Federal Agency for Cartography and Geodesy

The new version 2.12 of BKG Ntrip Client (BNC)

A. Stürze, L. Mervart*, G. Weber, A. Rülke, E. Wiesensarter, P. Neumaier

Introduction

The BKG Ntrip Client (BNC) is a program for simultaneously retrieving, decoding, converting, processing or analyzing real-time GNSS data streams applying the 'Networked Transport of RTCM via Internet Protocol' (Ntrip) standard. It comes with some post processing functionality as well. BNC's application areas are for example:

- **Decoding** of RTCM or RTNET (BNC's exchange format for SSR data) streams
- **RINEX** and **SP3 or ASCII** file input and output
- **Encoding** and **Upload** of State Space Representation (SSR) and ephemeris messages
- **PPP** (Precise Point Positioning)
- **Combining/merging** SSR or ephemeris messages from various real-time sources
- RINEX file based **Quality Check**

The poster highlights BNC features, which are new or extended in version 2.12 and beneficial to IAG institutions and services such as IGS/RT-IGS and to the interested public in general. This includes for example:

- Support of new GNSS signals, such as from BeiDou, Galileo, and QZSS and SBAS
- Simultaneous multi-station Precise Point Positioning
- Comparison of satellite orbit files in SP3 format
- Broadcast Ephemeris Data Check
- Full support of all BNC options via Command-line User Interface (CUI)

Multi-GNSS Support

BNC is permanently completed to finally support all existing GNSS systems throughout all features of the program. BNC 2.12 supports new GNSS observations and products from the BeiDou, Galileo and QZSS systems, as well as from modernized GPS and GLONASS satellites and any space-based augmentation systems (SBAS) as follows:

Table 1: Multi-GNSS Support in BNC 2.12; 'X': implemented; '(X)': under development; '*': proposed.

GNSS	RTCM Message #	RTCM Decoding	RINEX ASCII In- & Out put, QC	RTCM Encoding & Upload	PPP	Combination
Observations						
GPS	1001 – 1004	X	X		X	
	1071 – 1077	X	X		X	
GLONASS	1009 - 1012	X	X		X	
	1081 – 1087	X	X		X	
Galileo	1091 – 1097	X	X		X	
SBAS	1101* – 1007*	X	X			
QZSS	1111 – 1117	X	X			
BDS	1121* – 1127*	X	X		X	
Ephemerides						
GPS	1019	X	X	X	X	X
GLONASS	1020	X	X	X	X	X
Galileo	1045	X	X	X	X	
	1046*	X	X	X	X	
SBAS	1043*	X	X	X		
QZSS	1044	X	X	X		
BDS	63*	X	X	X	X	
SSR Orbits, Clocks, Combined Orbits and Clocks						
GPS	1057, 1058	X	X	X	X	X
	1060	X	X	X	X	X
GLONASS	1063, 1064	X	X	X	X	X
	1066	X	X	X	X	X
Galileo	1240*, 1241*	X	X	X	X	
	1243*	X	X	X	X	
SBAS	1246*, 1247*	X	X	X		
	1249*	X	X	X		
QZSS	1252*, 1253*	X	X	X		
	1255*	X	X	X		
BDS	1258*, 1259*	X	X	X	X	
	1261*	x	X	X	X	
SSR Code Biases, Phase Biases						
GPS	1059	X	X	X	X	
	1265*	X	X	X	(X)	
GLONASS	1065	X	X	X	X	
	1266*	X	X	X	(X)	
Galileo	1242*	X	X	X	X	
	1267*	X	X	X	(X)	
SBAS	1248*	X	X	X		
	1268*	X	X	X		
QZSS	1254*	X	X	X		
	1269*	X	X	X		
BDS	1260*	X	X	X	X	
	1270*	X	X	X	(X)	
SSR VTEC						
GNSS	1264*	X	X	X	(X)	

Broadcast Ephemeris Check

All Broadcast Ephemeris parameters pass through a plausibility check in BNC, which allows to ignore incorrect or outdated ephemeris data when necessary. Implemented are checks regarding the allowed age of the data sets, the plausibility of the satellite's radial distance and regarding the consistency with older ephemerides.

Multi-Station Precise Point Positioning (PPP)

BNC enables multi-station Precise Point Positioning for simultaneous processing of observations from a whole network of receivers. It uses code or code and phase data from one or more GNSS systems, such as from GPS and GLONASS, Galileo or BDS in ionosphere-free linear combinations together with the respective broadcast ephemeris and SSR information (see Table 1).

Beside coordinate displacements, troposphere parameter can be estimated as well to derive Zenith Total Delay values. Therefore, an site-specific tuning of the Kalman filter parameters is allowed.
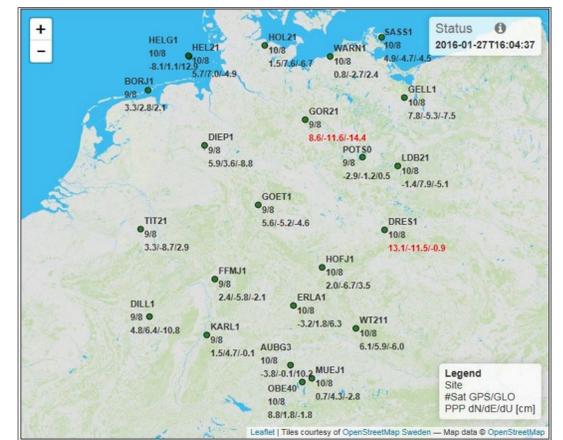

Figure 1: Real-time displacement-monitoring of the Integrated Geodetic Reference Network of Germany (GREF); North, East and Up displacements referring to a XYZ reference coordinate; Number of GPS/GLONASS satellites.

RINEX v 3.03 Support and RINEX Quality Check (QC)

BNC generates RINEX Observation and Navigation files in RINEX 3.03 format, including long file names and is able to convert RINEX Version 2 to RINEX Version 3 and vice versa.

BNC is coming now with QC options for GPS, GLONASS, QZS, BDS and Galileo, especially for RINEX 3.x files. As a result, the user gets visualized information about availability (Figure 2a), signal-to-noise ratio (Figure 2c) and multi-path (Figure 2d). The machine readable ASCII output (Figure 2b) summarizes key numbers for preservation and provides optional a more detailed epoch-wise analysis output.
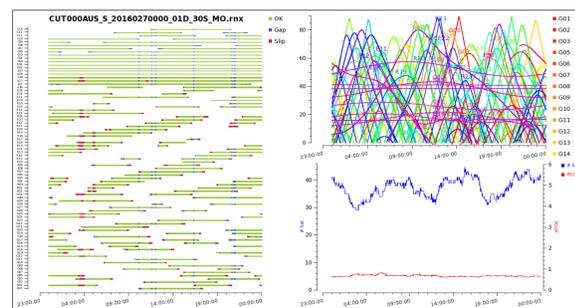

Figure 2a: Visualisation example of satellite availability, elevation and azimuth as well as PDOP values; CUT0, Australia.
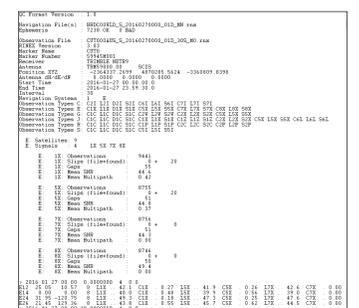

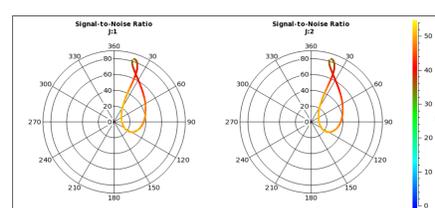Figure 2b: Machine readable ASCII output example of BNC's QC analysis; CUT0, Australia.

Figure 2c: Signal to Noise Ratio sky plot example for QZSS signals J1 and J2; CUT0, Australia.
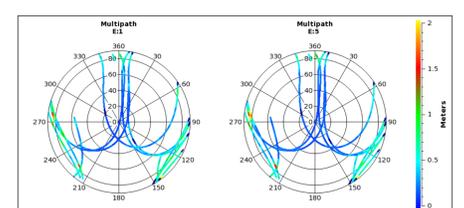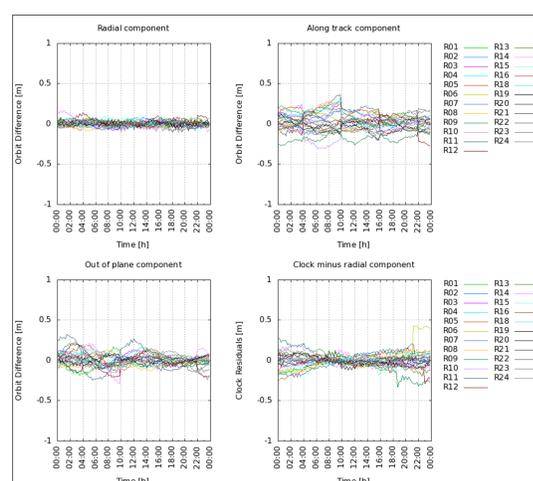

Figure 2d: Multipath sky plot example for Galileo signals E1 and E5; CUT0, Australia.

Comparison of Satellite Orbits and Clocks

BNC allows to compare the contents of two files containing GNSS orbit and clock data in SP3 format. To compare the satellite clocks, BNC first converts the coordinate differences dX, dY, dZ into along track, out-of-plane, and radial components. It then corrects the clock differences for the radial components of the coordinate differences.

Figure 3: Visualization example of an orbit and clock data comparison; SP3 file generated from BKG's GPS+GLONASS SSR Combination IGS03 versus ESA's rapid solution; DOY 23, 2016.

Standardization Efforts

Because of its membership in RTCM-SC104, BKG is actively involved in the standardization process. Proposals made in the RTCM-SC104 working groups are implemented in BKG's software tools at an early time to take part in interoperability tests, required to conclude the respective standardization step. Currently, messages regarding Vertical Total Electron Content (VTEC) and Satellite phase biases are under discussion and development.

Reference:

Weber, G., L. Mervart, A. Stürze, A. Rülke and D. Stöcker (2016) - *BKG Ntrip Client, Version 2.12.*, Mitteilungen des Bundesamtes für Kartographie und Geodäsie, Vol. 49, Frankfurt am Main, 2016 (in press)