect. A few seconds later, you have the ability to survey with cm-accuracy.

IMPORTANT NOTIFICATION
As of Thursday July 12, 2012 the proxy server IP Address is 108.59.49.226.
You will need to change the IP Address on your data collector/controller to the new IP address (108.59.49.226).
The port numbers will remain the same.

RTK Access
To get access to our RTK Service you must first agree to our User Agreement and Data Disclaimers. Complete the [User Agreement](#), print, sign and return it to our office for processing by mail, fax or e-mail to:

Land & Aerial Survey Office
InCORS Network Administrator
120 South Shorsridge Road
Indianapolis, IN 46219-8705
Phone: 317-810-7251, ext. 293
Fax: 317-358-9251
E-mail: incors@indot.in.gov

Currently the InCORS is providing Network RTK in RTCM (Real Time Correction Message) 2.3, and 3.1 in the MAX (R2K2 Full) and i-MAX (R2K2 LITE) formats via NTRIP (Networked Transport of RTCM via Internet) and TCP/IP, as well as CMR and CMR+ in the MAX (R2K2 Full) and i-MAX (R2K2 LITE) formats via NTRIP, and TCP/IP. The main difference between MAX and i-MAX is the processing is done at the ROVER for MAX and with i-MAX the processing is done at the servers.

In order to access these messages the user will need a wireless modem device that can access the wireless web. The modems come in all shapes and styles and through different wireless providers. INDOT does not recommend one provider over the other, the user must determine the coverage in his/her particular area to determine the best solution.

The users also need to complete the RTK Users Agreement which is available as a link on this page. Once the RTK User Agreement is signed and returned to INDOT, INDOT will provide the IP address, port number, account username and account password to the user.



Available RTK Corrections/Products

BROADCAST RTK CORRECTIONS FROM THE InCORS NETWORK

May 27, 2011

RT Product Name	RT Product Type	Message Type	Connection Type	Connection Port	Ntrip Mount Point	Network Correction	Glonass Capable
RTCM 3.1 MAX (GNSS)	Automatic cells	MAX RTCM 3.x (Extended;1015;1016)	NTRIP-Client	10000	RTCM3_MAX	Yes	Yes
RTCM 3.1 iMAX (GNSS)	Automatic cells	i-MAX RTCM 3.x (Extended)	NTRIP-Client	10000	RTCM3_IMAX	Yes	Yes
RTCM 2.3 iMAX (GPS)	Automatic cells	i-MAX RTCM 2.x (Type 18;19)	NTRIP-Client	10000	RTCM2_IMAX	Yes	No
RTCM 3.1 Nearest (GNSS)	Nearest site	RTCM 3.x (Extended)	NTRIP-Client	10000	RTCM3_NEAR	No	Yes
RTCM 2.3 Nearest (GPS)	Nearest site	RTCM 2.x (Type 1;2;18;19)	NTRIP-Client	10000	RTCM2_NEAR	No	No
CMR Nearest (GPS)	Nearest site	CMR	NTRIP-Client	10000	CMR_NEAR	No	No
CMR+ Nearest (GPS)	Nearest site	CMR+	NTRIP-Client	10000	CMRP_NEAR	No	No
CMR+ iMAX (GPS)	Automatic cells	i-MAX CMR+	NTRIP-Client	10000	CMRP_IMAX	Yes	No
CMR+ iMAX (GNSS)	Automatic cells	i-MAX CMR+	NTRIP-Client	10000	CMRP_IMAX(GNSS)	Yes	Yes
CMR+ Nearest (GNSS)	Nearest site	CMR+	NTRIP-Client	10000	CMRP_NEAR(GNSS)	No	Yes
INAG RTCM iMAX *	Single Cell	i-MAX RTCM 3.x (Extended)	NTRIP-Client	10000	INAG_RTCM_IMAX	Yes	Yes
INEL RTCM iMAX *	Single Cell	i-MAX RTCM 3.x (Extended)	NTRIP-Client	10000	INEL_RTCM_IMAX	Yes	Yes
INGY RTCM iMAX *	Single Cell	i-MAX RTCM 3.x (Extended)	NTRIP-Client	10000	INGY_RTCM_IMAX	Yes	Yes
INLP RTCM iMAX *	Single Cell	i-MAX RTCM 3.x (Extended)	NTRIP-Client	10000	INLP_RTCM_IMAX	Yes	Yes
RTCM 3.1 iMAX (GNSS)	Automatic cells	i-MAX RTCM 3.x (Extended)	TCP/IP	11000		Yes	Yes
RTCM 2.3 iMAX (GPS)	Automatic cells	i-MAX RTCM 2.x (Type 18;19)	TCP/IP	11001		Yes	No
RTCM 2.3 Nearest (GPS)	Nearest site	RTCM 2.x (Type 1;2;18;19)	TCP/IP	11002		No	No
CMR+ iMAX (GNSS)	Automatic cells	i-MAX CMR+	TCP/IP	11003		Yes	Yes
CMR Nearest (GPS)	Nearest site	CMR	TCP/IP	11005		No	No
CMR+ Nearest (GPS)	Nearest site	CMR+	TCP/IP	11006		No	No
RTCM 3.1 MAX (GNSS)	Automatic cells	MAX RTCM 3.x (Extended;1015;1016)	TCP/IP	11007		Yes	Yes
RTCM 3.1 Nearest(GNSS)	Nearest site	RTCM 3.x (Extended)	TCP/IP	11008		No	Yes
CMR+ iMAX (GPS)	Automatic cells	i-MAX CMR+	TCP/IP	11009		Yes	No
CMR+ iMAX (GNSS)	Automatic cells	i-MAX CMR+	TCP/IP	11010		Yes	Yes
RTCM3_INxx **	Single Site	RTCM 3.x (Extended)	NTRIP-Client	7071	RTCM3_INxx	No	Yes
CMR_INxx **	Single Site	CMR	NTRIP-Client	7072	CMR_INxx	No	No
CMRP_INxx **	Single Site	CMR+	NTRIP-Client	7073	CMRP_INxx	No	Yes

* = These products include only the InCORS stations around the Indiana/Michigan border. They were created because some of the Michigan stations are not Glonass capable which eliminates Glonass from the network solution when the Michigan sites are used.

** = These products are single base corrections. Since they are tied to one base and do not utilize the Nearest capability the user will have to manually switch to a new base product if the station they are using goes offline. (INxx stands for the site code for example Alexandria is INAX and the CMR+ mount point would be CMRP_INAX)



InCORS – System Status Page

The screenshot displays the InCORS System Status Page on the IN.gov website. The page is titled "INDOT Continous Operating Reference Stations (InCORS)" and includes navigation links for Intro, Data, Real Time (RTK), System Status, FAQ, Links, and O&E.

System Status Table:

Station ID	RTK Status	RTK Data	RTK Quality	RTK Accuracy	RTK Precision	RTK Reliability	RTK Availability
INDR	OK	OK	OK	OK	OK	OK	OK
INDN	OK	OK	OK	OK	OK	OK	OK
INDS	OK	OK	OK	OK	OK	OK	OK
INDG	OK	OK	OK	OK	OK	OK	OK
INDY	OK	OK	OK	OK	OK	OK	OK
INDT	OK	OK	OK	OK	OK	OK	OK
INDU	OK	OK	OK	OK	OK	OK	OK
INDV	OK	OK	OK	OK	OK	OK	OK
INDW	OK	OK	OK	OK	OK	OK	OK
INDX	OK	OK	OK	OK	OK	OK	OK
INDZ	OK	OK	OK	OK	OK	OK	OK

INMT File Availability: A table showing file availability for the last 30 days, with columns for Date, File #, and File #. The table indicates that files are generally available, with some instances of unavailability.

INMT Quality Plots: Two line graphs showing cycle slips per 1000 observations (stat) over time. The top plot shows a low number of cycle slips, while the bottom plot shows a higher number of cycle slips, indicating a potential issue with the station's performance.

Map: A map of Indiana showing the locations of the InCORS reference stations, marked with green dots and labeled with station IDs.

Footer: The page includes a footer with navigation links for Calendar, Help, IN.gov User Survey, Newsletter, Online Services, Policies, and Sites. It also provides contact information for the Indiana Department of Transportation, including a phone number (1-800-487-6283).



What You Need

- Need a rover that at a minimum, can:
 - Connect to the internet via cell phone or cell modem
 - Network is independent of cell service provider, select the provider with best service in the area you work in!
 - Send a NMEA message with account username and password, or has NTRIP functionality
 - Can utilize RTCM 2.3, RTCM 3.x, CMR, CMR+ or Leica message formats
- Strongly encourage all users to run the most recent firmware for the rover they are using.
- For Construction/Ag machine control or project areas in cell service voids, solutions exist to provide on-site radio broadcast of baseline and network solutions.



InCORS – RTK User Agreement



INDIANA DEPARTMENT OF TRANSPORTATION



Indiana Continuously Operating Reference Station (InCORS) Network Real Time Correction Message User's Responsibility and Agreement for the Use and Access of Data

GENERAL

The Real Time Network Correction broadcasts in Radio Technical Commission for Maritime Services (RTCM) format and Compact Measurement Record (CMR) format for the stations which are a part of the InCORS system and are offered to you, the user ("User"), as a public service. You should read the following to understand the limitations regarding the information provided and the use to be made of these RTCM and CMR broadcasts.

Government personnel and the general public may use this system to retrieve RTCM and CMR Messages. A User may not:

- 1) knowingly and without authorization, alter, damage, or destroy the Indiana Department of Transportation ("INDOT") or another user's computer system, network, software, program, documentation or data contained therein;
- 2) use this service to conduct or attempt to conduct any business or activity or solicit the performance of any activity that is prohibited by law. In addition, taking action which results in blocking access to this IP address by other users, will be deemed an unauthorized use and may subject the User to law enforcement action.

This system uses administrative monitoring of Users accessing the system. System administrators may provide evidence of possible criminal activity identified during such monitoring to the appropriate law enforcement officials. If you (User) do not wish to consent to monitoring, exit this system now.

A User shall not hold himself or herself out as a representative, agent, or employee of INDOT and INDOT shall not be liable for any representation, act or omission of the User.

DISCLAIMER OF LIABILITY AND RELIABILITY

In preparation of this RTCM and CMR Broadcast Service, INDOT has endeavored to offer current, correct, and clearly expressed information. Nevertheless, errors may occur. INDOT expressly disclaims any liability, of any kind, or for any reason, that might otherwise arise out of any use of the RTCM and/or CMR information broadcast provided by this service. In particular but without limiting its disclaimer, INDOT disclaims any responsibility for typographical errors or inaccuracies of the information provided or contained within the broadcast message. INDOT makes no warranties or representations whatsoever regarding the quality, content, completeness, availability, suitability, adequacy, sequence, accuracy, or timeliness of the information and data provided by this service.

INDOT makes no representations or warranties of any kind regarding this service that may serve as the basis for holding INDOT liable, under any circumstances, for any consequence of the use of this information contained in the RTCM and/or CMR broadcast message. INDOT makes no representations or warranties regarding the condition or functionality of this Broadcast Service, its suitability for use, or that this Broadcast Service will be uninterrupted or error-free.

If misleading, inaccurate or otherwise inappropriate information is discovered, INDOT asks that it be brought to INDOT's attention so that efforts may be made to correct or remove it.

Reference in this document/service/website to any specific commercial products, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by INDOT.

It is the responsibility of the user to determine the quality, accuracy, and suitability of the service provided.

The user shall agree not to disclose any information regarding IP addresses, account usernames and account passwords to any other entity without the express written consent of INDOT.

If the user agrees to all the provisions of this document, the entity capable of executing documents on behalf of the firm or company utilizing this service must sign, date, and return this document together with the following:

- 1.) The name of the Individual or Firm.
- 2.) Name and signature of the officer of the firm or representative authorized to execute documents on the firm's behalf.
- 3.) Contact information for the individual or firm (name, address, e-mail).*
- 4.) Equipment manufacturer make and model of equipment.

Once INDOT processes the completed agreement you will be provided with a username and password that will allow you access to the Broadcast Service. At this time this service is provided free of charge, however INDOT reserves the right to assess fees in the future if it becomes necessary in order to defray network maintenance and upgrade costs.

JURISDICTION

Use of this service is governed by the laws of the State of Indiana.

SEVERABILITY

If any part of this Disclaimer is determined to be invalid or unenforceable pursuant to applicable law including, but not limited to, the warranty disclaimers and liability limitation set forth above, then the invalid or unenforceable provision will be deemed superseded by a valid, enforceable provision that most closely matches the intent of the original provision and the remainder of the Disclaimer shall continue in effect.

Any rights not expressly granted herein are reserved.

Fill out information neatly and sign below.

Contact Information: Company Name: _____
 Name of Contact Person: _____
 Address: _____

 Phone: _____
 Fax: _____
 * E-mail: _____

* NOTE: The e-mail address you provide is used to communicate information to the user regarding network status updates, scheduled maintenance, and software/firmware upgrades which may affect network availability. It is the user's responsibility to ensure all contact information, including e-mail address, is correct and updated when necessary.

Primary Application (Check One): Survey
 Construction
 Agriculture
 Geographic Information Systems
 Other, please Specify _____

Number of accounts requested: _____
 Equipment Make & Model: _____

I agree to all the provisions of this agreement:

 Signature of Firm Officer or Authorized Representative Date: _____

 Printed Name and Title

Mail, Fax or E-mail completed form to: Land & Aerial Survey Office
 Attn: Network Administrator
 120 South Shortridge Road
 Indianapolis, IN 46219-6705
 Fax: (317) 356-9351
 E-mail: incors@indot.in.gov

(Please allow ample time for processing, incomplete forms will delay processing)

This section for office use only:
 Rover User Name: _____ User Name: _____ Password: _____



RTK User Accounts

- After we receive your signed agreement
 - We will register you into SpiderNet
 - Username & password assigned
 - Email sent out w/ info

Typical email information:

The IP address is: xx.xxx.xx.xxx

The port is: 10000 for NTRIP which includes: RTCM 2.3, 3.0, etc

User Name: xxxxxxxx Password: xxxxxxxx

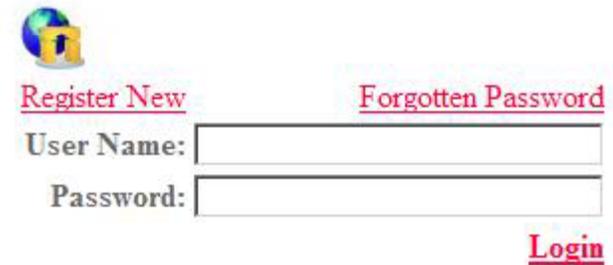
If you need TCP/IP connection please send email request...

Tech support document attached

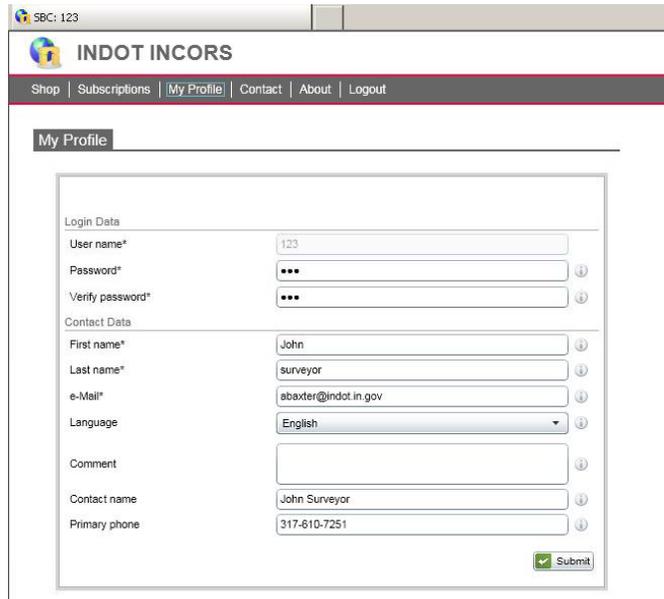


Spider Website for Users

- Login to Spider at <http://10.114.30.153/sbc/>
- Within Spider you will be able:
 - Change your password
 - Update contact information
 - Contact us for information and questions



The image shows the Spider website's user interface. At the top left is a logo with a globe and a key. Below it are two links: [Register New](#) and [Forgotten Password](#). Below these links are two input fields: "User Name:" and "Password:". At the bottom right is a [Login](#) button.

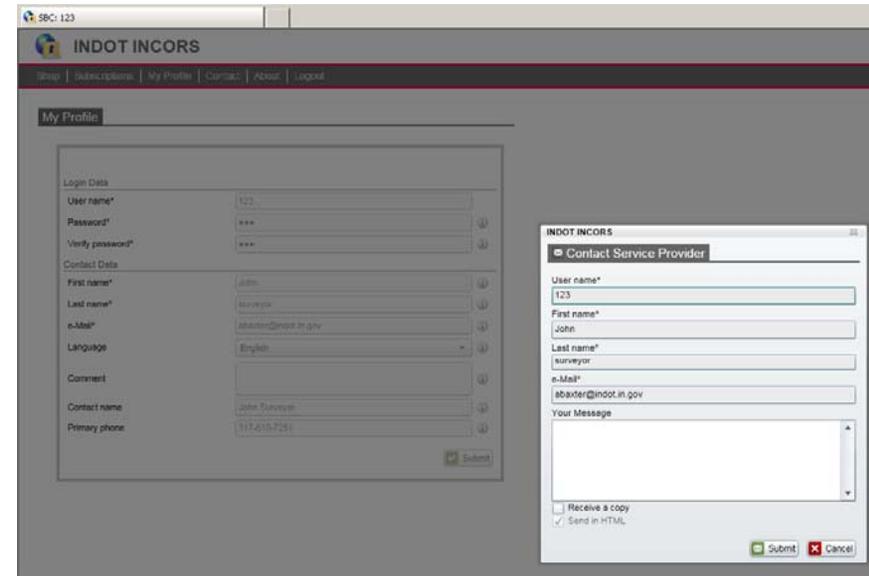


This screenshot shows the "My Profile" page in the Spider website. The page has a header with the "INDOT INCORS" logo and navigation links: Shop, Subscriptions, My Profile, Contact, About, Logout. The "My Profile" section contains several form fields:

Login Data	
User name*	123
Password*	***
Verify password*	***

Contact Data	
First name*	John
Last name*	surveyor
e-Mail*	ebaxter@indot.in.gov
Language	English
Comment	
Contact name	John Surveyor
Primary phone	317-610-7251

At the bottom right of the form is a "Submit" button with a green checkmark icon.



This screenshot shows the "My Profile" page in the Spider website, displaying a different view of the user's profile information. The page has a header with the "INDOT INCORS" logo and navigation links: Shop, Subscriptions, My Profile, Contact, About, Logout. The "My Profile" section contains several form fields:

Login Data	
User name*	123
Password*	***
Verify password*	***

Contact Data	
First name*	John
Last name*	surveyor
e-Mail*	ebaxter@indot.in.gov
Language	English
Comment	
Contact name	John Surveyor
Primary phone	317-610-7251

At the bottom right of the form is a "Submit" button with a green checkmark icon.

Below the main form is a "Contact Service Provider" section with the following fields:

Contact Service Provider	
User name*	123
First name*	John
Last name*	surveyor
e-Mail*	ebaxter@indot.in.gov
Your Message	

At the bottom right of this section are "Submit" and "Cancel" buttons, and a checkbox for "Receive a copy" with "Send in HTML" checked.



InCORS Network Administration (Behind the Scenes)



Network Admin Software (GNSS Spider)

GNSS Spider 4.3.0.4633 - [Server Management]

File View Management Processing Server Tools Window Help

Management

Server Management

Name	Description	Server type	PC name / TCP/IP address	Dial-up connection
dotcorp11vw	InCORS North Site Server	Site server	dotcorp11vw	
dotcorp12vw	InCORS South Site Server	Site server	dotcorp12vw	
dotcorp13vw	InCORS Network Server	Network server	dotcorp13vw	

dotcorp13vw

Content

Cluster	Product	Date/Time	User	Category	Text
InDOT South Cluster		29.11.2012 10:35:20	ClusterServer	Cluster	Cluster InDOT South Cluster: Broadcast Ephemeris available for SV G5 in network
InDOT North Cluster		29.11.2012 10:35:20	Spider Server	Network...	Ephemeris updated on RTK server. Satellite: G05, IODE: 62, Time: 11-29-2012
InDOT North Cluster		29.11.2012 10:34:23	Spider Server	Network...	Site 'INLP Laporte' fixed ambiguities available.
InDOT South Cluster		29.11.2012 10:34:12	Spider Server	Network...	Site 'INSB Salisbury' fixed ambiguities available.
InDOT South Cluster		29.11.2012 10:33:34	ClusterServer	Cluster	Cluster InDOT South Cluster: Broadcast Ephemeris missing for SV G5 in network
InDOT North Cluster		29.11.2012 10:33:32	Spider Server	Network...	Site 'INLP Laporte' Less than 5 satellites with fixed ambiguities available.
InDOT North Cluster		29.11.2012 10:32:34	Spider Server	Network...	Site 'INCR Crawfordsv' Less than 5 satellites with fixed ambiguities available.
InDOT South Cluster		29.11.2012 10:32:10	Spider Server	Network...	Site 'KYTB' fixed ambiguities available.
InDOT North Cluster		29.11.2012 10:30:45	Spider Server	Network...	Site 'MICV Centerville' fixed ambiguities available.
InDOT North Cluster		29.11.2012 10:30:44	Spider Server	Network...	Site 'INNC Noble Co' fixed ambiguities available.
InDOT North Cluster		29.11.2012 10:30:44	Spider Server	Network...	Site 'MICV Centerville' Less than 5 satellites with fixed ambiguities available.
InDOT North Cluster		29.11.2012 10:30:44	Spider Server	Network...	Site 'INNC Noble Co' Less than 5 satellites with fixed ambiguities available.

For Help, press F1

Real-Time Processing started Remote User level: Administrator NUM Local time : 10:44:38



North Site Server (dotcorp11vw)

GNSS Spider 4.3.0.4633 - [dotcorp11vw]

File View Management Raw Data Status Tools Window Help

Management
dotcorp11vw
Sites

Site Name	Site Code	Comm Activity	12 09:55	29.11.2012 10:00	29.11.2012 10:05	29.11.2012 10:10	29.11.2012 10:15	29.11.2012 10:20	29.11.2012 10:25
INTP Tipton	INTP	receive data							
INAB Albany	INAB	receive data							
INAX Alexandria	INAX	receive data							
INPD Pendleton	INPD	receive data							
INCR Crawfordsvi	INCR	receive data							
INBF Bluffton	INBF	receive data							
INWB Wabash	INWB	receive data							
INWR Warsaw	INWR	receive data							
INEL Elkhart	INEL	receive data							
INFW Fort W...	INFW	receive data							
INAG Angola	INAG	receive data							
INLP Laporte	INLP	receive data							
INWL W Lafa...	INWL	receive data							
INFR Frankfort	INFR	receive data							
INPL Plainfield	INPL	receive data							
INCL Cloverdale	INCL	receive data							
INFL Fowler	INFL	receive data							
INNP Newport	INNP	receive data							
INPR Peru	INPR	receive data							
INMO Monticello	INMO	receive data							
INWN Winamac	INWN	receive data							
INRN Renssel...	INRN	receive data							
INGY Gary	INGY	receive data							
INLW Lowell	INLW	receive data							
INBR Bremen	INBR	receive data							
INSB Salisbury	INSB	receive data							
MICV Centerville	MICV	receive data							
MITO THREE ...	MITO	receive data							

Site Map Site Sensor **Raw Data Status** File Products RT Products RT Positioning PP Positioning

Content	Site	Date/Time	User	Category	Text
All		29.11.2012 10:02:25	Spider Server	Site Server	FTP push finished. 0 files failed; 1 files succeeded (last transferred file: 'INWL334o00.zip')
All Sites		29.11.2012 10:02:24	Spider Server	Site Server	FTP push started.
Query (Offline)	INWL W Lafayette	29.11.2012 10:02:24	Spider Server	Site	Site 'INWL W Lafayette': Create product 'Leica MDB' finalized : D:\GNSS Spider\Data\MDB\20
		29.11.2012 10:02:24	Spider Server	Site Server	FTP push finished. 0 files failed; 1 files succeeded (last transferred file: 'inax334h.rnx.zip')
		29.11.2012 10:02:24	Spider Server	Site Server	FTP push started.
	INAX Alexandria	29.11.2012 10:02:24	Spider Server	Site	Site 'INAX Alexandria': Create product 'Rinex GPS Only' finalized : D:\GNSS Spider\Data\GPS
		29.11.2012 10:02:22	Spider Server	Site Server	FTP push finished. 0 files failed; 1 files succeeded (last transferred file: 'inax334h.zip')
		29.11.2012 10:02:22	Spider Server	Site Server	FTP push started.

For Help, press F1 Remote User level: Administrator NUM Local time : 10:48:11



South Site Server (dotcorp12vw)

The screenshot displays the GNSS Spider 4.3.0.4633 interface for the 'dotcorp12vw' server. The main window is divided into several sections:

- Management:** Shows the server name 'dotcorp12vw'.
- Sites:** A list of 25 sites with their names, codes, and activities. The 'Raw Data Status' tab is active, showing a grid of green bars representing data reception for each site. The sites listed are:

Site Name	Site Code	Comm Activity
INMT Indpls	INMT	receive data
INLB Liberty	INLB	receive data
INBL Blooming...	INBL	receive data
INMD Madison	INMD	receive data
INFC Falls City	INFC	receive data
INSG Scottsburg	INSG	receive data
INPA Paoli	INPA	receive data
INJS Jasper	INJS	receive data
INTC Tell City	INTC	receive data
INBD Bedford	INBD	receive data
INDA Dale	INDA	receive data
INLN Linton	INLN	receive data
INVI Vincennes	INVI	receive data
INAS Ashboro	INAS	receive data
INES Evansville	INES	receive data
INGG Greensb...	INGG	receive data
INWR Versailles	INWR	receive data
INCB Columbus	INCB	receive data
INSY Seymour	INSY	receive data
KYRR	KYRR	receive data
KYTE	KYTE	receive data
KYTD	KYTD	receive data
KYTB	KYTB	receive data
KYTF	KYTF	receive data
INNC Noble Co	INNC	receive data
KYBU	KYBU	receive data
KYHN	KYHN	receive data
- Content:** A log of events with columns for Site, Date/Time, User, Category, and Text. Recent entries include:

Site	Date/Time	User	Category	Text
INTC Tell City	29.11.2012 10:01:15	Spider Server	Site	Site 'INTC Tell City': Raw data file received. D:\GNSS Spider\Data\Temp\INTC\INTC334o.m00
	29.11.2012 10:01:13	Spider Server	Site Server	FTP push finished. 0 files failed; 1 files succeeded (last transferred file: 'Infc334o.rnx.zip')
	29.11.2012 10:01:13	Spider Server	Site Server	FTP push started.
INFC Falls City	29.11.2012 10:01:13	Spider Server	Site	Site 'INFC Falls City': Create product 'Rinex GPS Only' finalized : D:\GNSS Spider\Data\GPS2
INLN Linton	29.11.2012 10:01:11	Spider Server	Site	Site 'INLN Linton': Download raw data finished.
INLN Linton	29.11.2012 10:01:11	Spider Server	Site	Site 'INLN Linton': Cleanup of file on the sensor succeeded. INLN334o.m00
	29.11.2012 10:01:11	Spider Server	Site Server	FTP push finished. 0 files failed; 1 files succeeded (last transferred file: 'INFC334o00.zip')
INLN Linton	29.11.2012 10:01:11	Spider Server	Site	Site 'INLN Linton': Raw data file received. D:\GNSS Spider\Data\Temp\INLN\INLN334o.m00

At the bottom, the status bar shows: Remote | User level: Administrator | NUM | Local time : 10:46:36



Network Server (dotcorp13vw)

GNSS Spider 4.3.0.4633 - [dotcorp13vw]

File View Management Processing Status Tools Window Help

Management Contents

dotcorp13vw

dotcorp13vw

FTP Locations

Operators

Events

Rover Users

Transformations

Business Center

Network

- Clusters
 - GG InDOT North Cluster
 - GG InDOT South Cluster
- Cells
 - GG RTCM - INLP
 - GG RTCM - INEL
 - GG RTCM - INGY
 - GG RTCM - INAG
- Automatic Cells
 - INFR
- Sites

Net Config RT Products **Map View** Rover Status Sat Status

Content	Cluster	Product	Date/Time	User	Category	Text
All			15.01.2013 07:46:08	Spider Server	Network...	FTP Download finished.
All Clusters			15.01.2013 07:45:57	Spider Server	Network...	FTP Download started.
All Products	InDOT South Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'INPA Paoli' fixed ambiguities available.
Query (Offline)	InDOT North Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'INBR Bremen' fixed ambiguities available.
	InDOT North Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'INRN Rensselaer' fixed ambiguities available.
	InDOT North Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'INWN Winamac' fixed ambiguities available.
	InDOT South Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'KYTF' fixed ambiguities available.
	InDOT South Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'INPL Plainfield' fixed ambiguities available.
	InDOT South Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'INSB Salisbury' fixed ambiguities available.
	InDOT North Cluster		15.01.2013 07:42:47	Spider Server	Network...	Site 'INGY Gary' fixed ambiguities available.



InCORS Network Broadcast Corrections



Broadcast Corrections

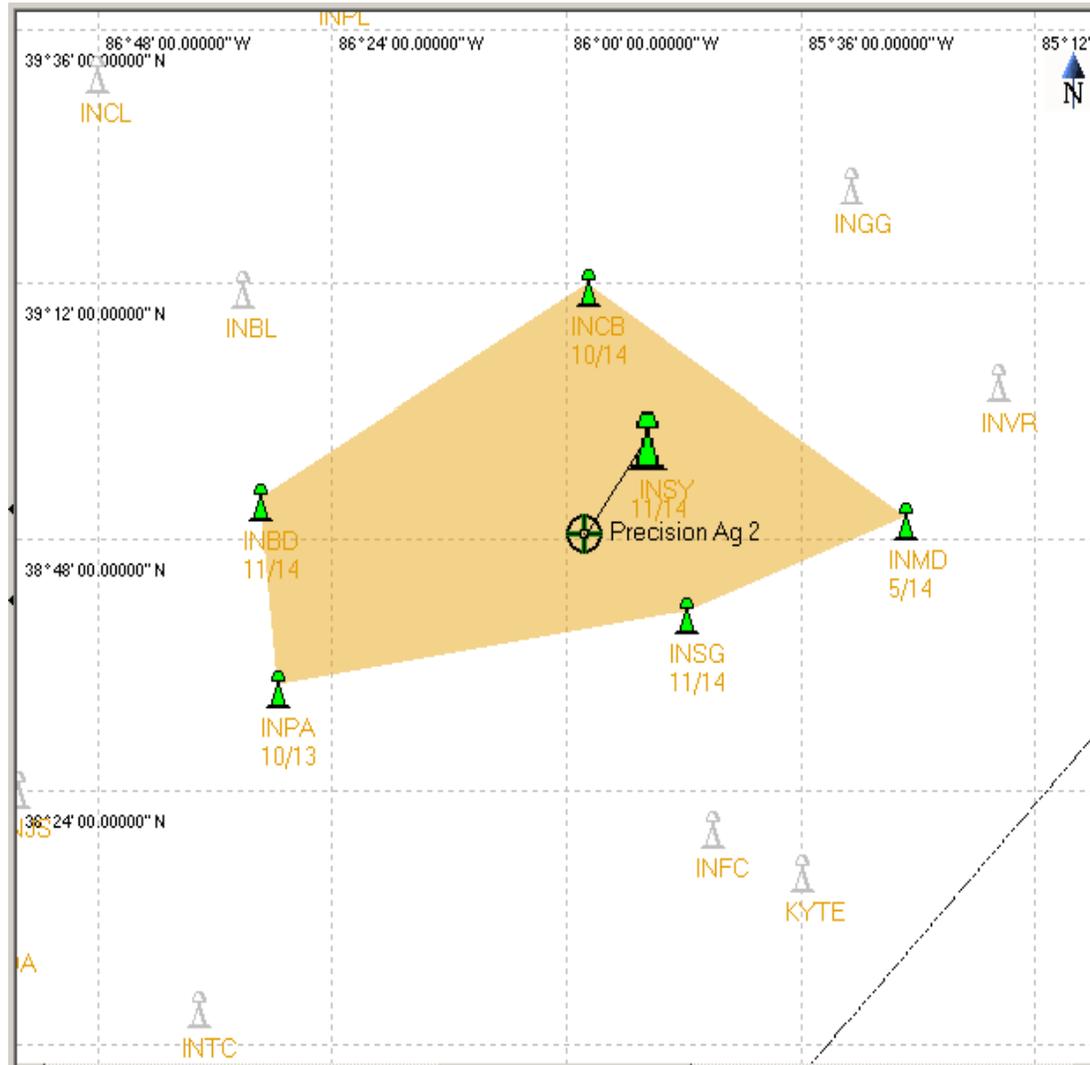
- Two types of corrections
 - Nearest Site
 - Automatic Cell
- Nearest Site Correction
 - Single Baseline Solution
 - CMR, CMR+, RTCM 2.3, RTCM 3.1 available
 - PPM errors increase with rover distance from base
 - Network software automatically selects the closest reference station to the rover based on the submitted NMEA message
- Automatic Cell
 - Network Solution
 - CMR+, RTCM 2.3, RTCM 3.1 available with MAX and iMAX
 - Network software automatically selects the closest reference station and then uses it and next five nearest stations to model corrections
 - Helps to minimize PPM errors due to rover distance from base



Nearest Solution (Single Baseline)



Automatic Cell



Rover Status

GNSS Spider - [dotcorp03pw]

File View Management Processing Tools Window Help

Management	Name	Connectio...	Duration	Sats Rov / Ref	Product	Latency	Ref. Stn. ID
dotcorp03pw	Michigan DOT	28.08.20...	3 Days 02:38:53	- / 0	RAW_INLP	0.00	INLP--1
	Michigan DOT	29.08.20...	1 Day 16:20:41	- / 0	RAW_INAG	0.00	INAG--1
	API 1	30.08.20...	1 Day 05:10:14	5 / 16	RTCM 3.1 Nearest (GNSS)	0.00	INWR-203
	Michigan DOT	30.08.20...	21:00:26	- / 0	RAW_INEL	0.00	INEL--1
	Precision Ag 2	31.08.20...	12:48:14	8 / 11	RTCM 3.1 IMAX (GNSS)	0.00	INSY-605
	Gelfius 2	31.08.20...	06:13:04	4 / 11	CMR+ Nearest (GPS)	0.00	INCB-26
	Gelfius 3	31.08.20...	06:07:01	8 / 11	CMR+ Nearest (GPS)	0.00	INCB-26
	Milestone 4	31.08.20...	06:04:07	5 / 11	CMR+ Nearest (GPS)	0.00	INCB-26
	JL Equipment 3	31.08.20...	02:12:31	10 / 11	CMR+ Nearest (GPS)	0.00	INES-27
	Paarberg 1	31.08.20...	01:58:04	12 / 11	CMR+ Nearest (GPS)	999.90	INLP-6
	Paarberg 2	31.08.20...	01:44:41	12 / 11	CMR+ Nearest (GPS)	999.90	INLP-6
	Hamilton 2	31.08.20...	01:08:23	4 / 11	CMR+ Nearest (GPS)	0.00	INGG-27
	JL Equipment 2	31.08.20...	00:33:53	10 / 11	CMR+ Nearest (GPS)	0.00	INES-27
	Krause 1	31.08.20...	00:33:24	8 / 16	RTCM 3.1 MAX (GNSS)	0.94	INMO-107
	Schneider 1	31.08.20...	00:24:45	3 / 16	RTCM 3.1 Nearest (GNSS)	0.00	INWL-302
	MEI 1	31.08.20...	00:16:14	6 / 12	CMR+ IMAX (GNSS)	0.00	INLN-21
	Rekeweg 1	31.08.20...	00:11:03	11 / 11	CMR+ Nearest (GPS)	999.90	INFW-14
	BLA 6	31.08.20...	00:07:54	6 / 10	CMR+ IMAX (GNSS)	0.00	INES-27
	Taylor 1	31.08.20...	00:06:14	5 / 7	RTCM 3.1 IMAX (GNSS)	0.00	MICW-0
	Site Specific 2	31.08.20...	00:03:44	9 / 11	CMR+ Nearest (GPS)	0.00	INBR-7

Management
dotcorp03pw
FTP Locations
Operators
Events
Rover Users
Transformations

Net Config RT Products Map View **Rover Status** Sat Status



Rover Location Map

GNSS Spider - [dotcorp03pw]

File View Management Processing Tools Window Help

Management

dotcorp03pw

Name	Connectio...	Duration
Michigan DOT	28.08.20...	3 Days
Michigan DOT	29.08.20...	1 Day 1
API 1	30.08.20...	1 Day 0
Precision Ag 2	31.08.20...	13:33:1
Gelfius 2	31.08.20...	06:58:0
Gelfius 3	31.08.20...	06:52:0
Milestone 4	31.08.20...	06:49:1
JL Equipment 3	31.08.20...	02:57:3
Paarlberg 1	31.08.20...	02:43:0
Paarlberg 2	31.08.20...	02:29:4
Hamilton 2	31.08.20...	01:53:2
Schneider 1	31.08.20...	01:09:5
Rekeweg 1	31.08.20...	00:56:0
Michigan DOT	31.08.20...	00:38:5
Blankenkoper 1	31.08.20...	00:23:5
Hamilton 3	31.08.20...	00:20:0
Wilcox 9	31.08.20...	00:19:5
Beals Moore 2	31.08.20...	00:11:5
Site Specific 2	31.08.20...	00:08:2
JL Equipment 2	31.08.20...	00:07:1
Gourdie-Fraser 1	31.08.20...	00:05:2
Aerial Engineering	31.08.20...	00:02:3
Schneider 25	31.08.20...	00:01:0
BLA 6	31.08.20...	00:00:1

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4200 Agency, IndianaMap Framework Data, GeoEye, S... Map data ©2010 Google - Terms of Use Report a problem

Net Config RT Products Map View **Rover Status** Sat Status



Leica Geosystem's Focus on Network Solution Concepts for the Indiana RTN



National Geodetic Survey Guidelines for Real Time GNSS Networks



March 2011
v. 2.0



The "Seven C's"

1. Check Equipment, Data Collector Parameters & Site information
2. Conditions
3. Coordinates
4. Communication
5. Constraining to passive monuments (a.k.a. Calibrations or Localizations)
6. Collection
7. Confidence



Check Equipment, Data Collector Parameters & Site information

- Measure the actual height of the antenna reference point (ARP)
- Ensure that all necessary and correct projection parameters are in the collector
- Test your wireless data communications
- Make sure all your devices are fully charged



Conditions

- Use mission planning

Allowing one GLONASS (shortened to GLN in the following) satellite for the GLN/GPS system time parameter resolution, a minimum combination of these two constellations for RT positioning is given as:

GPS \geq 5, GLN = 0

GPS = 4, GLN = 2

GPS = 3, GLN = 3

GPS = 2, GLN = 4 (Can't initialize with only GLN sats.)

(Gakstatter, 2009)

- Be aware of multipath conditions
- Check NOAA's Space Weather Prediction Center (SWPC)



Coordinates

- Most RTN in the U.S. maintain their reference station ARP coordinates in the NAD 83 datum, albeit with varying adjustments and epochs. Recall that our national “horizontal” datum of NAD 83 has had several adjustments:

NAD 83 (1986) – the original adjustment

NAD 83 (HARN)

NAD 83 (FBN-CBN)

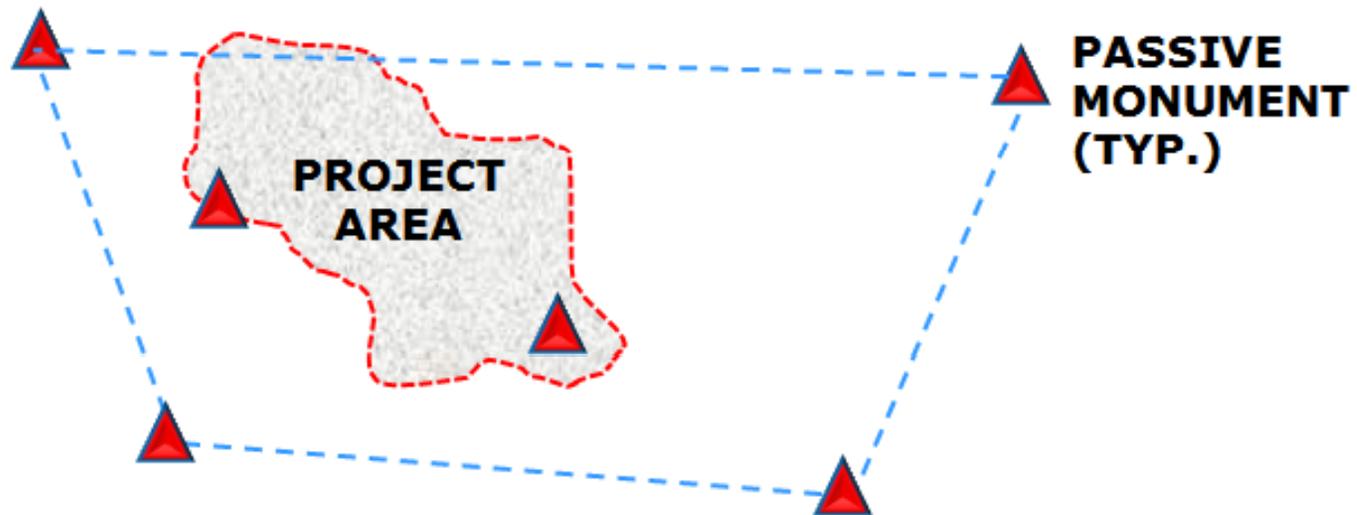
NAD 83 (CORS 96)\ epoch 2002.0 (current InCORS)

NAD 83 (NSRS 2007)\ epoch 2007.0

NAD 83 (2011)\ epoch 2010.0 (future InCORS)



Constraining to passive monuments



Collection

- Check a known coordinate point before, during and at the end of data collection.
- Set an elevation cut-off or mask of between 10° and 15° .



Confidence

- Redundancy is the king of RT GNSS positioning
- Checks on known points
- Obvious Multipath



metadata

Example of Surveying and Mapping Documentation (*Metadata*)

Basis of Bearings and Coordinates

Linear unit: International foot (ift)

Geodetic datum: North American Datum of 1983 (2007)

Vertical datum: North American Vertical Datum of 1988 (see below)

System: Arizona LDP

Zone: Cochise County

Projection: Transverse Mercator

Latitude of grid origin: 31° 19' 00" N

Longitude of central meridian: 109° 45' 00" W

Northing at grid origin: 0.000 ft

Easting at central meridian: 240,000.000 ift

Scale factor on central meridian: 1.000195 (exact)

All distances and bearings shown hereon are projected (grid) values based on the preceding projection definition. The projection was defined such that projected (grid) distances are equivalent to "ground" distances in the project area. The basis of bearings is geodetic north. Note that the grid bearings shown hereon (or implied by grid coordinates) do not equal geodetic bearings due to meridian convergence.



Rule 12

865 IAC 1-12-22 Measurements for route surveys

Authority: IC 25-21.5-2-14

Affected: IC 25-21.5

Sec. 22. (a) When conducting a route survey, the land surveyor shall be responsible to use the minimum standards of measurement for urban surveys provided for in section 7 of this rule, except that relative positional accuracy may not exceed five tenths (0.5) feet for a route survey.

(b) Measurements generally shall be shown on the route survey plat with a number of significant figures representative of the precision of the work.

(c) The measurements specifications outlined in this section will apply to all of the following items shown on a route survey:

(1) The control survey points.

(2) Survey ties to either of the following:

(A) The nearest United States Public Land Survey subdivision corners that are reasonably accessible on both sides of the controlling survey line.

(B) Monuments with established state plane coordinates.

(3) All monuments and reference monuments, and any ties thereto, that are set relative to the controlling survey line.

(d) If the route survey references or is based on state plane coordinates or utilizes the Global Positioning System (GPS), the written surveyor's report shall identify the following:

(1) The datum and projection.

(2) The year of applicable datum adjustment.

(3) The originating or controlling monuments.

(4) The GPS base stations or positioning software used, for example, the Online Positioning User Service (OPUS).

(5) The source and format of the corrections if real time kinematic GPS was used.

(6) The Geoid model used, if applicable.

(7) The scale, elevation, and combination factors used in the coordinate calculations.

(8) Information on any translation to or from a local system.

(9) The collection processes and methodology of final positioning.

(10) Whether the distances shown are grid or ground.

(State Board of Registration for Land Surveyors; 865 IAC 1-12-22; filed Jul 17, 1991, 4:30 p.m.: 14 IR 2250; filed Oct 13, 1992, 5:00 p.m.: 16 IR 893; errata, 21 IR 4537; readopted filed May 22, 2001, 9:55 a.m.: 24 IR 3237; filed May 4, 2006, 1:25 p.m.: 29 IR 3016; readopted filed Nov 9, 2012, 11:26 a.m.: 20121205-IR-865120390RFA)

NOTE: 864 IAC 1.1-13-37 was renumbered by Legislative Services Agency as 865 IAC 1-12-22.



INDOT Mission & Values

- INDOT Mission:
 - INDOT will plan, build, maintain and operate a superior transportation system enhancing safety, mobility and economic growth

- INDOT Values:
 - Respect
 - Teamwork
 - Accountability
 - Excellence



Contact Information

For Questions/Issues e-mail:

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- Andrew “Dee” Baxter, PLS
 - Survey Section Coordinator
 - InCORS Administrator
 - abaxter@indot.in.gov
 - 317-610-7251, ext. 293

