New Guide to GNSS Base stations

Asian Base Stations Project

Updated on December 2017

Outline

1st Chapter (page3 – page25) -Setting of The Base Station-

- Introduction
- Example of base Station (TUMSAT)
- Preparation for setting up a base station
- Procedure for setting up a base station
- Example of each Univ.

2nd Chapter (page26-) -After Setting-

- Current Situation of existing base stations
- Some problems which could be considered
- Actual operation
- Request for the participants of Asian base stations

Based on documents

- ✓ Introduction to GPS (Global Positioning System) by Leica
- ✓ GPS Reference Stations and Networks An introductory guide by Leica
- ✓ Trimble NetR9 GNSS reference Receiver User GUIDE

- Setting of The Base Station –

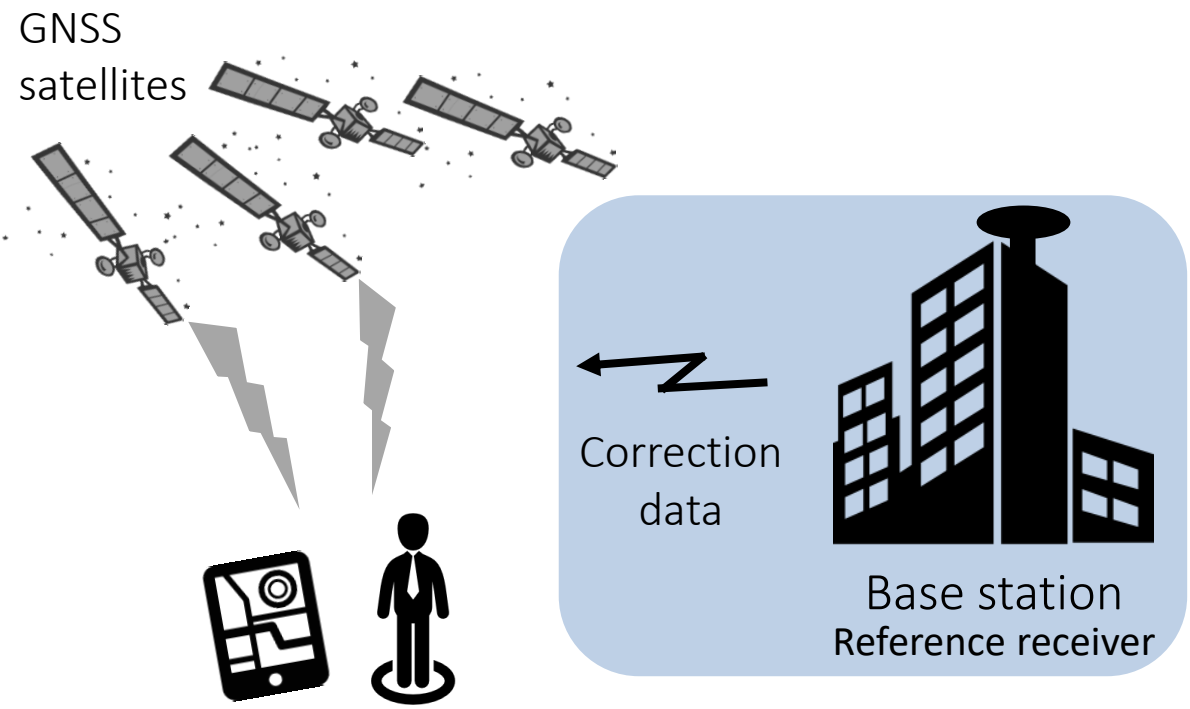
Concept

Actual settings

Receivers

Introduction

This guide describe and advice how to set up the reference receiver for the base station.

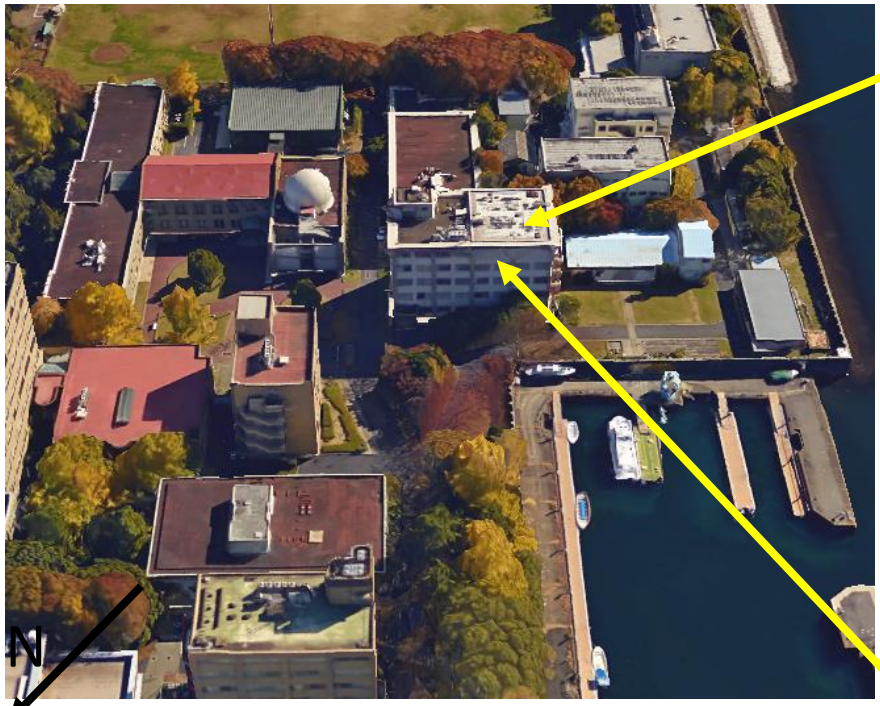


Real time correction data
Accuracy 10m → 2cm

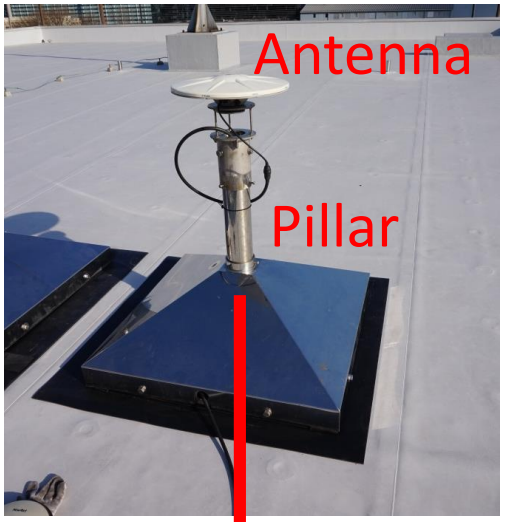
Many of the errors affecting the measurement of satellite range can be using differential measurement techniques. The Reference receiver antenna is mounted on a previously measured point with known coordinates. Because it is on a known point, the reference receiver can estimate very precisely what the ranges to the various satellites should be. The reference receiver can therefore work out the difference between the computed and measured range values. These differences are known as corrections.

Example of Base Station at TUMSAT

(TUMSAT: Tokyo University of Marine Science and Technology)



Roof top of the building at TUMSAT



Sky view
(No obstacles)

Cable

Receiver

Top floor the building (our lab. is there)

Receiver (Trimble NetR9)

- ✓ Built in battery and memory
- ✓ Suited for Continuously Operating Reference Station(CORS)
- ✓ Supports NTRIP Server

This base station has achieved for 5-10 years.

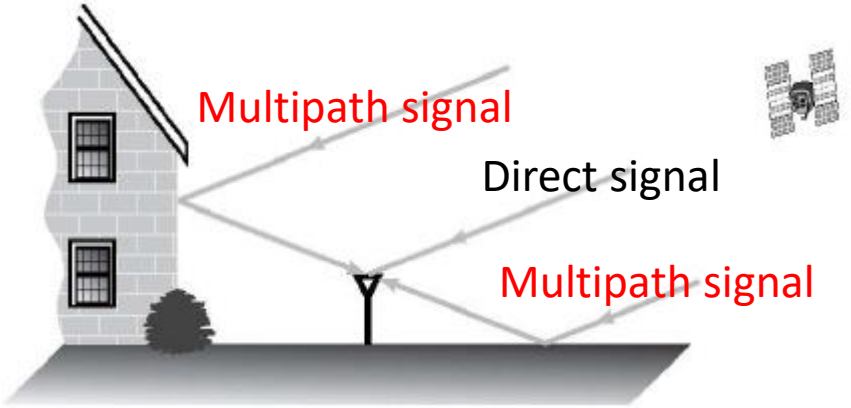
Preparation for setting up a base station

1. Selecting suitable sites
2. Selecting equipment
   - GNSS receivers
   - GNSS antennas
   - Antenna cables
3. Power supply and Network
4. Conclusion

1. Selecting suitable site

Requirements for the Base station

- Continuously for logging reliable data
  - Need to be stable
- No obstacles to secure the quality of data
  - Obstacles cause loss of satellite signals
  - Obstacles cause receiving multipath signal
- Known positions
  (close to the other base station is better)
  - To provide high accurate correction data

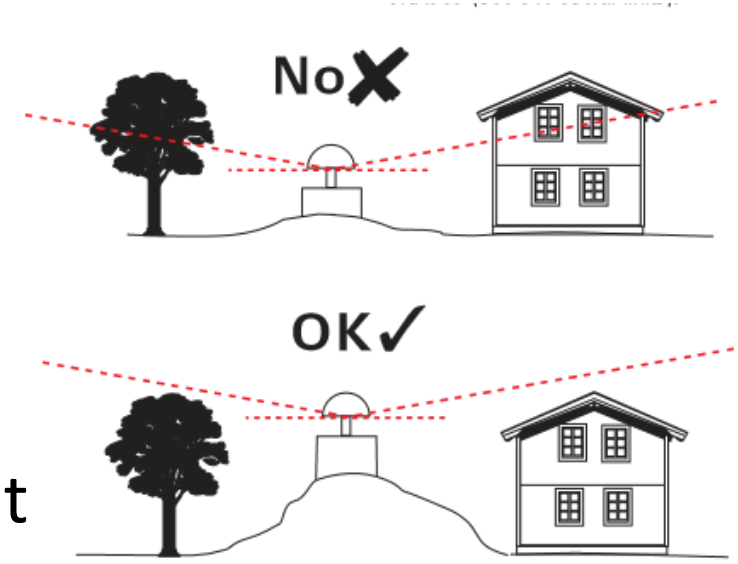


Preparation for setting up a base station

1. Selecting suitable site

Specifications for site of Base Station

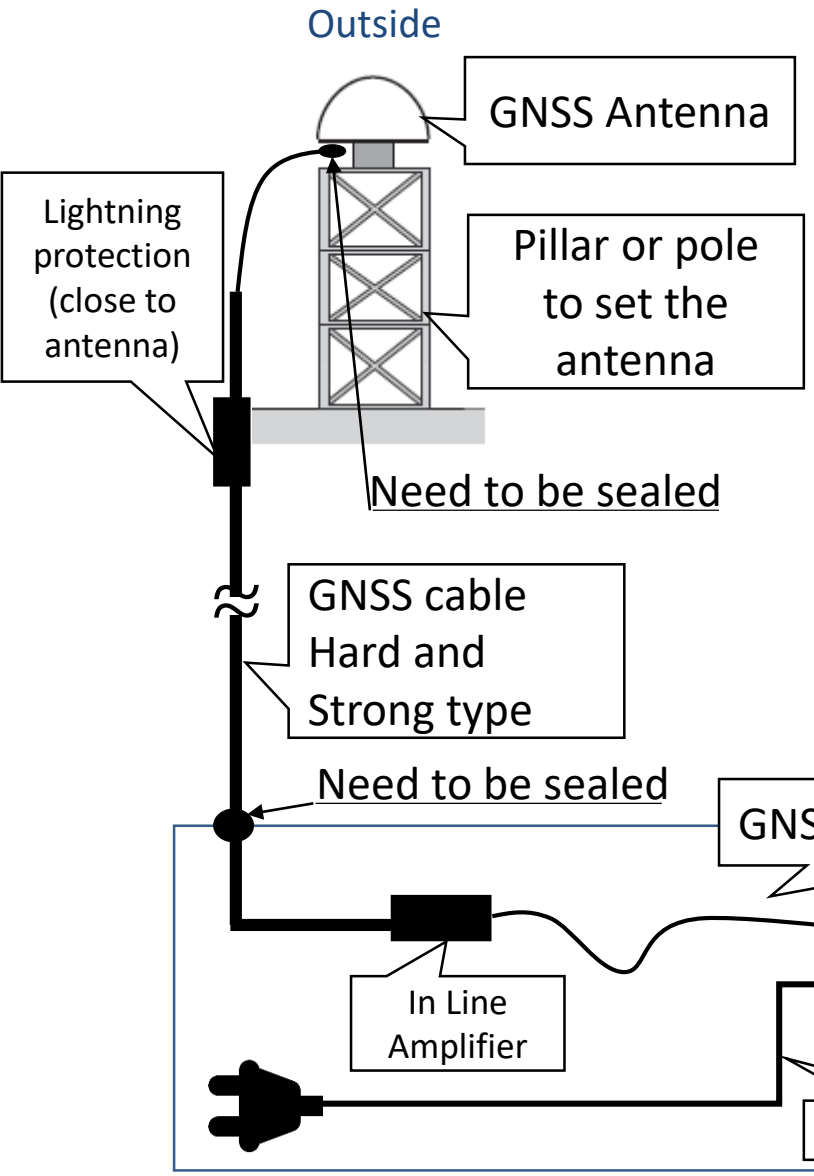
- Open view of the sky
- No objects in the vicinity
- No other transmitters
- Power and communication
- House and Protect the equipment
- How to provide a stable mount for the antenna?
- Accessibility for inspection and service



It is usually easy to arrange a stable mount for the antenna on the roof of a building.

Preparation for setting up a base station

2. Selecting equipment



- ✓ **GNSS antenna**
- ✓ **GNSS receiver**
- ✓ **Several Antenna cables (TNC-type connector)**
  - Standard 10m
  - Longer cable -it has to be to minimize loss of signal and the heavier and more unwieldy.
  - TNC extension cable
- GNSS In Line Amplifier for the extension cable
- Lightning protection
- Sealing tape, rubber tape for water proof

Preparation for setting up a base station

2. Selecting equipment

- Selecting suitable **receivers** and **antennas** for your objective
  - Dual/single frequency
  - Multi-GNSS/GPS satellite constellation
  - Provide types of observation
  - Cost

Trimble Zephyr Geodetic Antenna

Trimble Zephyr Geodetic Antenna

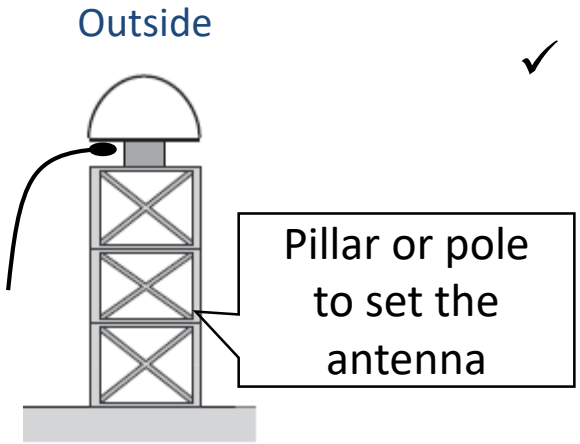
- ✓ Technology for multipath reduction
- ✓ Supports multiple satellite signal
- ✓ Sub-millimeter phase center repeatability
- ✓ **5/8" x 11 female threaded stainless steel mount point**
- ✓ **TNC-type female connecter for connecting to an antenna**

Trimble NetR9 GNSS Reference Receiver

- ✓ Built in battery and memory
- ✓ Suited for Continuously Operating Reference Station(CORS)
- ✓ Supports NTRIP Server

Preparation for setting up a base station

2. Equipment for antenna

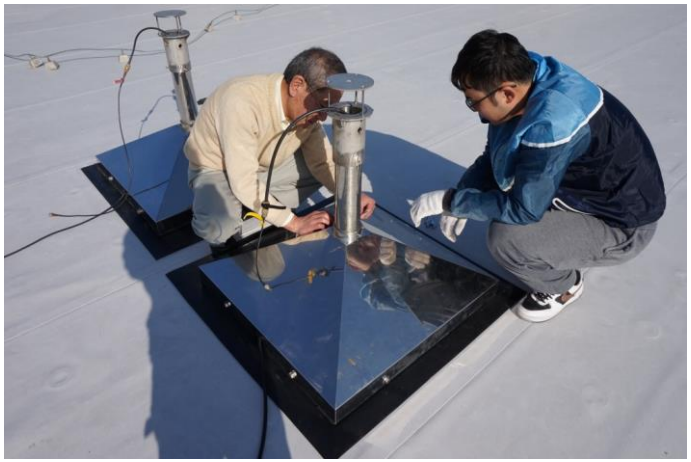


✓ Pillar

- Solid foundations, bedrock, suitably designed
- Provide reliable power and communication
- To place the receiver, power supply and communication device
- Security
- Stay horizontally for the antenna

Chulalongkorn Univ.

TUMSAT

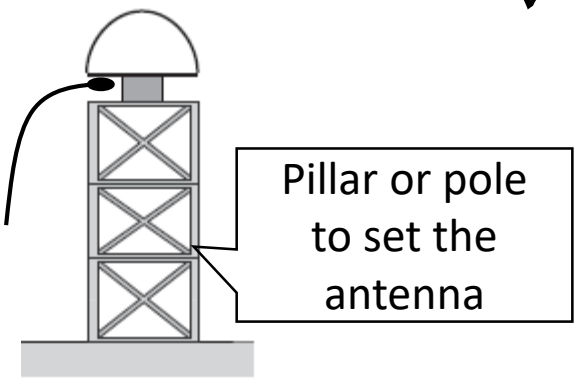


Univ. of Philippines

Preparation for setting up a base station

2. Equipment for antenna

Outside



- ✓ Pole
  - Using 5/8" x 11 male threaded stainless steel mount point fixed firmly in position
  - Attaching a pole or console to a wall, etc

Universitas Indonesia

5/8" x 11 female threaded stainless steel mount point

3. Power supply and Network

- GNSS base station needs a reliable, continuous power supply.
  - NetR9 include a battery for several hour
  - No need UPS
- To provide the correction data via the internet for Real-time
  - Fixed Global IP address
  - Continuous internet network
- To configure the receiver, PC with Ethernet port are required.

Conclusion –check list for preparation

- Selecting suitable site
  - Roof top?
  - Are there any obstacles?
  - Are there any other transmitters?
  - Pillar or pole? Is it stable?
  - How long distance between receiver room and antenna?
- Selecting suitable equipment
  - Receiver and antenna
  - Enough stable for setting antenna?
  - Is it a cable of enough length?
  - In Line Amplifier for the extension cable
  - How secure for each equipment?
  - Are there continuously power and network?
  - Will it be able to obtain precise position for the base station ?

Procedure for setting up a base station

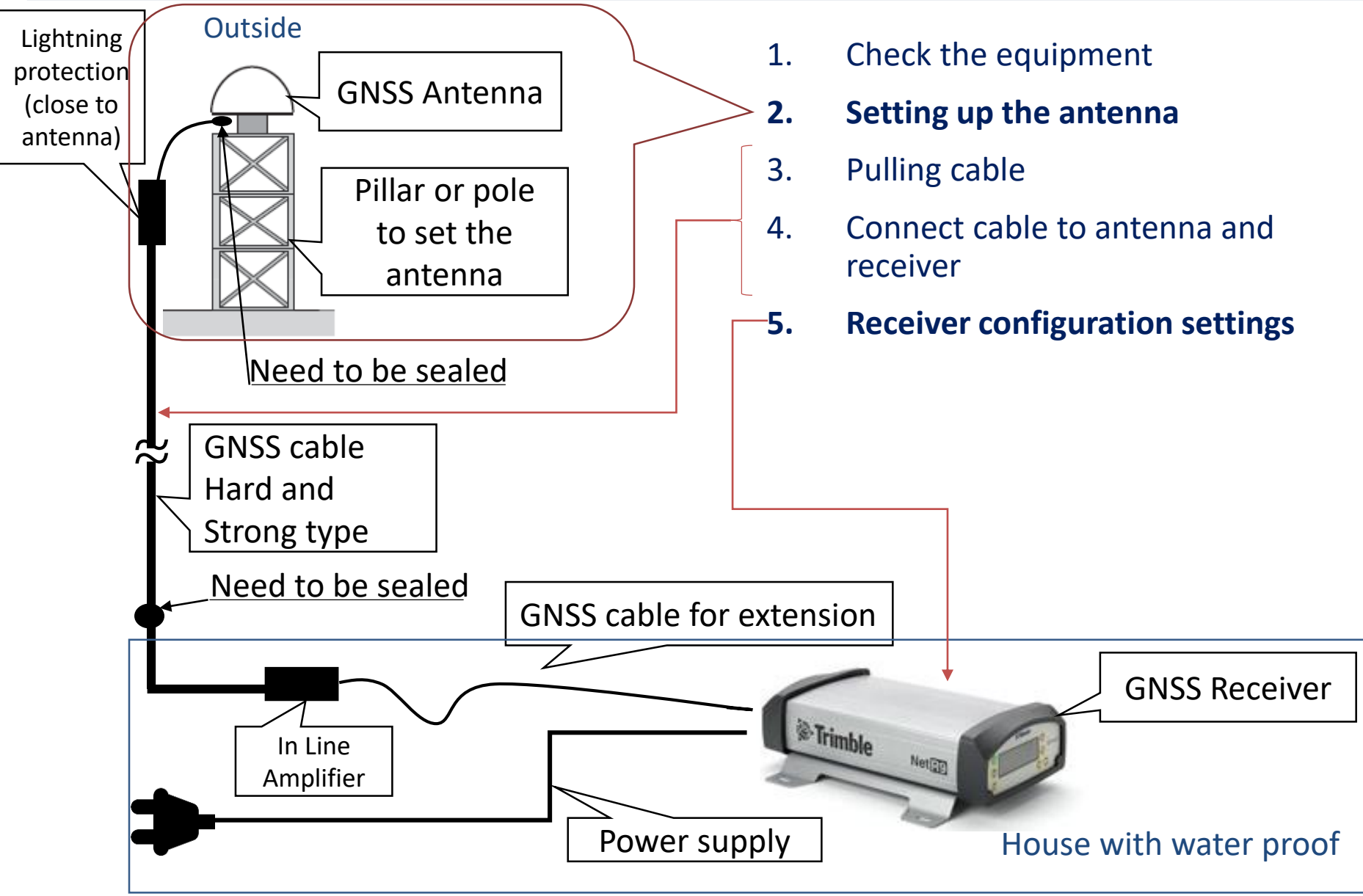
1. Check the equipment
2. **Setting up the antenna**
3. Pulling cable
4. Connect cable to antenna and receiver
5. **Receiver configuration settings**

For the at least one day

6. Obtaining your new base station position

Procedure for setting up a base station

Connecting outline for equipment

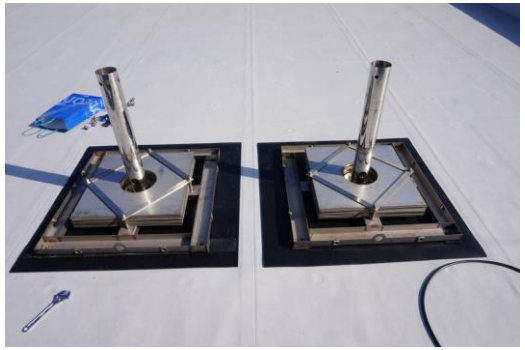


1. Check the equipment
2. **Setting up the antenna**
3. Pulling cable
4. Connect cable to antenna and receiver
5. **Receiver configuration settings**

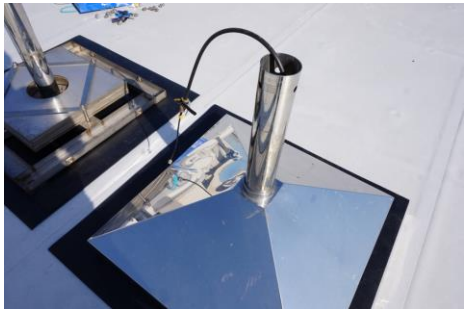
Procedure for setting up a base station

2. Setting up the antenna

Case1. Pillar (Example at TUMSAT)

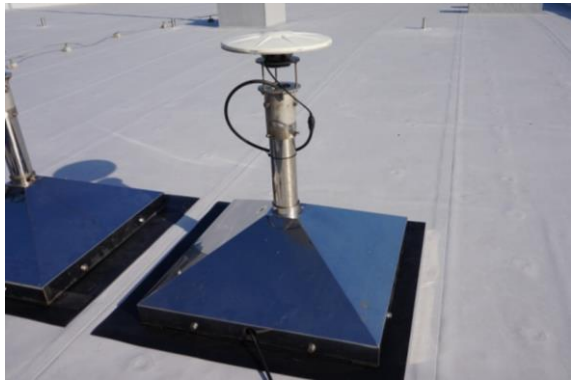


1. Set the basement structure on the roof top of building.
Basement stricture is made by stainless steel and heavy.



2. Pulling cable
For the antenna.
Cable is through the pillar for secure and for the wind.

3. Fixed the antenna
With stainless steel mount for the basement structure.

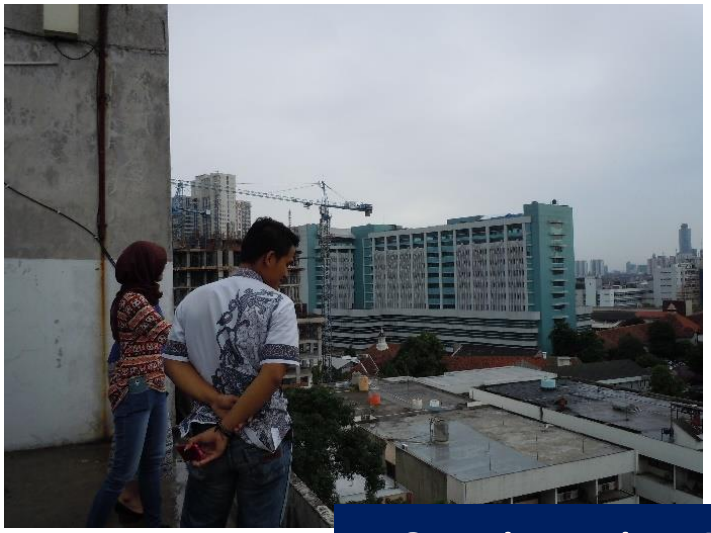


4. Finish for setting antenna.
Then connect to the cable.

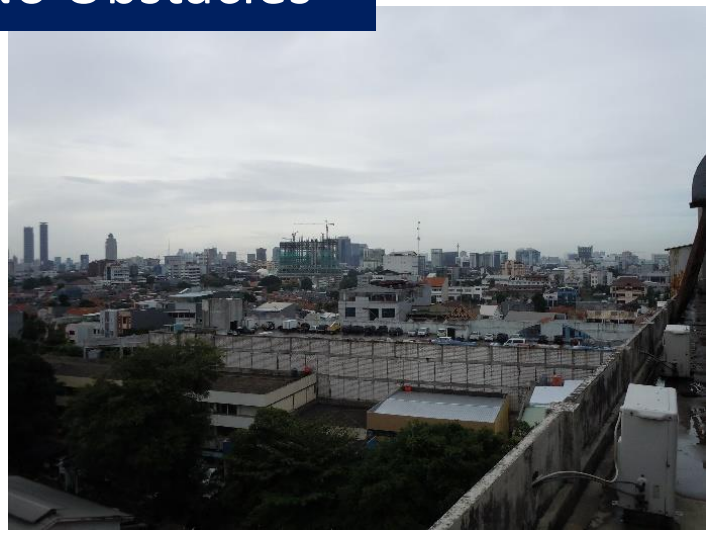
Procedure for setting up a base station

2. Setting up the antenna

Case2. Pole (Example at Universitas Indonesia)



Setting site No Obstacles



Procedure for setting up a base station

2. Setting up the antenna

Case2. Pole (Example at Universitas Indonesia)

1. Set the pole on the roof top of the building.
Fixed to the wall.
Cable is already well fixed on the wall.

2. Set the metal basement for the top of pole.

3. After the setting up the pole, the antenna is connected to the cable .

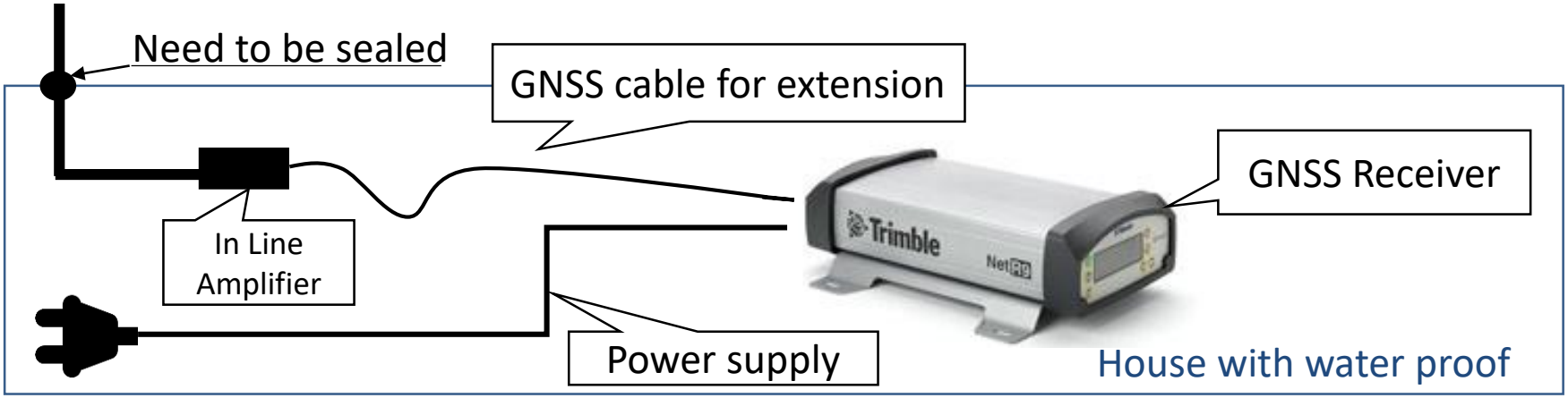
Procedure for setting up a base station

Check point for the setting equipment

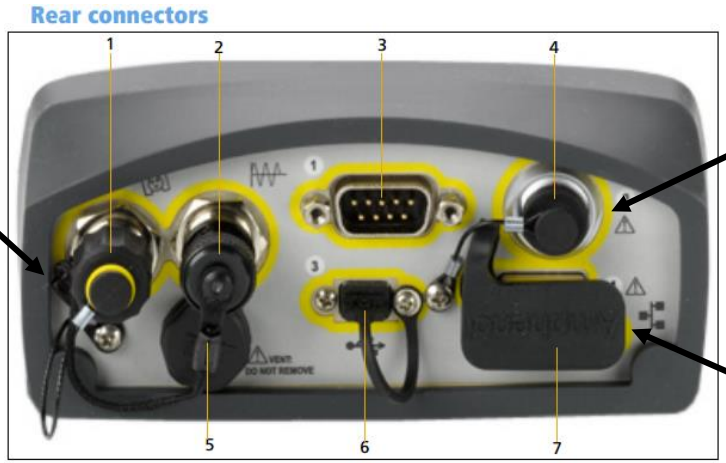
- For the antenna
  - Is the antenna basement installed with stable?
  - Is the antenna installed with horizontally?
- For the outside of cable
  - Is the cable pulled plenty of length? Are there any stress for the cable?
  - Is the cable well fixed against the wind?
  - Are the joint parts sealed against the water proof?
    - Antenna-cable, cable-cable, the point to pull the cable inside the room.
- Other item
  - The In Line Amplifier for the extension cable
  - Lightning protection

Procedure for setting up a base station

5. Receiver configuration settings

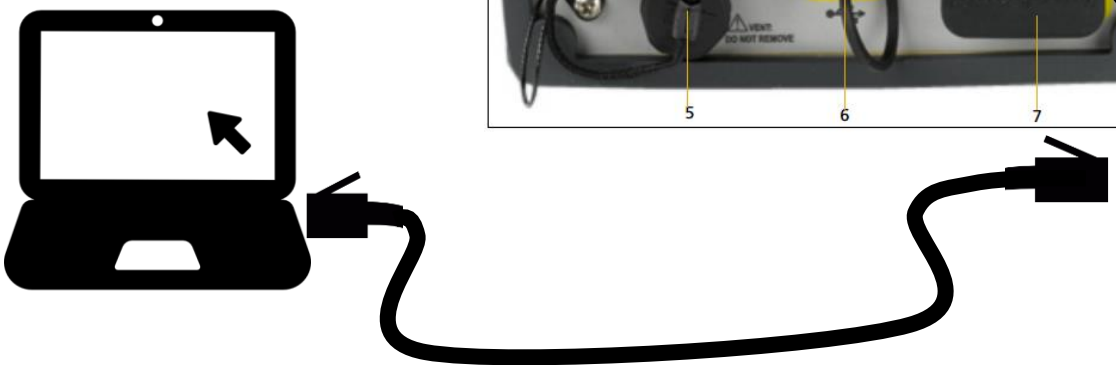


1. Connect to the **antenna cable**



2. Connect to the **Power supply**

3. Connect to the **PC** to configuring the receiver with Ethernet communications



Procedure for setting up a base station

5. Receiver configuration settings

User Guide
http://trl.trimble.com/docushare/dsweb/Get/Document-495804/NetR9_UserGuide_13506.pdf

Button	Name	Function
	Power	Turn on or turn off the receiver. To turn off the receiver, hold down for two seconds.
	Escape	Return to the previous screen or cancel changes you make on a screen.
	Enter	Advance to the next screen or accept changes you make on a screen.
	Up	Move the cursor between multiple fields on a screen, or make changes.
	Down	Move the cursor between multiple fields on a screen, or make changes.
	Left	Move the cursor between characters in an editable field.
	Right	Move the cursor between characters in an editable field. Initiate edit mode for the current field.

- Power on and check the display
  - SV# is the number of received satellite. If antenna is connected successfully, more than 10 satellite will be able to receive.
- Connect to the PC
  - The receiver Ethernet port connects to an Ethernet network, you can configure and monitor the receiver.
  - The default setting of the receiver is to use DHCP. This enables the receiver to automatically obtain an IP address.
  - When a receiver is connected to a network using DHCP, the network assigns the receiver an IP address. To verify this address, open the Home screen and then press

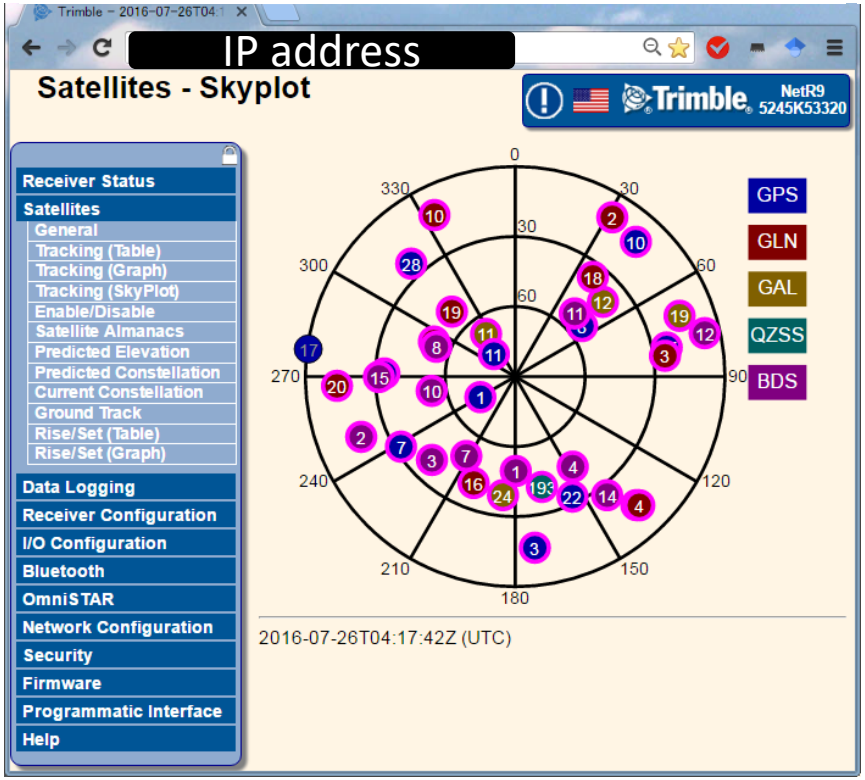
Procedure for setting up a base station

5. Receiver configuration settings

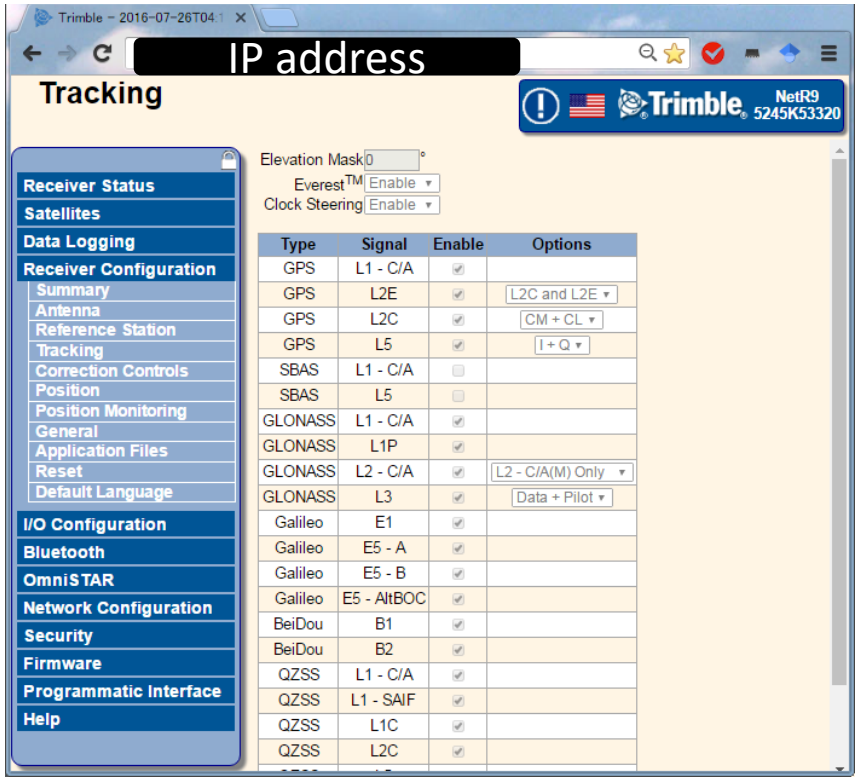
User Guide
http://trl.trimble.com/docushare/dsweb/Get/Document-495804/NetR9_UserGuide_13506.pdf

1. Enter the IP address of the receiver into the address bar then enter
2. Configure the receiver status and monitor

Example 1. Satellites-> Tracking(Skyplot)



Example 2. Recover configuration -> Tracking



Procedure for setting up a base station

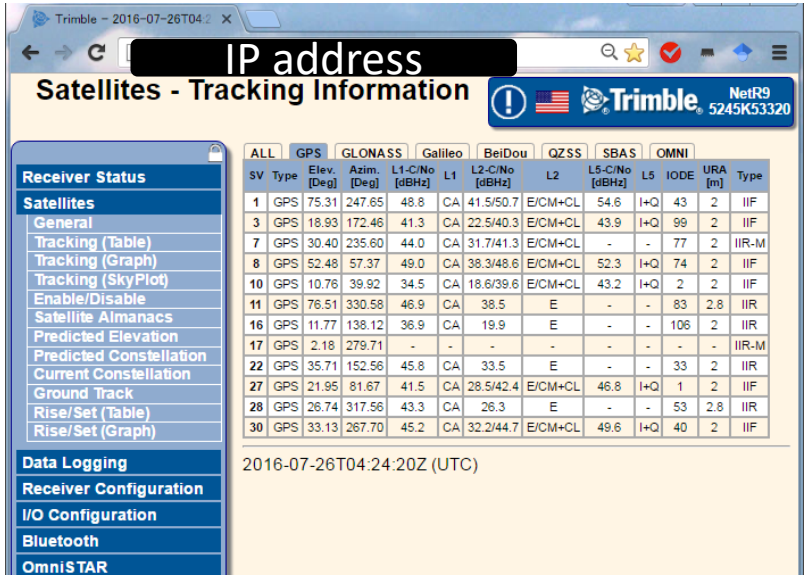
5. Receiver configuration settings

User Guide
http://trl.trimble.com/docushare/dsweb/Get/Document-495804/NetR9_UserGuide_13506.pdf

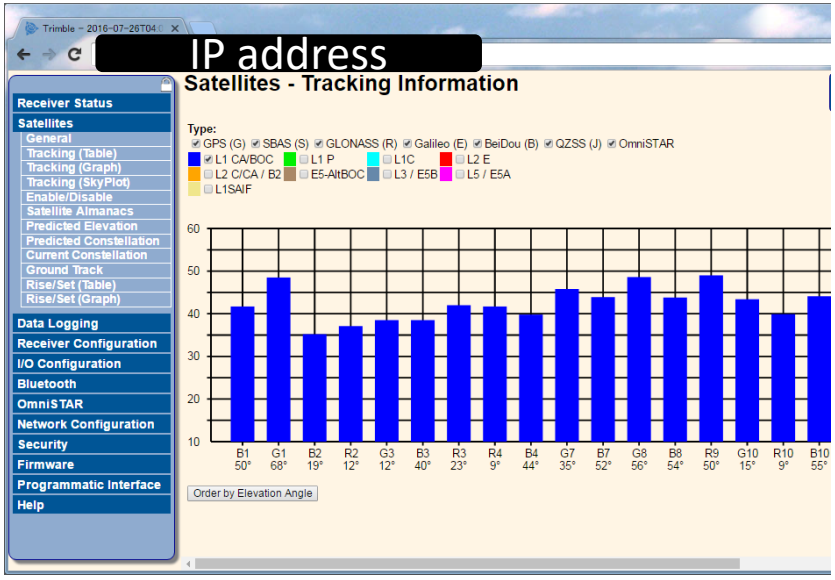
Do not forget to check the signal strength for received satellites

If antenna is connected successfully, the maximum C/N_0(Carrier to Noise ratio) for L1 signal will be approximately 50 dB-Hz

Example of TUMSAT base station
Satellites ->Tracking (Table)



Example of TUMSAT base station
Satellites ->Tracking (Graph)



Procedure for setting up a base station

5. Receiver configuration settings

User Guide
http://trl.trimble.com/docushare/dsweb/Get/Document-495804/NetR9_UserGuide_13506.pdf

- Data Logging
  - For the data logging to obtain a raw data for Post-processes relative positioning.
- I/O Configuration
  - For the Streaming correction messages as for the Base station
  - To setup all receiver outputs and inputs. The receiver can output several format correction messages.

I/O Configuration

Type	Port	Input	Output
TCP/IP	5017	-	RT27(1Hz)
TCP/IP	5018	-	-
UDP	9750	-	-
TCP/IP	14999	-	NMEA-GGA(5 Sec.)
TCP/IP	28001	-	-
TCP/IP	28002	-	-
NTRIP Client	155.63.159.80:28004/VRS_CMRx	CMR	NMEA-GGA(5 Sec.)
NTRIP Server	-	-	-
NTRIP Caster 1	2101	-	-
NTRIP Caster 2	2102	-	-
NTRIP Caster 3	2103	-	-
Serial	Serial 1 (38.4K-8N1)	-	-
Serial	Serial 2 (38.4K-8N1)	-	-
Bluetooth	1	-	-
Bluetooth	2	-	-
Bluetooth	3	-	-
USB	-	-	-

- After Setting -

Checking your base station

It is needed to check the base station whether it is continuously running or not at least monthly.

Following slides(page28, 29) are showing how to check your base station's health briefly.

Current Situation of existing base stations

Signal strength

Satellites - Tracking Information

ALL | GPS | GLONASS | Galileo | BeiDou | QZSS | SBAS | OMNI

SV	Type	Elev. [Deg]	Azim. [Deg]	L1-C/No [dBHz]	L1	L2-C/No [dBHz]	L2	L5-C/No [dBHz]	L5	IODE	URA [m]	Type
2	GPS	23.11	308.28	40.2	CA	25.6	E	-	-	84	2	IIR
5	GPS	30.00	236.64	46.7	CA	31.2/42.6	E/CM+CL	-	-	105	2	IIR-M
6	GPS	38.33	358.63	46.5	CA	36.7/45.8	E/CM+CL	49.7	I+Q	58	2	IIF
9	GPS	35.42	76.72	45.8	CA	35.4/46.3	E/CM+CL	49.2	I+Q	73	2	IIF
12	GPS	16.32	311.14	40.7	CA	24.0/39.0	E/CM+CL	-	-	30	2	IIR-M
17	GPS	60.83	85.36	50.2	CA	40.0/47.2	E/CM+CL	-	-	79	2.8	IIR-M
19	GPS	63.99	34.49	49.2	CA	40.6	E	-	-	35	2	IIR
23	GPS	14.48	53.66	43.2	CA	22.8	E	-	-	84	2	IIR
28	GPS	22.84	172.32	41.3	CA	22.3	E	-	-	9	2	IIR

2017-07-31T07:49:47Z (UTC)

Satellites - Tracking Information

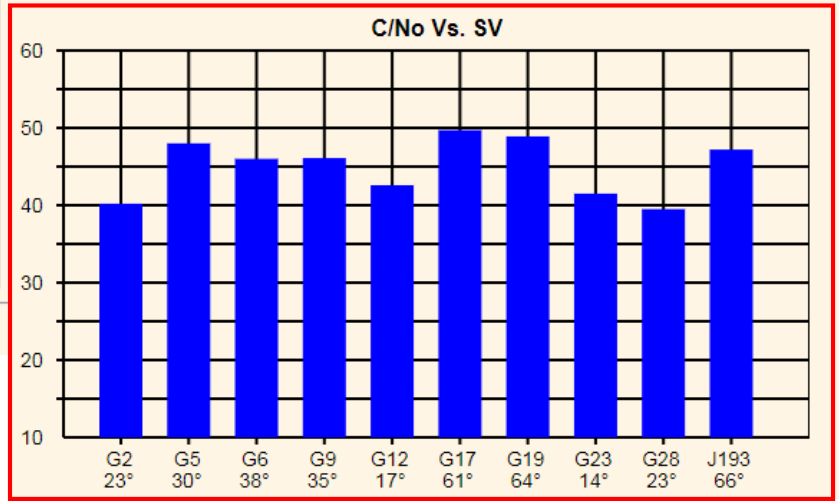
Type:

GPS (G) SBAS (S) GLONASS (R) Galileo (E) BeiDou (B) QZSS

L1 CA/BOC L1 P L1C L2 E

L2 C/CA / B2 E5-AltBOC L3 / E5B L5 / E5A

L1SAIF



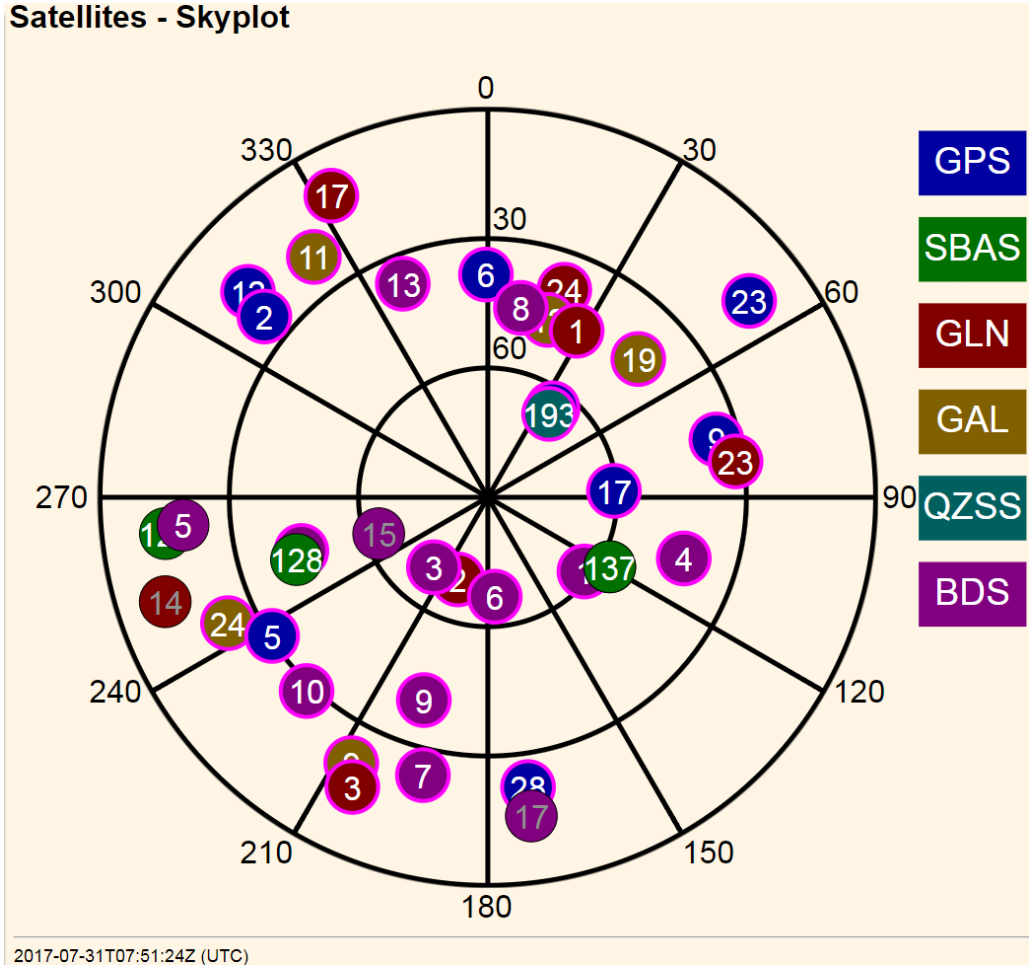
GPS

We think the most important part of base station's health is signal strength of each satellite as mentioned in 1st chapter.

※35-50 dBHz is needed on base station (within a red frame).

Current Situation of existing base stations

Skyplot and Data volume



Please confirm whether satellites look normal.

Data Volume

170701: 45.83MB	170717: 46.76MB
170702: 45.56MB	170718: 46.85MB
170703: 46.50MB	170719: 45.32MB
170704: 46.85MB	170720: 45.89MB
170705: 46.40MB	170721: 46.45MB
170706: 45.68MB	170722: 45.93MB
170707: 46.29MB	170723: 45.63MB
170718: 46.85MB	170724: 46.20MB
170709: 43.83MB	170725: 45.57MB
170710: 45.60MB	170726: 45.14MB
170711: 46.01MB	170727: 46.04MB
170712: 45.37MB	170728: 45.81MB
170713: 46.11MB	170729: 45.36MB
170714: 46.37MB	170730: 45.93MB
170715: 45.78MB	170731:
170716: 44.92MB	

※Data is good overall in this example.

Recent some problems of existing base stations

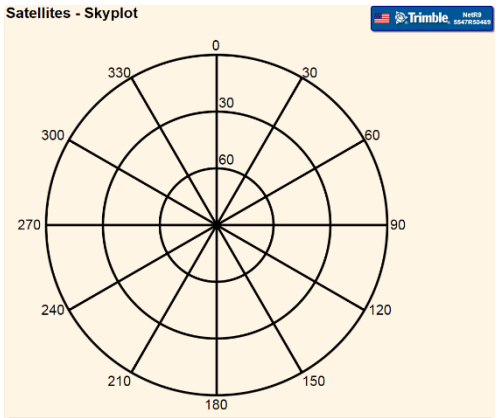
What is the base station's problem?

We need to consider about the problem of your running base station which can be occurred.

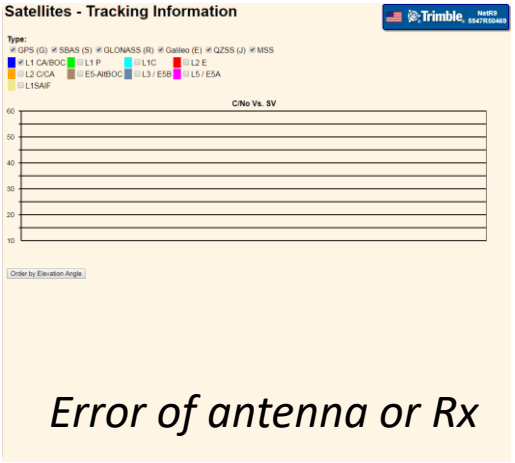
For example,

- Error of the connector
- Communication of global IP
- Interference by other radio waves

etc…

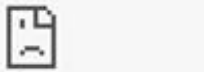


No satellites



Error of antenna or Rx

Error of communication



You cannot access this site.
このサイトにアクセスできません

[redacted] からの応答時間が長すぎます。

次をお試しください:

- 接続を確認する
- プロキシとファイアウォールを確認する
- Windows ネットワーク診断ツールを実行する

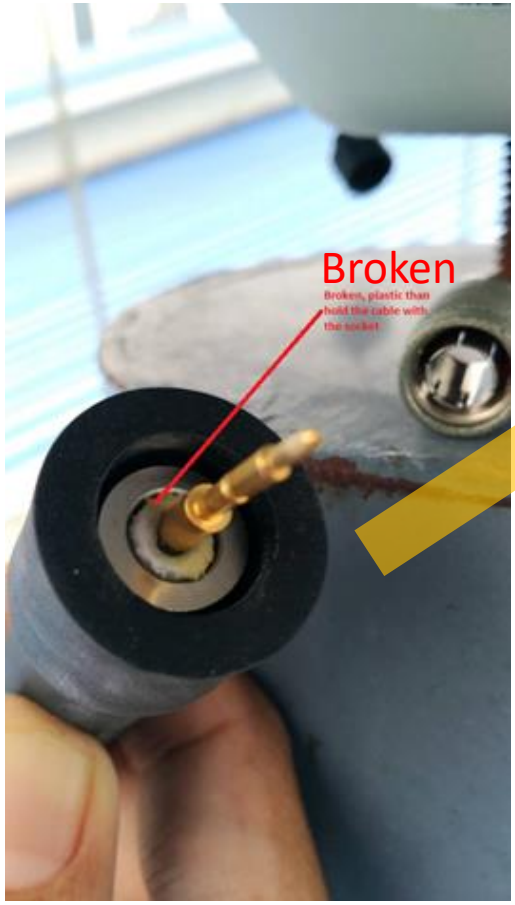
ERR_CONNECTION_TIMED_OUT

再読み込み

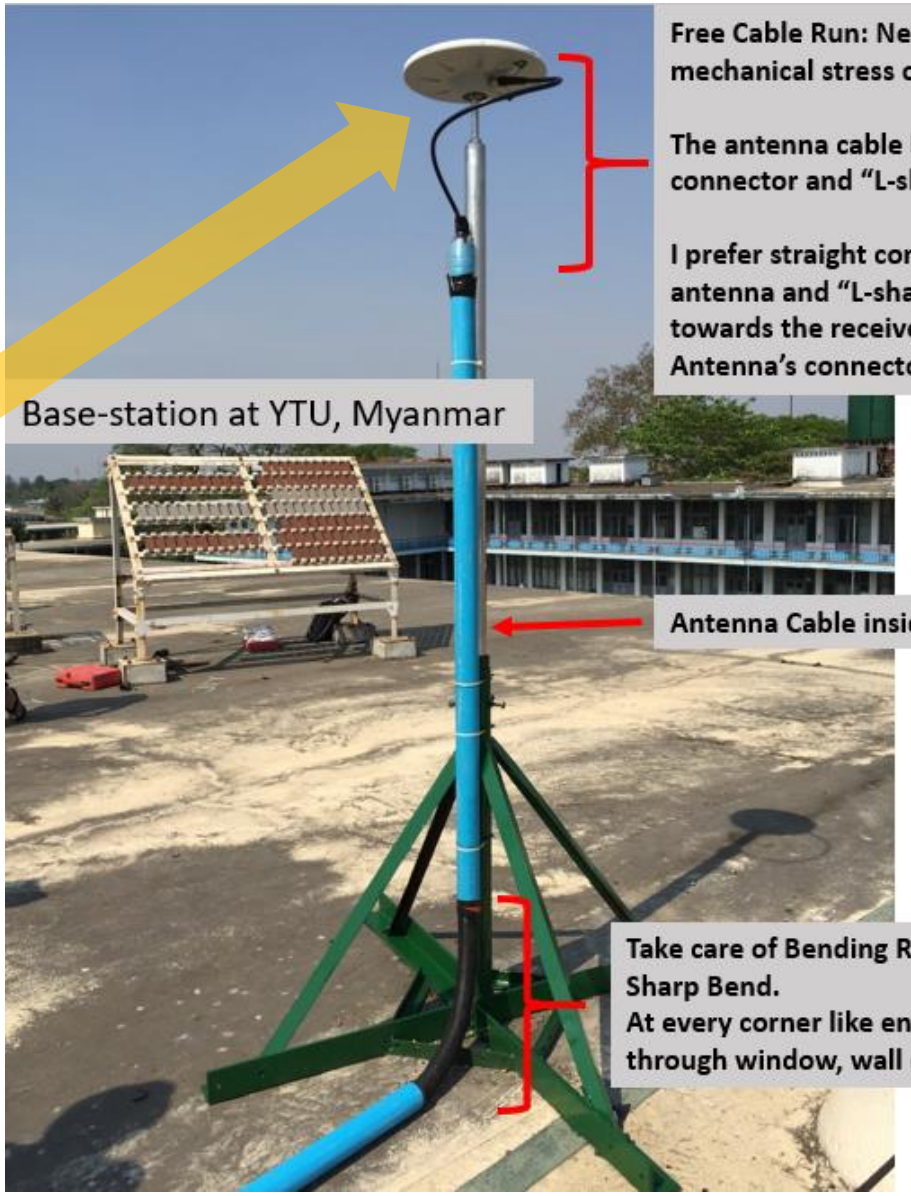
Reload

Recent some problems of existing base stations

One recent example of MJIIT (from September on 2017)



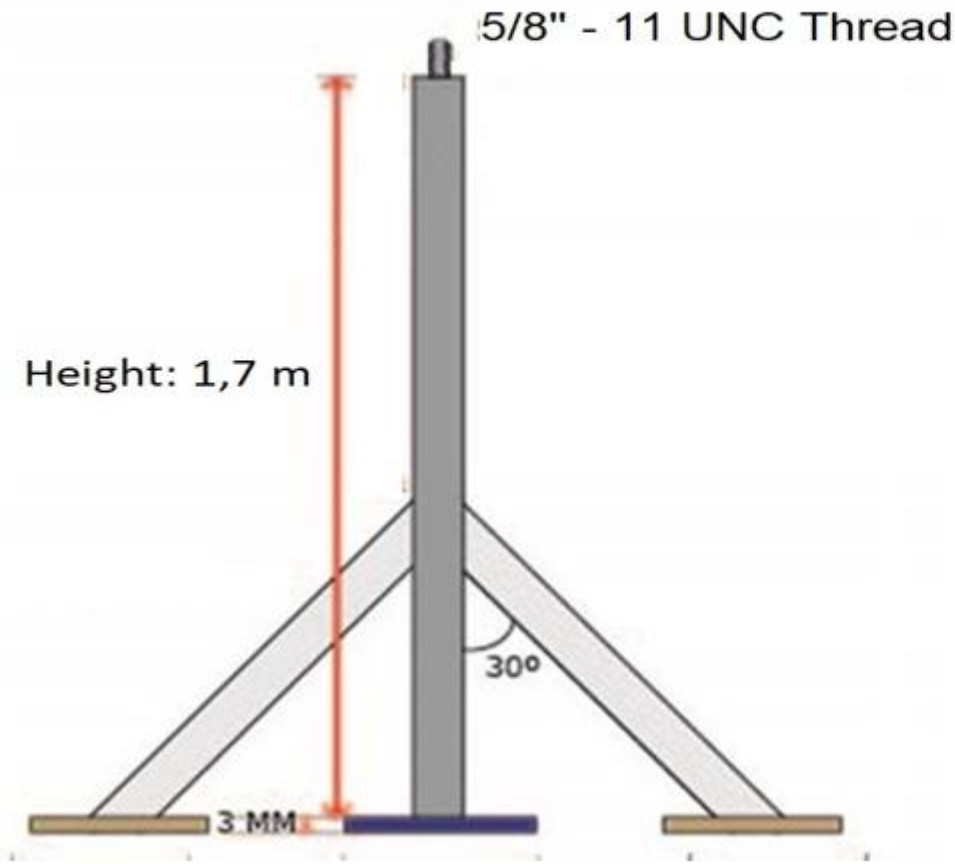
※If the antenna cable is broken, please prepare this equipment like the right picture. (Next slide shows actual setting)



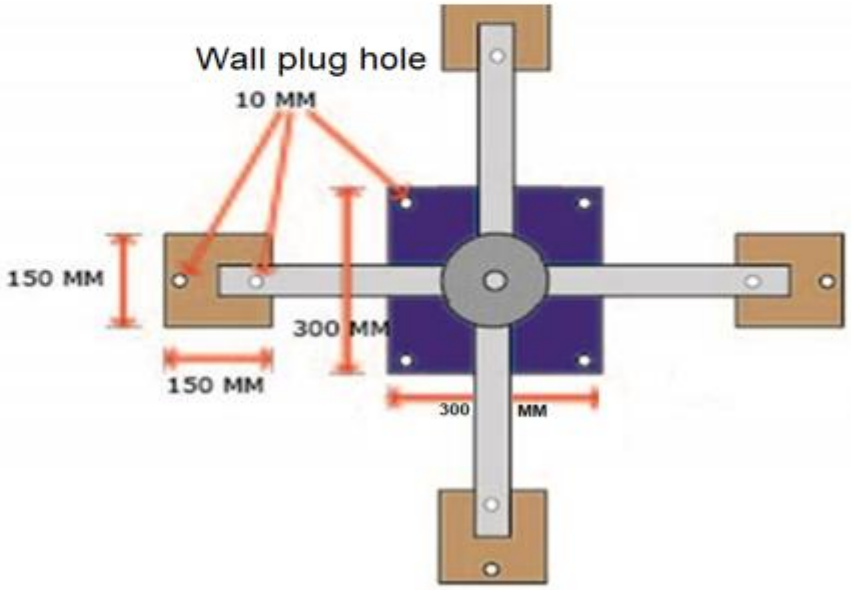
Recent some problems of existing base stations

Actual Setting (one example)

GNSS Base-station at IU



Top View



Recent some problems of existing base stations

Actual Setting (one example)

Place for installing the GNSS antenna

The base-station for antenna will be the same as the bellowing image.

Place for storing GNSS receiver

※ *Request for the participants of Asian base stations*

We think we need to add new information to this base station manual more, so please share some information about your base station to us to brush up this guide for installing base station.

And if your base station has any problems, let’s share.

Thank you.

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