Introduction to the WVDOH CORS & VRS

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Agenda, part 1

- WVDOH/RTI relationship
- Introduction to GNSS
- GPS
- GLONASS
- Other GNSSs
- WVDOH CORS stations
- The Reference Data Shop
- Data communication
- Conceptualizing Virtual Reference Stations (VRS)
- Generation and Distribution of Correction Data in Real Time
- Sentence types
- Real Time Output
- The NTRIP Caster
- Reporting

Agenda, part 2

- Conceptualizing Virtual Reference Stations (VRS)
- Generation and Distribution of Correction Data in Real Time
- Sentence types
- Real Time Output
- The NTRIP Caster
- Reporting VRS Monitoring and Web application
- The Web application
- System monitoring
- Field Work

Global Navigation Satellite Systems (GNSS)

- GPS
  - The Global Positioning System
  - USDOD
- GLONASS
  - GLObal'naya NAvigatsionnaya Sputnikovaya Sistema
  - Russian Federation
- Galileo
  - European Consortium
- Compass
  - People’s Republic of China

The GPS

- Several different satellite (space vehicles, aka SVs) types with increasingly sophisticated characteristics
  - Block II, 1989–1990, 0 in orbit
  - Block IIA, 1990–1997, 11/19 in orbit & healthy
  - Block IIR, 1997–2004, 12/13 in orbit & healthy
  - Block IIR-M, 2005–2009, 7/8 in orbit & healthy
  - Block IIF, 2010–2011, first scheduled launch May 2010
- 30 total in orbit and healthy as of April 17, 2010

GLONASS

- Twenty one in orbit and healthy SVs
- Currently flying second generation Uragan-M class SVs

Trimble

WVRA

NetR5

SN: 4910K61056

- Receiver Status
- Satellites
- Data Logging
- Receiver Configuration
- I/O Configuration
- Bluetooth
- Network Configuration
- Security
- Firmware
- Help

Trimble - GNSS Infrastructure Receiver

What's Up?

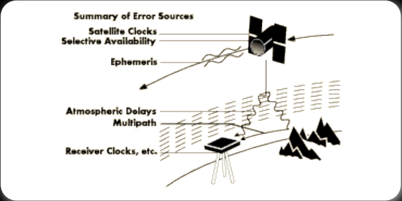
SV	Type	Elev. [Deg]	Azim. [Deg]	L1-C/No [dBHz]	L1	L2-C/No [dBHz]	L2	IODE	URA [m]	Type
2	GPS	8.99	123.87	40.6	CA	23.9	E	30	2	IIR
5	GPS	29.12	64.12	47.6	CA	35.9	E	4	2	IIR-M
7	GLONASS	60.29	329.27	51.8/51.2	CA/P	45.9	P	69	5	M
8	GPS	9.49	43.27	38.3	CA	20.1	E	72	2	IIA
8	GLONASS	26.40	267.17	49.9/47.8	CA/P	44.3	P	69	4	M
9	GLONASS	13.05	119.63	43.8/42.4	CA/P	20.6	P	69	7	M
9	GPS	8.37	155.22	39.8	CA	26.7	E	61	4	IIA
15	GPS	74.93	108.53	51.8	CA	44.7	E	79	2	IIR-M
15	GLONASS	6.16	19.16	43.0/40.2	CA/P	36.1	P	69	7	M
18	GPS	34.94	270.82	45.8	CA	32.4	E	3	2	IIR
21	GLONASS	29.49	184.60	49.0/46.8	CA/P	43.6	P	69	7	M
21	GPS	45.08	310.25	50.3	CA	37.4	E	21	2	IIR
22	GLONASS	61.86	257.62	53.9/51.4	CA/P	49.7	P	69	5	M
23	GLONASS	27.25	324.98	47.8/46.6	CA/P	44.4	P	69	4	M
24	GPS	37.23	309.98	47.7	CA	35.3	E	18	2	IIA
26	GPS	37.45	198.25	46.5	CA	33.6	E	58	2	IIA
27	GPS	14.72	145.43	40.7	CA	25.6	E	132	2	IIA
29	GPS	45.86	216.10	49.5	CA	39.9	E	8	2	IIR-M

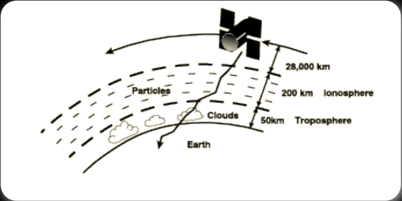
As seen by WVRA 17Apr2010, 10:30am

Why Reference Stations?
To correct for errors in signal transmission

Signals in Space Errors

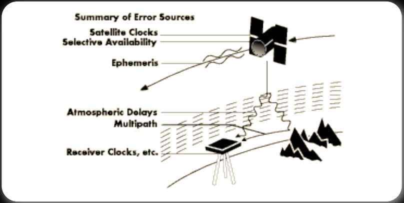
- Satellite orbit errors
- Gravity
- Solar wind
- Satellite clock errors
- Relativity - special
- Relativity - general
- Ionospheric delay
- Tropospheric delay

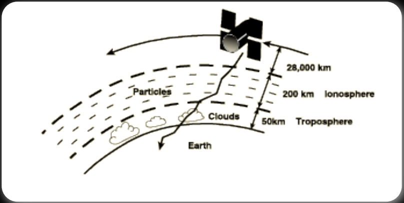




Why Reference Stations?
To correct for errors in signal transmission

- Multi-Path signal reflections
- Receiver Clock error
- Difficult to correct error
  - SVs low on the horizon
    - Greater airmass
    - Mask lower elevation angles

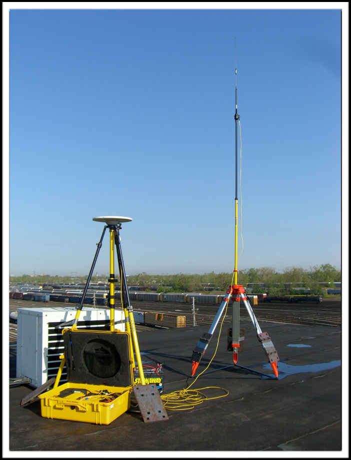




Single Station RTK

Limitations Of Single Station RTK

- Requires at least two receivers
  - One fixed reference
  - At least 1 mobile
- Potential gross error in establishing reference station position
- Must be corrected in post
- Requires Local Communication
  - VHF/UHF radio
- Requires Power supply
- Equipment and/or Productivity loss



Single Base Station RTK Surveying

- Limited range of single reference station due to VHF/UHF LOS
- Errors grow with baseline length (ppm)
- Reliability and performance decrease with distance to the (next) reference station
- Dependency on single reference station
- Performance loss

Benefits of Permanent Reference Stations

- Reduction in gross error
  - Potential gross errors in establishing ad hoc reference stations are eliminated.
- Productivity increase
  - Set-up of ad hoc base receiver and radio not required.
  - No need to change ad hoc base batteries.
  - Securing the ad hoc base in not required.
- Increased security
- Reduction in survey party equipment
  - One receiver per survey party.
  - Several corrector data Tx/Rx schemes available.

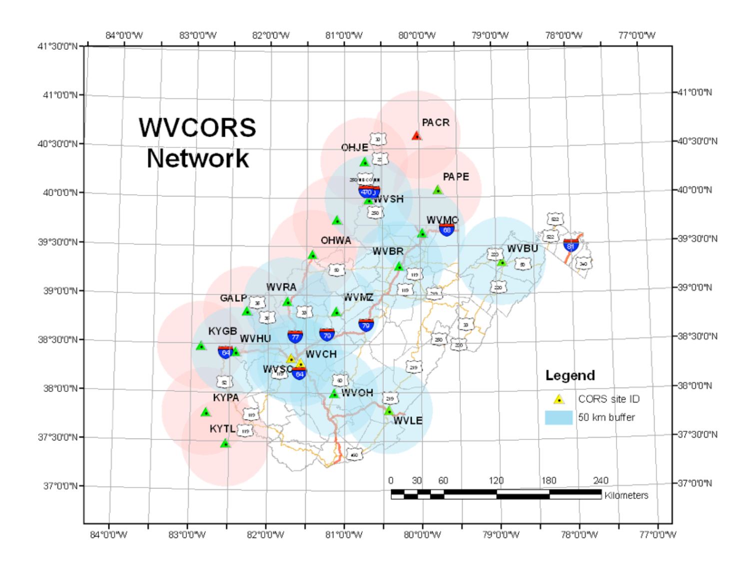
Scaleable Infrastructure Solutions

Infrastructure Software consists of the following components:

- NTRIP Caster: Corrector Server
- Ephemeris Download: Satellite orbit calculations
- VRS^{3}Network: Virtual Reference Station server
- Streaming Manager: Handles data flows.
- Integrity Manager: Insures real time and stored data is complete.

WVCORS Network

April 2010



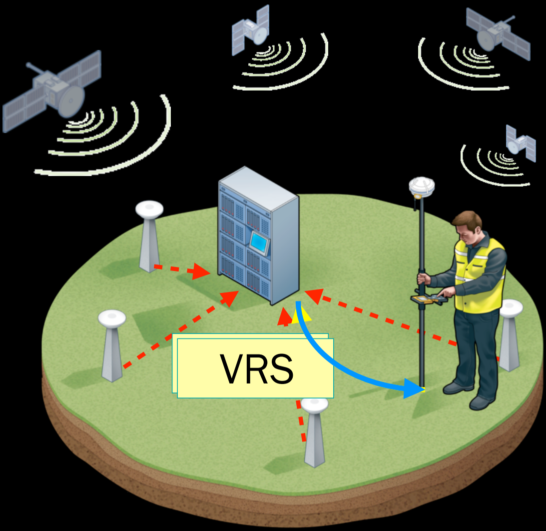
VRS: How does it work?

VRS Data Flow

1. CORS observations stream to the control center

2. Rover receiver sends its position back to the control center

3. Control Center generates individual VRS Position for each rover



Advantages of VRS Networking

- Significantly reduces systematic errors
- Extended operating range with improved initialization and accuracy
- Increased productivity
- Eliminates needs to establish local reference station
- Provides integrity monitoring
- Provides alarming
- All users in common, established coordinate frame
- Uses established communications like GSM and GPRS
- Ionospheric model for linear and non linear parts first order
- Tropospheric model is applied
- VRS for post-processing

Current

- Geomatics
- Deformation monitoring
- Scientific research
- Surveying
- Construction
- Marine navigation and positioning
- Mapping and GIS

Infrastructure Applications

- Deformation monitoring
- Scientific/engineering research
- Surveying
- Construction
  - Bench marks
  - Machine control
- Marine navigation and positioning
- Mapping and GIS
  - Highway assets
  - River profile
  - Regulatory compliance
- Infrastructure monitoring
  - Dams
  - Bridges
  - Coal slurry impoundments

RTI

West Virginia Dept. Of Highways' VRS, managed by the Rahall Transportation Institute.

- Home
  - Login
  - Register
- Trimble

Welcome

Welcome to WV's Virtual Reference Station service. Real Time Kinematic correctors on demand and a user tailored reference data shop for post processing your GNSS data.

Login

Login to: http://wvcors01.cors.us

Create Account for Yourself

1. http://wvcors01.cors.us
2. Complete registration
3. Receive acknowledgement from VRSadmin
4. Login and test your credentials
    - Data Reference Shop
    - RTK WVCORS / VRS
5. Setup survey controller

Survey Controller Setup

- Create a new survey style
- Create a dial profile named WVCORS
- Enter IP address and port number
  - wvcors01.cors.us or 206.248.207.9
  - Port number 2101

Survey Controller Setup

- Enter login credentials
- Save survey style
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