

3rd Asia Oceania Regional Workshop on GNSS

QZSS Demonstration: RTKLIB



Tokyo Univ. of Marine Science and Technology

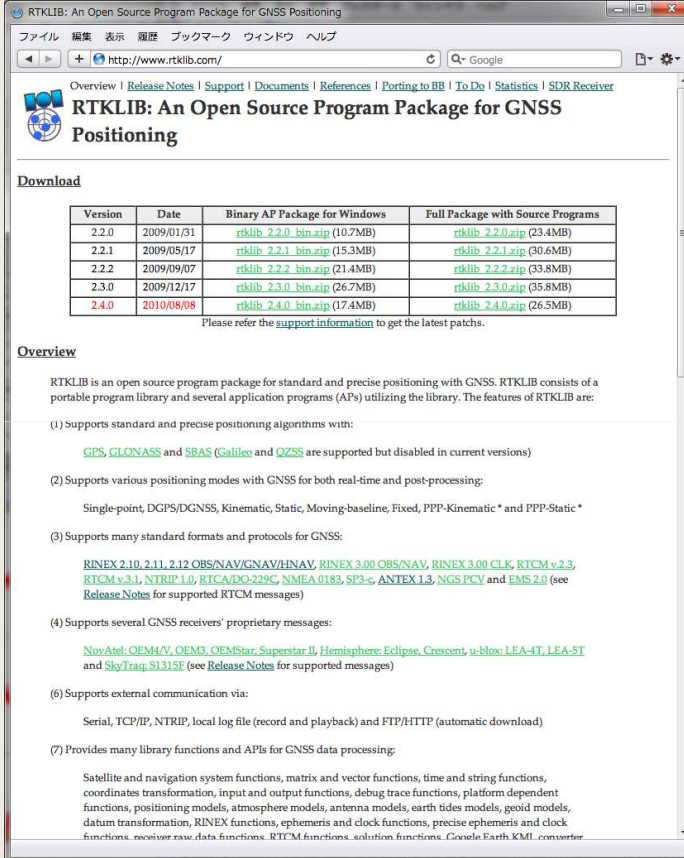
Tomoji TAKASU

November 2-3 2011, @Jeju, Korea

What is RTKLIB?

RTKLIB

- **An Open Source Program Package for GNSS Positioning**
 - Distributed under **GPLv3**
 - Has been developed by the author since 2006
- **Portable Library + useful positioning APs**
 - GUI APs on Windows
 - CUI APs on Linux etc ...



The screenshot shows the RTKLIB website with the following content:

Download

Version	Date	Binary AP Package for Windows	Full Package with Source Programs
2.2.0	2009/01/31	rtklib_2.2.0_bin.zip (10.7MB)	rtklib_2.2.0.zip (23.4MB)
2.2.1	2009/05/17	rtklib_2.2.1_bin.zip (15.3MB)	rtklib_2.2.1.zip (30.6MB)
2.2.2	2009/09/07	rtklib_2.2.2_bin.zip (21.4MB)	rtklib_2.2.2.zip (33.8MB)
2.3.0	2009/12/17	rtklib_2.3.0_bin.zip (26.7MB)	rtklib_2.3.0.zip (35.8MB)
2.4.0	2010/08/08	rtklib_2.4.0_bin.zip (17.4MB)	rtklib_2.4.0.zip (26.5MB)

Please refer the [support information](#) to get the latest patches.

Overview

RTKLIB is an open source program package for standard and precise positioning with GNSS. RTKLIB consists of a portable program library and several application programs (APs) utilizing the library. The features of RTKLIB are:

- (1) Supports standard and precise positioning algorithms with:
[GPS](#), [GLONASS](#) and [SBAS \(Galileo and QZSS\)](#) are supported but disabled in current versions
- (2) Supports various positioning modes with GNSS for both real-time and post-processing:
Single-point, DGPS/DGNSS, Kinematic, Static, Moving-baseline, Fixed, PPP-Kinematic* and PPP-Static*
- (3) Supports many standard formats and protocols for GNSS:
[RINEX 2.10.2.11](#), [2.12 OBS/NAV/GNAV/HNAV](#), [RINEX 3.00 OBS/NAV](#), [RINEX 3.00 CLK](#), [RTCM v.2.3](#), [RTCM v.3.1](#), [NTRIP 1.0](#), [RTCA/DO-229C](#), [NMEA 0183](#), [SP3](#), [ANTEX 1.3](#), [NGS PCV](#) and [IMS 2.0](#) (see [Release Notes](#) for supported RTCM messages)
- (4) Supports several GNSS receivers' proprietary messages:
[NovAtel OEM4/V](#), [OEM3](#), [OEMStar](#), [Superstar II](#), [Hemisphere Eclipse](#), [Crescent u-blox](#), [LEA-4T](#), [LEA-5T](#) and [SkyTraq 51315f](#) (see [Release Notes](#) for supported messages)
- (6) Supports external communication via:
Serial, TCP/IP, NTRIP, local log file (record and playback) and FTP/HTTP (automatic download)
- (7) Provides many library functions and APIs for GNSS data processing:
Satellite and navigation system functions, matrix and vector functions, time and string functions, coordinates transformation, input and output functions, debug trace functions, platform dependent functions, positioning models, atmosphere models, antenna models, earth tides models, geoid models, datum transformation, RINEX functions, ephemeris and clock functions, precise ephemeris and clock functions, receiver raw data functions, RTCM functions, solution functions, Google Earth KML converter

<http://www.rtklib.com>

History of RTKLIB

2006/4	v.0.0.0	First version for RTK+C program lecture
2007/1	v.1.0.0	Simple post processing AP
2008/7	v.2.1.0	Add APs, support medium-range
2009/1	v.2.2.0	Add real-time AP, support NTRIP, start to distribute as Open Source S/W
2009/5	v.2.2.1	Support RTCM, NRTK, many receivers
2009/12	v.2.3.0	Support GLONASS, several receivers
2010/8	v.2.4.0	Support PPP, long-range-RTK
2011/6	v.2.4.1	Support QZSS , JAVAD receiver
2012/3 (?)	v.2.4.2	Support Galileo
2012/6 (?)	v.2.5.0	SDR-receiver Front-End

Download Statistics

version	2.2.0	2.2.1	2.2.2	2.3.0	2.4.0
2009/1-4	733	-	-	-	-
2009/5	51	120	-	-	-
2009/6	31	141	-	-	-
2009/7	28	110	-	-	-
2009/8	43	168	-	-	-
2009/9	30	45	211	-	-
2009/10	25	18	190	-	-
2009/11	65	31	987	-	-
2009/12	46	22	218	1380	-
2010/01	47	15	25	471	-
2010/02	38	16	23	324	-
2010/03	40	10	13	1556	-
2010/04	30	9	17	775	-
2010/05	33	12	15	1007	-
2010/06	34	5	13	860	-
2010/07	28	2	3	916	-
2010/08	63	20	26	118	1245
2010/09	51	9	10	222	1356
2010/10	58	11	13	490	382
2010/11	62	20	39	48	484
2010/12	44	12	12	32	974
2011/01	43	18	12	42	400
2011/02	65	20	13	29	441
2011/03	53	9	10	21	861
Total	1741	843	1837	8291	6143

RTKLIB Features

- **Standard and precise positioning algorithms with:**
 - GPS, GLONASS, SBAS, QZSS, (Galileo)
- **Positioning mode for real-time and post-processing:**
 - Single, SBAS, DGPS, RTK, Static, Moving-base and PPP
- **Supports many formats/protocols and receivers:**
 - RINEX 2.x/3.0, RTCM v.2/v.3, NTRIP 1.0, NMEA0183, SP3, RINEX CLK, ANTEX, NGS PCV, IONEX, EMS, ...
 - NovAtel, Hemisphere, u-blox, SkyTraq, JAVAD, Furuno, ...
- **Supports real-time communication via:**
 - Serial, TCP/IP, NTRIP and file streams

Supported Receiver Formats

Format	Data Message Types							
	GPS/QZSS Raw Data	GLONASS Raw Meas	GPS/QZSS Ephemeris	GLONASS Ephemeris	ION/UTC Parameters	Antenna Info	SBAS Messages	Others
RTCM v.2.3	Type 18, 19	Type 18, 19	Type 17	-	-	Type 3, 22	-	Type 1, 9, 14, 16
RTCM v.3.1	Type 1002, 1004	Type 1010, 1012	Type 1019	Type 1020	-	Type 1005, 1006, 1007, 1008, 1033	-	SSR corrections
NovAtel OEM4/V, OEMStar	RANGEB, RANGECMPB	RANGEB, RANGECMPB	RAWEPHEMB	GLO-EPHEMERISB	IONUTCB	-	RAWWAAS-FRAMEB	-
NovAtel OEM3	RGEB, RGED	-	REPB	-	IONB, UTCB	-	FRMB	-
NovAtel Superstar II	ID#23	-	ID#22	-	-	-	ID#67	ID#20, #21
u-blox LEA-4T, LEA-5T	UBX RXM-RAW	-	UBX RXM-SFRB	-	UBX RXM-SFRB	-	UBX RXM-SFRB	-
Hemisphere Crescent, Eclipse	bin 96	-	bin 95	-	bin 94	-	bin 80	-
SkyTraq S1315F	msg 0xDD (221)	-	msg 0xE0 (224)	-	msg 0xE0 (224)	-	-	msg 0xDC (220)
JAVAD (GRIL/GREIS)	[R*],[r*],[*R], [R*],[r*],[*R], [*r],[P*],[p*], [*r],[P*],[p*], [*p],[D*],[*d],[*p],[D*],[*d], [E*],[*E],[F*] [E*],[*E],[F*]	-	[GE],[GD], [gd]	[NE],[LD]	[IO],[UO], [GD]	-	[WD]	[~],[::],[RD], [SI],[NN],[TC], QZSS Data, Galileo Data
Furuno GW10 II	msg 0x08	-	msg 0x24	-	msg 0x26	-	msg 0x03	msg 0x20

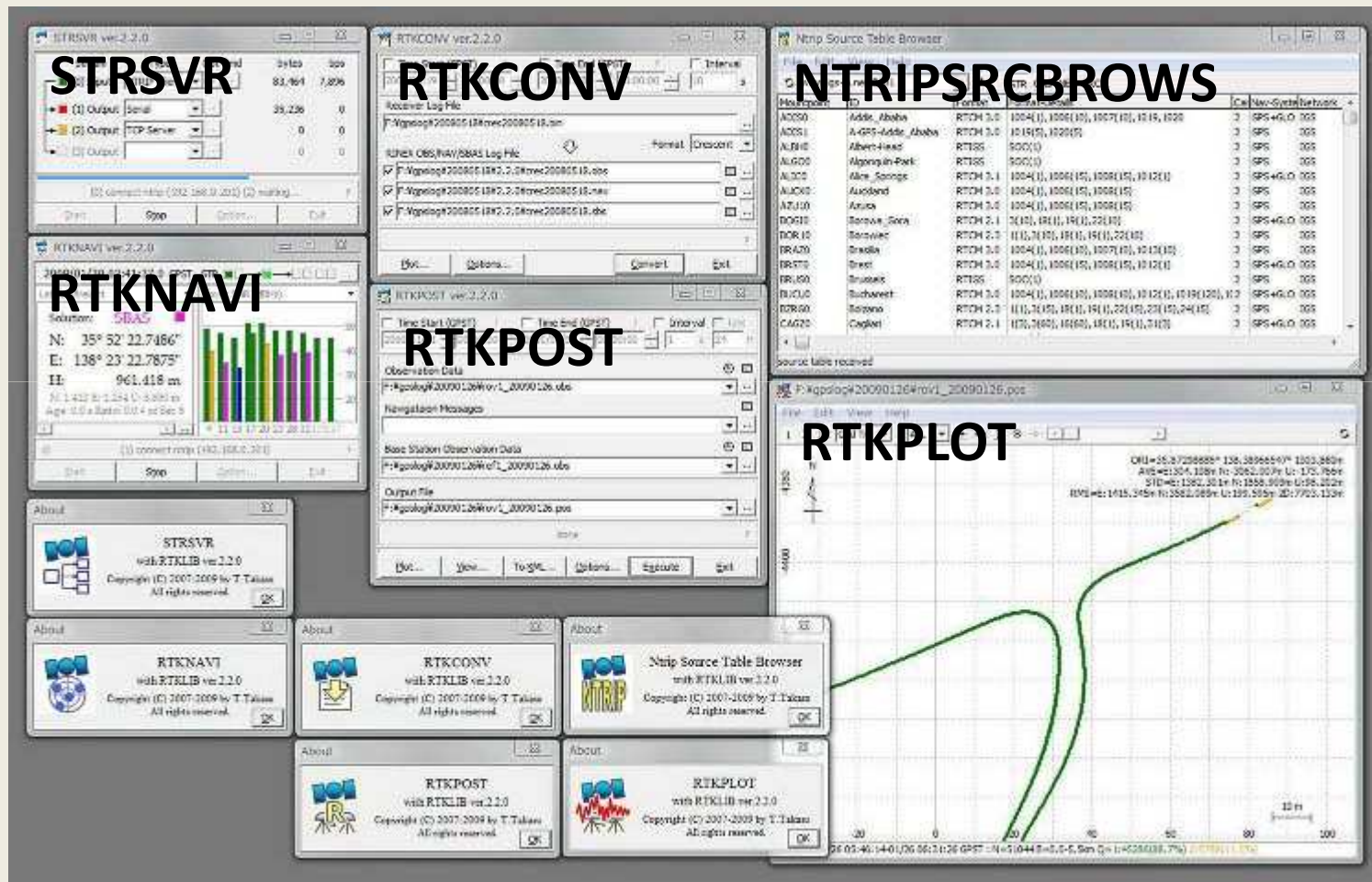
Supported RINEX File Types

RINEX Version	Observation Data (OBS)							MET
	GPS	GLO	GAL	QZSS	COMP	IRNSS	SBAS	
2.10,11,12	O	O	O	O*	-	-	O	-
3.00,01	O	O	O	O*	-	-	O	-

RINEX Version	Navigation Messages (NAV)							CLK
	GPS	GLO	GAL	QZSS	COMP	IRNSS	SBAS	
2.10,11,12	N	G	L*	J*	-	-	H	-
3.00,01	N	N	N	N*	-	-	N	C**

* extension, ** read only, - not supported

GUI APs on Windows



CUI APIs on Linux or Others

- **RNX2RTKP (rnx2rtkp)**
Post-processing Positioning
- **RTKRCV (rtkrvc)**
Real-time Positioning
- **CONVBIN (convbin)**
RINEX Translator
- **STR2STR (str2str)**
Stream Server
- **POS2KML (pos2kml)**
Google Earth Converter

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RTKLIB ver. 2.4.1 Manual

A.2 RNX2RTKP

SYNOPSIS
rnx2rtkp [option ...] file file [...]

DESCRIPTION
Read RINEX OBS/NAV/GNAV/HNAV/CLK, SP3, SBAS message log files and compute receiver
(rover) positions and output position solutions. The first RINEX OBS file shall
contain receiver (rover) observations. For the relative mode, the second RINEX OBS
file shall contain reference (base station) receiver observations. At least one
RINEX NAV/GNAV/HNAV file shall be included in input files. To use SP3 precise
ephemeris, specify the path in the files. The extension of the SP3 file shall be .sp3
or .eph. All of the input file paths can include wild-cards (*). To avoid command*,
line deployment of wild-cards, use "." for paths with wild-cards. Command line
options are as follows ([ ]:default). With -k option, the processing options are
input from the configuration file. In this case, command line options precede
options in the configuration file. For configuration file, refer B.4.

OPTIONS
-h          print help
-k file     input options from configuration file [off]
-o output  output file [stdout]
-ts ds ts  start day/time (ds=y/m/d ts=hh:mm:ss) [obs start time]
-te de te  end day/time (de=y/m/d te=hh:mm:ss) [obs end time]
-ti tint  time interval (sec) [all]
-p mode    mode (0:single, 1:dgps, 2:kinematic, 3:static, 4:moving-base
           5:fixed, 6:ppp-kinematic, 7:ppp-static) [2]
-m mask    elevation mask angle (deg) [15]
-f freq    number of frequencies for relative mode (1:L1, 2:L1+L2, 3:L1+L2+L5) [2]
-v thres   validation threshold for integer ambiguity (0.0:no AR) [3.0]
-b         backward solutions [off]
-c         forward/backward combined solutions [off]
-i         instantaneous integer ambiguity resolution [off]
-h         fix and hold for integer ambiguity resolution [off]
-e         output x/y/z-ecef position [latitude/longitude/height]

59
```

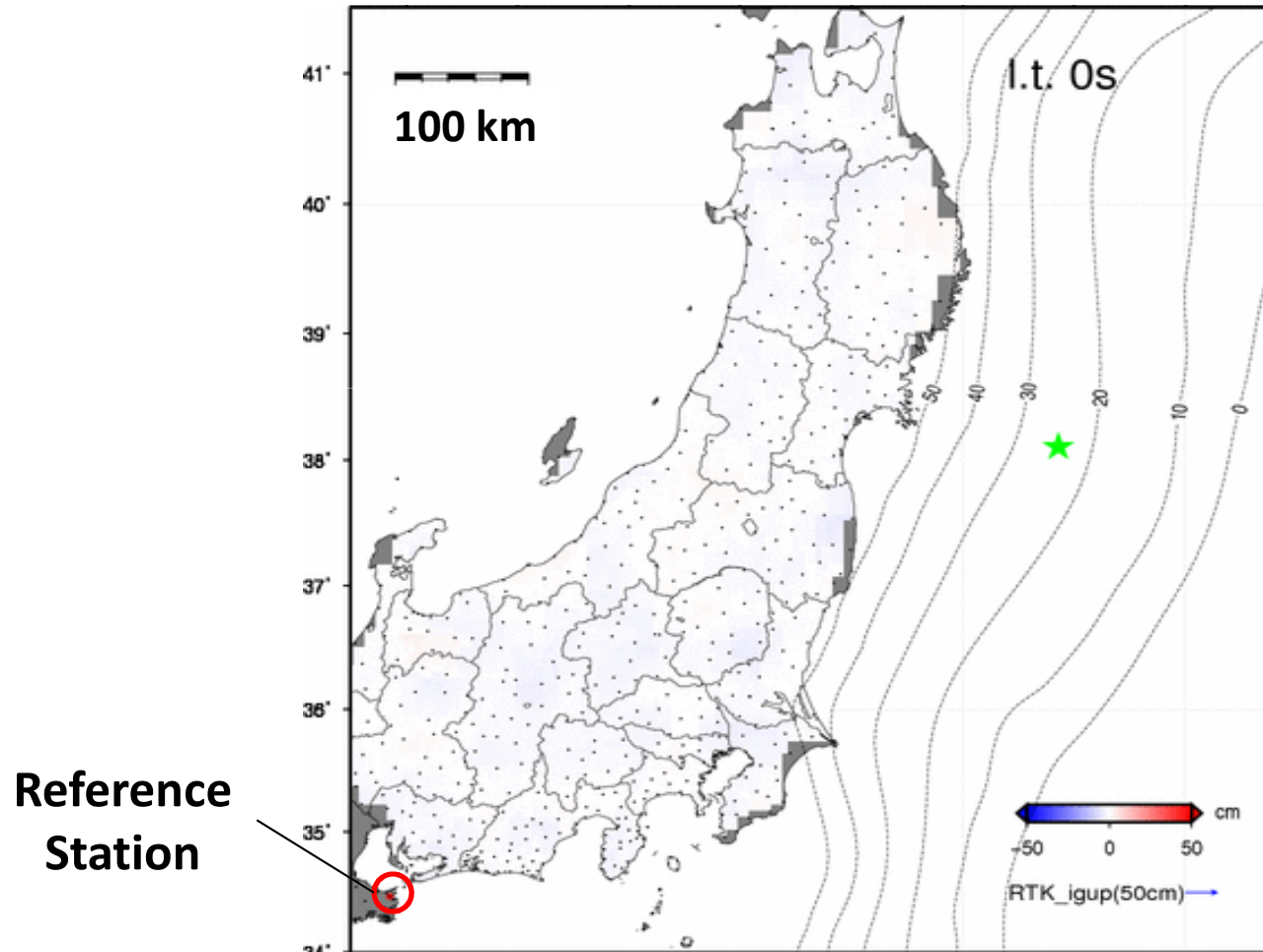
CUI Command Reference

Unique Features by RTKLIB:

- Long-Baseline-RTK**
- Real-time PPP**

Long-Baseline-RTK

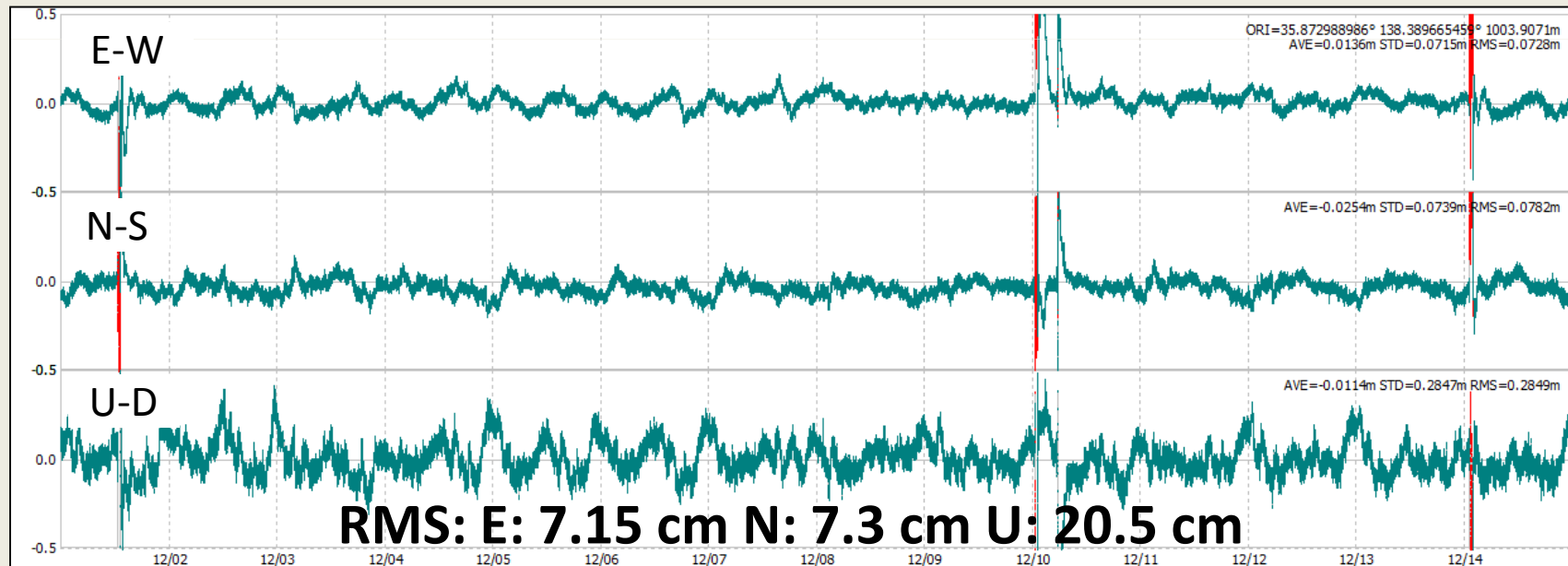
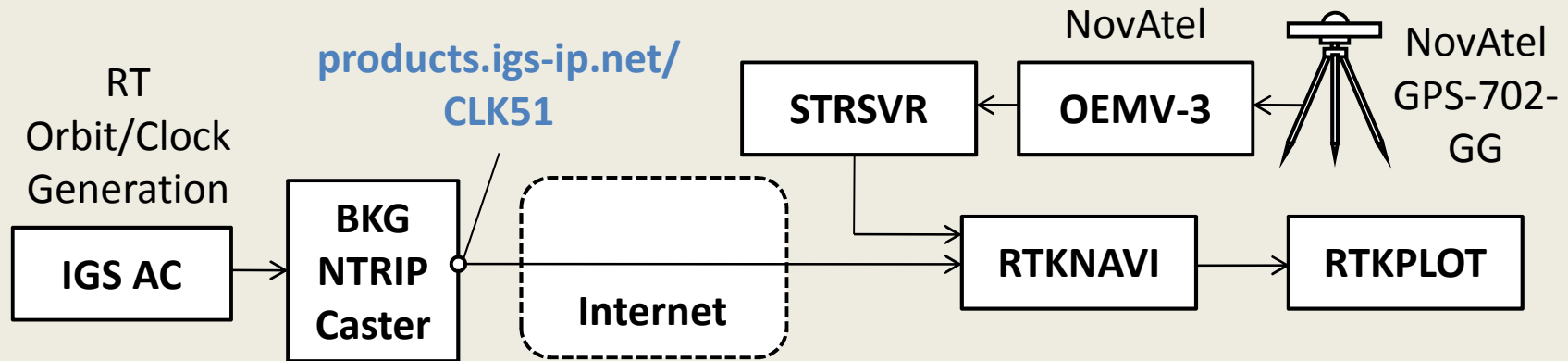
2011-3-11 15:45 JST Tohoku Earthquake (Mw=9.0)



Preliminary results of rapid determination of coseismic fault model using RTK-GPS

T.Kobayashi, Y.Ohta and S.Miura, JPGU, 2011

Real-time PPP

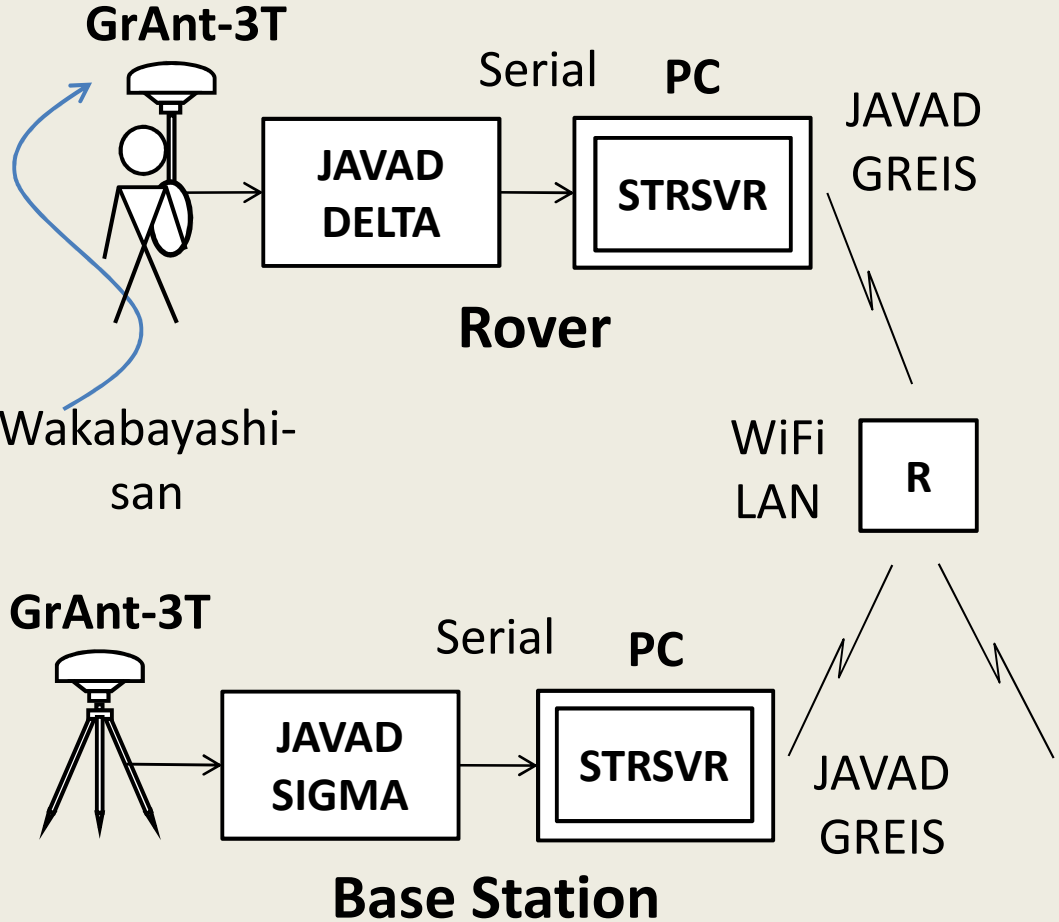


RMS: E: 7.15 cm N: 7.3 cm U: 20.5 cm

2010/12/1 0:00-12/14 23:59 GPST, 1 Hz, RTKLIB v.2.4.0

Multi-GNSS RTK Demo with QZSS

Demo Configuration



PC

