

u-blox 7 to u-blox 8/M8 Software Migration Guide

SW changes from FW1.01 to FW SPG3.01

Application Note

Abstract

This document identifies the major Software feature differences between the u-blox 7 and the u-blox 8 or u-blox M8 FW SPG3.01 product ranges.

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UBX-15031124 - R01

Document Information

Title	u-blox 7 to u-blox 8/M8 Software Migration Guide		
Subtitle	SW changes from FW1.01 to FW SPG3.01		
Document type	Application Note		
Document number	UBX-15031124		
Revision and date	R01		20-June-2016
Document status	Objective Specification		

Document status explanation

Objective Specification	Document contains target values. Revised and supplementary data will be published later.		
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1 Introduction

This document provides important software-related information for customers when migrating from u-blox 7 to u-blox 8 or u-blox M8 FW SPG3.01 based products. Although most of the receiver features remain unchanged, some new ones have been added and some older ones revised or altered. These changes are reflected in alteration or addition to the u-blox message protocol and an extended range of NMEA sentences. Note that all the features described below are applicable to the u-blox 8 and u-blox-M8 devices except in the satellite constellations allowed. The M8 is a concurrent multi-GNSS receiver that can be configured to receive combinations of GPS, SBAS, QZSS, Galileo, GLONASS and BeiDou. The u-blox 8 is similar to the u-blox 7 in that it can be configured to receive GPS plus SBAS and QZSS or GLONASS signals only.

For the u-blox 8 / M8 devices the assistance messages for AssistNow Offline and Online service have been overhauled to work effectively with all supported constellations. Also, the AssistNow Autonomous function adds support for all the major GNSS constellations. The major software and operational changes are summarized as follows:

- NMEA default version is now 4.0; 4.1, 2.3, and 2.1 can be enabled
- Multiple GNSS assistance with the MGA AssistNow services
- GeoFence capability added
- UBX message integrity mechanism
- A new wrist mounted platform dynamical model for arm-swing mitigation
- New Power Save Modes
- Anti spoofing measures provided
- Odometer function for trip and total distance plus a Low Speed COG filter (intended for marine use)
- Reference for time pulse and time mark switched to UTC instead of GPS
- Operation with the Japanese Indoor MESSaging System (IMES)

As a quick reference, this document lists the basic message changes and then expands on these to provide some background information on the features that have been introduced or changed with this generation of Firmware. For a fuller explanation and description of the u-blox 8 / M8 capabilities, customers are directed to the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [1].



An index finger points out key information pertaining to integration and performance.



A warning symbol indicates actions that could negatively impact performance or damage the device.

2 Protocol message changes

The u-blox 8 functionality carries over the default GNSS constellation settings available from the u-blox 7 device but incorporates all the message and functionality improvements provided with FW SPG3.01.

The u-blox M8 products are concurrent Multi-GNSS receivers. They are capable of receiving and processing signals from multiple Global Navigation Satellite Systems (GNSS): GPS, Galileo, GLONASS or BeiDou, along with the corresponding SBAS (WAAS, EGNOS, MSAS) plus QZSS. When correctly configured, the u-blox M8 can acquire and track satellites from the chosen multiple GNSS systems and utilise them in positioning. This functionality is reflected in changes to the NMEA and UBX protocol when migrating from u-blox 7 to u-blox 8 / M8.

2.1 NMEA protocol

The NMEA output has been updated to reflect the multiple GNSS nature of the receiver. For u-blox 8 / u-blox M8 devices, the default NMEA protocol is 4.0, as compared with 2.3 for u-blox 7. This should pose no significant difference to customers, as the messages used are essentially the same. Although version 4.0 is the default, versions 4.1, 2.3, and 2.1 can be enabled using the `UBX-CFG-NMEA` message. N.B. version 4.1 is required for Galileo or BeiDou capability.

The u-blox 8 / M8 FW SPG3.01 includes two new messages, which are itemised below.

Message	Remark
NMEA-Standard-GBQ	Standard message query for current talker ID – GB see section 3.2.1
NMEA-Standard-VLW	Dual ground/water distance – see section 3.6

One of the ways the NMEA standard differentiates between GNSS types is by using a two-letter message identifier – the "Talker ID". The table below shows the Talker ID that will be used depending on the GNSS combination that is configured on the device.

The default GNSS configuration for u-blox M8 is GPS+SBAS+QZSS+GLO, with the default Talker ID GN. For the u-blox 8 the default combination is GPS+SBAS+QZSS, with the default Talker ID GP.

Configured GNSS	Talker ID
GPS, SBAS, QZSS	GP
GLONASS	GL
Galileo	GA
BeiDou	GB (can be configured via <code>UBX-CFG-NMEA</code>)
Any combination of GNSS	GN (Default)

2.2 Satellite numbering

The NMEA protocol identifies satellites with a two-digit number, reserving the numbers 1 to 32 for GPS, 33-64 for SBAS and 65-96 for GLONASS. So, for example, GLONASS SV4 is reported using number 68. u-blox receivers support this method in their NMEA output when "strict" SV numbering is selected. In most cases this is the default setting, but can be checked or set using the `UBX-CFG-NMEA` message.

Unfortunately there is currently no standard way of identifying satellites from a GNSS other than GPS, GLONASS, BeiDou and the future Galileo system within the NMEA protocol. In order to support QZSS and IMES within current receivers and prepare for support of other systems in the future, an "extended" SV numbering scheme can be enabled (using `UBX-CFG-NMEA`). This uses the NMEA-defined numbers where possible, but uses larger number ranges to support other GNSS. Note, these non-standard extensions require 3 digit numbers, which may not be supported by some NMEA parsing software. For example QZSS satellites are reported using numbers in the range 193 to 197.

A summary of all SV numbering schemes is provided against the active protocol configuration in Table 1.

GNSS Type	SV Range	UBX GNSS ID:SVID	UBX SVID	NMEA 2.X-4.0 (strict)	NMEA 2.X-4.0 (extended)	NMEA 4.1+ (strict)	NMEA 4.1+ (extended)
GPS	G1-G32	0:1-32	1-32	1-32	1-32	1-32	1-32
SBAS	S120-S158	1:120-158	120-158	33-64	33-64,152-158	33-64	33-64,152-158
Galileo	E1-36	2:1-36	211-246	-	301-336	1-36	1-36
BeiDou	B1-B37	3:1-37	159-163,33-64	-	401-437	1-37	1-37
IMES	I1-10	4:1:10	173-182	-	173-182	-	173-182
QZSS	Q1-Q5	5:1-5	193-197	-	193-197	-	193-197
GLONASS	R1-R32, R?	6:1-32, 6:255	65-96, 255	65-96, null	65-96, null	65-96, null	65-96, null

Table 1: SV numbering schemes

2.3 u-blox protocol

This section provides a list of the changed messages to alert users migrating from u-blox 7 to the changes involved when moving from FW1.01 to FW SPG3.01.



For a full description of the new message structures, refer to the u-blox 8 / u-blox M8 Receiver Description and Protocol Specification document [1].

2.3.1 New UBX messages

The following new messages have been introduced with the u-blox 8 / u-blox M8 products.

The features section below provides some more details regarding the major changes:

Message	Remark
UBX-CFG-DYNSEED	Feature for signing nominated UBX messages using a dynamic key value - see section 3.11
UBX-CFG-FIXSEED	Signature generated to sign UBX messages with a fixed key value - see section 3.11
UBX-CFG-GEOFENCE	Geographic area initialization for the Geofence function - see section 3.4.2
UBX-CFG-ODO	Configuration of odometer support - see section 3.6
UBX-CFG-PMS	Simpler configuration message for popular Power Save Mode profiles - see section 6.1.2
UBX-LOG-RETRIEVEPOSEXTRA	Extra position data returned to host – see section 3.6
UBX-MGA-ACK	MGA message acknowledge – for all MGA information see section 5
UBX-MGA-ANO	MGA message for delivering Offline assistance information to the receiver
UBX-MGA-DBD	MGA message for navigation database poll/delivery
UBX-MGA-FLASH	MGA flash storage access for host stored AssistNow Autonomous data
UBX-MGA-BDS	MGA messages for delivering BeiDou assistance information
UBX-MGA-GAL	MGA messages for delivering Galileo assistance information
UBX-MGA-GLO	MGA for delivering GLONASS assistance information
UBX-MGA-GPS	MGA for delivering GPS assistance information
UBX-MGA-INI	MGA Initial data aiding (position, time)
UBX-MGA-QZSS	MGA messages for delivering QZSS assistance information
UBX-MON-GNSS	Multi GNSS support information - see section 3
UBX-NAV-EOE	Marks end of NAV message collection within one epoch - see section 3.4.1
UBX-NAV-GEOFENCE	Outputs the state of geofences for current epoch - see section 3.4.2
UBX-NAV-ODO	Odometer data output - see section 3.6

Message	Remark
UBX-NAV-ORB	Satellite orbit information – see section 5.1.5
UBX-NAV-RESETO	Odometer reset – see section 3.6
UBX-NAV-TIMEBDS	M8 Only: Provides precise BeiDou time from latest nav fix, - see section 4.1.3
UBX-NAV-TIMEGAL	M8 Only: Provides precise Galileo time from latest nav fix - see section 4.1.4
UBX-NAV-TIMEGLO	Provides precise Glonass time from latest nav fix - see section 4.1.5
UBX-NAV-TIMELS	Provides info on up-coming leap second - see section 4.1.2
UBX-RXM-IMES	IMES beacon information (replacement for UBX-NAV-IMES) - see section 3.3
UBX-RXM-MEASX	Satellite code phase and Doppler values - see section 3.8
UBX-RXM-RLM	Galileo RLM messages (short and long) see section 3.2.3
UBX-RXM-SFRBX	Demodulated satellite message - see section 3.8
UBX-SEC-SIGN	Message signature of previously sent message - see section 3.11
UBX-SEC-UNIQID	Allows retrieval of a unique chip ID code - see section 3.9

2.3.2 Deleted UBX messages

These particular u-blox 7 messages have been dropped from u-blox 8 / u-blox-M8 devices owing to the improved assistance protocol.

Message	Remark
UBX-AID-ALP	Replaced by MGA aiding messages
UBX-AID-ALPSRV	Replaced by MGA aiding messages
UBX-AID-DATA	Customers should use UBX-MGA-DBD, or poll the AID messages individually.
UBX-AID-REQ	No longer supported

Support for ALP (legacy AssistNow Offline format) has been dropped from u-blox 8 / u-blox M8. AssistNow Offline uses the new MGA functionality for delivering assistance data. The UBX-AID-* messages are superseded by the new UBX-MGA-* style messages - see section 5 below.

2.3.3 Deprecated UBX messages

Although the u-blox 8 / u-blox M8 products will continue to parse these particular GPS assistance messages, they have been superseded by newer variants. Customers are recommended to change their host software appropriately to allow future compatibility.

Message	Remark
UBX-AID-ALM	Use UBX-MGA-GPS-ALM
UBX-AID-EPH	Use UBX-MGA-GPS-EPH
UBX-AID-HUI	Use UBX-MGA-GPS-HEALTH/UTC/IONO
UBX-AID-INI	Use UBX-MGA-INIT-POS/TIME etc
UBX-NAV-SVINFO	Use UBX-NAV-SAT
UBX-RXM-SVSI	Use UBX-NAV-ORB



Note that MGA assistance messages are input only

2.3.4 Changes to UBX messages

The following table lists significant changes to an individual message structure when changing from a u-blox 7 to a u-blox 8 / u-blox M8 device.



This section only lists the major changes, for individual details, refer to the u-blox 8 / u-blox M8 Receiver Description and Protocol [1].

Message	Remark	Backwards compatible
UBX-CFG-GNSS	Altering configuration will now provoke a navigation system restart, see section 3	Yes
UBX-CFG-NAV5	Added max static hold distance and 'wrist' platform model for sports watch apps	Yes
UBX-CFG-NMEA	NMEA protocol version adjustments, M8 Only: BeiDou support	Yes
UBX-CFG-ITFM	Added option to enable scanning on auxiliary RF channel	Yes
UBX-CFG-PM2	New parameter fields added (<code>maxStartupStateDur</code> , <code>extIntInactivityMs</code>)	No
UBX-CFG-TP5	M8 only: Time base can be changed to BeiDou or Galileo Time	Yes
UBX-NAV-AOPSTATUS	Satellite availability masks are not filled in anymore	No
UBX-NAV-PVT	Added vehicle heading	No
UBX-NAV-TIMEUTC	Added the UTC standard identifier	Yes
UBX-NAV-STATUS	Added spoofing state to NAV status	Yes
UBX-RXM-PMREQ	New states allowed in back-up mode	No

2.3.5 Changed UBX message default settings

This section lists the notable changes only, for details, refer to the u-blox 8 / u-blox M8 Receiver Description and Protocol [1].

Message	Remark	Public
UBX-CFG-GNSS	u-blox-M8 default: GPS+SBAS+QZSS+GLO, u-blox 8 default: GPS+SBAS+QZSS	Yes
UBX-CFG-NAVX5	maxSVs 20 for u-blox M8, week number rollover adjusted minCNO set to 6 dbHz	Yes
UBX-CFG-NMEA	Defaults to NMEA 4.0, strict numbering	Yes
UBX-CFG-SBAS	The SBAS PRNs searched by default adapted to current constellation (SDCM removed from scan list).	Yes
UBX-CFG_TP5	Time pulse referenced to UTC by default	Yes

3 Features

The following sections outline the changed or newly introduced aspects of the u-blox 8 / u-blox M8 receivers compared with the u-blox 7 receiver operation.

3.1 GNSS configuration

UBX-CFG-GNSS :

Applying this message with any changes will always provoke a receiver restart. This is to increase the FW robustness and hence simply ramping up and down SV channels cannot be used to fade in and out wanted and unwanted constellations. With FW SPG3.01, u-blox has designated the major satellite navigation systems as BeiDou, Galileo, GLONASS and GPS. The receiver requires that at least one major GNSS constellation is configured for use at any time with the specific exception of IMES operation. QZSS is used as an augmentation system (to GPS) and hence cannot now be run in isolation.

u-blox 8 based receivers can receive and track either GPS or GLONASS signals. The augmentation systems: SBAS and QZSS can be enabled only if GPS operation is configured.



The default configuration for u-blox 8 devices is GPS, including SBAS and QZSS reception

3.2 Multi-GNSS configuration: u-blox M8 only

With the u-blox M8 receiver it is possible to enable concurrent reception of up to three GNSS constellations out of GPS, GLONASS, Galileo, BeiDou. If the GPS band is enabled, then SBAS and QZSS can also be enabled.

The message UBX-CFG-GNSS allows for switching on and off the desired GNSS signal reception. u-blox M8 devices can be configured to operate with the combinations shown in Table 2.

GPS	Galileo	GLONASS	BeiDou
•	•	–	–
•	•	•	–
•	•	–	•
•	–	•	–
•	–	–	•
–	•	•	–
–	•	–	•
–	–	•	•

Table 2 Permissible GNSS combinations (• = enabled)



The default configuration for u-blox M8 devices is GPS+GLONASS+SBAS+QZSS.

The following features are supported in all GNSS combinations:

- Time Pulse
- Weak Signal Tracking
- Interference Suppression
- Logging

Table 3 below shows an overview of the features available in the firmware depending on the configured GNSS combination. The UBX-MON-GNSS message reports the currently selected GNSS configuration.

GNSS Combo	GPS Galileo SBAS QZSS GLONASS	GPS Galileo SBAS QZSS BeiDou	BeiDou GLONASS	GPS Galileo QZSS	BeiDou	GLONASS
Feature						
PSM	Supported	Supported	Supported	Supported	Supported	Supported
AssistNow Online	Supported (except SBAS)	Supported (except SBAS)	Supported	Supported	Supported	Supported
AssistNow Offline	GPS, GLONASS only	GPS only	GLONASS only	GPS Only	Not Supported	Supported
AssistNow Autonomous	GPS, GLONASS only	GPS only	GLONASS only	GPS Only	Not Supported	Supported
RTCM	Not Supported	Not Supported	Not Supported	GPS Only	Not Supported	Not Supported

Table 3: Overview of available features depending on GNSS combination

3.2.1 BeiDou

Support for the BeiDou satellite constellation has been added with u-blox M8. The B1I signal is used for navigation. Use of BeiDou signals is disabled by default and can be enabled using the `UBX-CFG-GNSS` message. Note that the NMEA `GBQ` sentence enables polling of a standard NMEA message when the talker ID is GB.

3.2.2 Galileo

New UBX messages are added to allow u-blox M8 operation with the Galileo constellation. GPS and Galileo signals can be processed concurrently together with BeiDou or GLONASS signals, enhancing coverage, reliability and accuracy.



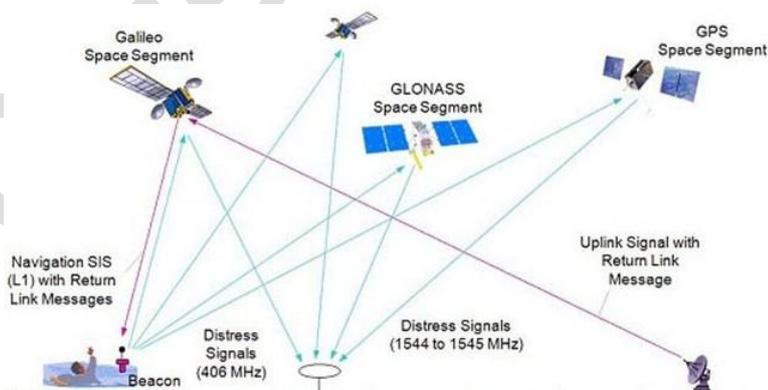
Galileo has been implemented according to ICD release 1.2 (November 2015) and verified with live signals from the Galileo in-orbit validation campaign. Since the Galileo satellite system has not yet reached Initial (IOC) nor Full Operational Capability (FOC), changes to the Galileo signal specification (OS SIS ICD) remain theoretically possible. u-blox recommends to use Flash memory in designs utilizing Galileo signals in order to allow for a FW update in the unlikely event of a change to the Galileo signal specification (OS SIS ICD).



Galileo reception is by default disabled, but can be enabled by sending a configuration message (`UBX-CFG-GNSS`) to the receiver. See the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [1] for more information.

u-blox will keep the Galileo signal-in-space status under review during introduction of the constellation for any material changes that will affect our customers.

3.2.3 Galileo SAR return link message



All the Galileo constellation satellites carry a payload which transfers the output signal from distress beacons conforming to the Cospas-Sarsat standard. The signals from all satellite transponders are relayed to a control

center that processes the received signals to provide the distress beacon location. To provide a return path from the control center to the distress beacon, Galileo satellites reserve a portion of their navigation broadcast message structure to send a return link message (RLM) to any activated distress beacon. Hence, beacons that utilize a Galileo receiver can process the return link message passing important information back to the user. FW SPG3.01 has a new message (UBX-RXM-RLM) which supports this function for both the long and short message formats providing:

- Message type
- Distress Beacon ID
- Message code
- Message Parameters
- Sending Satellite ID

3.3 IMES

Customers can now receive the Japanese Indoor Messaging System (IMES) information through the UBX-RXM-IMES message. This replaces the previous UBX-NAV-IMES message, which is not supported in FW SPG3.01. The receiver parses the data and provides information pertaining to the received signal i.e. IMES location info and transmitter ID Doppler offset and C/No. The data decoded from the IMES transmitter is made available in the UBX-RXM-SFRBX message.

 IMES reception is disabled by default and the service is authorized and available only in Japan.

3.4 New navigation messages

3.4.1 End of eEpoch

UBX-NAV-EOE :

This message delimits the end of navigation messages output over one epoch period. It is intended to be used as a marker to collect all navigation messages within a navigation epoch period. It is output after all the enabled NAV class messages (except UBX-NAV-HNR) and after all enabled NMEA messages.

3.4.2 Geofencing

UBX-NAV-GEOFENCE :



FW SPG3.01 supports up to four circular Geofence areas defined on the Earth's surface using a 2D model.

The Geo-fence feature is activated/deactivated by the UBX message UBX-CGF-GEOFENCE in which the Geofence areas are defined. Geo-fencing is active when at least one Geo-fence is defined and the current status can be found when polling UBX-NAV-GEOFENCE . A PIO pin can be nominated to indicate status to, e.g. wake up a host on activation.

3.5 Position coordinate frames

GPS, GLONASS and BeiDou employ different coordinate frames to express their satellite positions (WGS84, PZ90.02, CGCS2000). However, all output in NMEA and UBX is related to WGS84, regardless of the GNSS used.

3.6 Odometer and low-speed COG filter

Introduced with the u-blox 8 / M8 products is an odometer function which computes the traveled distance. A trip distance value is maintained since the last odometer reset plus a cumulative distance traveled between cold starts of the receiver. These values are saved into the device Battery Backed RAM (BBR) together with an accuracy estimate (1-sigma). The trip distance is reset using the `UBX-NAV_RESETODO` message and the total distance measurement is reset when a cold start is applied.

These odometer outputs can be retrieved using the `UBX-NAV-ODO` or `NMEA_VLW` message. The odometer function is configured via the `UBX-CFG-ODO` message which provides three user profiles: "running", "cycling" and "car".

With a u-blox 8 / u-blox M8 receiver, the logging function also stores the odometer information with each update. This data can be retrieved using the `UBX-LOG-RETRIEVEPOSEXTRA` message.

Also, a velocity and heading low-pass filter, as well as a low-speed Course Over Ground (COG) filter enabling COG computation at very low speeds can be activated and set up in `UBX-CFG-ODO`.

3.7 NAV dynamic model: wrist

A new navigation dynamical model is available for wearable wrist-mounted receivers. This model helps to mitigate coupling of the of the arm swing period and the navigation update rate. The feature is provided by specifying the "wrist worn watch model" in `UBX-CFG-NAVX5`. Trials show an improved position deviation compared to the existing dynamical models. This can be further improved using a higher navigation update rate, e.g. 4 Hz.

3.8 Broadcast navigation data and satellite signal measurements

All FW SPG3.01 based receivers can output all the GNSS broadcast data upon reception from tracked satellites. This includes all the supported GNSS signals plus the augmentation services SBAS, QZSS and IMES. The `UBX-RXM-SFRBX` message reports a complete sub-frame of broadcast navigation data received from a single satellite.

FW SPG3.01 also makes available the tracked satellite signal information, i.e. raw code phase and Doppler measurements in a form aligned and intended for use with the ETSI mobile cellular location services protocol (RRLP) [3] **Error! Reference source not found.** The message `UBX-RXM-MEASX` reports the satellite system reference time, carrier to noise ratio, measured code phase and Doppler values for all tracked signals. For more details, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [1].

3.9 Product Identification using the unique chip ID code

New with FW SPG3.01 is the ability to provide a unique identifier for each chip. The code is applied during manufacture and allows users to make use of a permanent hard coded five byte number for tracking and tracing purposes. The number is accessed via polling the `UBX-SEC_UNIQID` message.

3.10 Spoofing detection

Spoofing is a process whereby someone (or something) tries to control the reported position out of a device. This may take the form of reporting incorrect positioning, velocity or time. To help combat this, FW SPG3.01 includes some anti-spoofing measures. If a PVT measurement is suspected of being altered, then an indication of spoofing activity flag is set in the `UBX-NAV-STATUS` message. This indicator reflects the state within the current navigation epoch and hence is most useful when at the transition between a real and spoofed signal.



This flag is a **warning** only when signals appear to be suspicious.

3.11 Message integrity protection

FW SPG3.01 provides a feature to detect third party interference with the UBX message stream sent from receiver to host. This new feature has been added in response to customers requiring a mechanism for detecting “man-in-the-middle” types of attack. Note that the feature itself cannot guarantee that a system is secure if the host, the final system hardware, and the production setup are not secure.

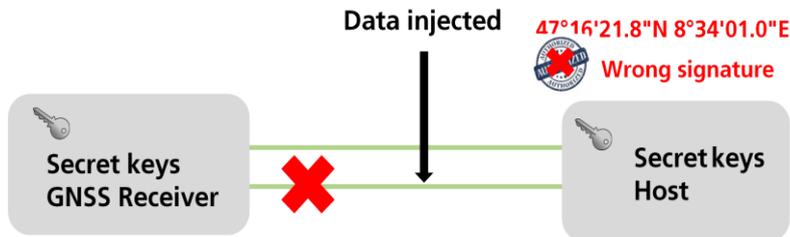


Figure 1: Typical “Man-in-middle” message integrity attack

The mechanism requires “signing” up to 10 UBX messages nominated within the `UBX-CFG-FIXSEED` message. The “signature” is a 256 bit hash code of a nominated message which is held within a subsequent `UBX-SEC-SIGN` message. This “signature” message is sent after any of the nominated messages to allow immediate verification of the message content by the host.

As well as providing a fixed seed for the hash algorithm, users have a choice in deploying a dynamically changing seed using the `UBX-CFG-DYNSEED` message to combat temporal shifting of message data. For more information, see the u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification [1].

3.12 Production testing

For customers currently using the `UBX-MON-PT` (NDA required) message for production, this has been replaced by the `UBX-MON-PT2` message to cater for multi-GNSS testing.

4 GNSS time

With multiple GNSS constellations, a reference time has to be chosen and presented to the user. The u-blox 8 / u-blox M8 receiver autonomously selects the reference time system for the navigation solution based upon signal availability. Depending on the chosen reference time, the UTC time output is then based on a particular UTC realization. `UBX-NAV-TIMEUTC` contains a new field `utcStandard` which identifies the currently used UTC reference. Note that the difference between these UTC realizations should be very small in practice, ie sub-microsecond.

The table below shows the particular time systems and their related UTC reference.

GNSS	Time system	UTC reference
GPS	GPS Time (GPST)	USNO
SBAS	SBAS Network Time (SNT)	System provider dependent
QZSS	QZSS System Time (QZSSST)	NICT
GLONASS	GLONASS Time	SU
BeiDou :M8 Only	BeiDou Time (BDT)	NTSC
Galileo :M8 Only	Galileo System Time (GST)	European

Table 4: Time systems and their related UTC reference

The new multi-GNSS messages use UTC as a time reference. For the legacy UBX messages which output GPS time references, the internal time is converted to GPS time as accurately as possible.

4.1.1 Time pulse output

For u-blox M8 receivers the time pulse output is now aligned to UTC by default rather than GPS Time as implemented in u-blox 7. As the GNSS are referenced to different UTC realizations, small discontinuities ($< 1 \mu\text{s}$) might be experienced when the internal reference time is switched. Time jumps may also occur when the receiver obtains new information on GNSS to UTC time offsets.

`UBX-CFG-TP5`:

This message has been expanded to allow Time pulse synchronization to Galileo time. Note that if the time pulse is enabled prior to GNSS lock then the `TIM-TP` output message should be used as an indicator that the time-pulse is valid and in the 'locked' state. In most cases, the time-pulse will be enabled after the first complete sub-frame has been received (6s for GPS).

4.1.2 Leap second event information

`UBX-NAV-TIMELS` :

This message provides information pertaining to leap second handling and provides the following information to the user:

- Source of the current number of leap second information
- Current number of leap seconds since start of GPS time (Jan 6, 1980)
- Future leap second change if one is scheduled.
- Number of seconds until the next leap second event
- GPS week number (WN) of the next leap second
- GPS day of week number (DN) for the next leap second event

4.1.3 BeiDou time

UBX-NAV-TIMEBDS :

This message reports the precise BeiDou time for the most recent navigation solution providing BeiDou time of week and week number plus UTC leap second offset.

4.1.4 Galileo time

UBX-NAV-TIMEGAL :

This message reports the precise Galileo time for the most recent navigation solution providing Galileo TOW and week number plus UTC leap second offset.

4.1.5 GLONASS time

UBX-NAV-TIMEGLO :

This message reports the precise GLONASS time for the most recent navigation solution providing GLONASS time of day and current GLONASS four year interval and day number.

Each GNSS time message provides the GPS TOW for the current receiver navigation epoch with validity flags and time accuracy estimates.

5 Multi-GNSS Assistance services

A new Multi-GNSS Assistance (MGA) internet service has been set up to provide multi-GNSS assistance data over the internet to u-blox 8 / u-blox M8 receivers. A token-based authentication process replaces the username/password method used with the legacy GPS-only AssistNow services. These tokens are distributed to customers via the sales team. Note that multiple devices can be serviced by this method, as it was with the previous assistance services. Also note that existing users of the legacy GPS-only service are strongly advised to migrate to the new MGA service.



The existing GPS-only assistance service will still run as a legacy option within the MGA AssistNow Online service access. For more information see the Multiple GNSS Assistance Services User Guide [4]

A new set of messages is available for providing GNSS assistance information when using u-blox's AssistNow Online and AssistNow Offline services. The new message class "MGA" identifies a multi-GNSS assistance message. Specific assistance for each constellation type appends the required constellation designation: BDS, GAL, GPS, GLO and QZSS. For example, `UBX-MGA-GPS` for GPS and `UBX-MGA-GLO` for GLONASS. The Message IDs are subdivided into types according to GNSS information type, e.g. EPH, ALM, etc. For example, the following message supplies GLONASS ephemeris: `UBX-MGA-GLO-EPH`.

All the u-blox 7 current assistance messages except the offline messages `UBX-AID-ALP` will continue to be supported by u-blox 8 / u-blox M8. However, it is recommended to change over to the new versions for future compatibility. Unlike the existing `UBX-AID` message, the MGA messages are **not** poll-able. Instead a special `MGA-DBD` (database dump) message has been added to dump the state of the navigation database and allow it to be restored later.

FW SPG3.01 supports all the major GNSS constellations for the AssistNow Online and AssistNow Offline services. However, due to the lack of accurate orbit predictions for QZSS, BeiDou and Galileo, the AssistNow Offline service cannot yet provide useful data for these constellations. It may be possible for the AssistNow Offline service to be enabled later for these constellations when good quality data becomes available. The firmware will then accept and use this data with no changes required.

The FW SPG3.01 AssistNow Autonomous feature adds support for BeiDou, GLONASS and Galileo satellites on circular and near-circular orbits. It will not consider satellites on orbits with an eccentricity of > 0.05 (e.g. E18). Also, QZSS satellites orbits are not supported. Besides these limitations, the AssistNow Autonomous feature will use any available satellite and constellation when enabled.

For BeiDou, GLONASS and Galileo satellites a suitable flash memory is necessary. For flash memory requirements, refer to the Receiver Description [1] and u-blox M8 Hardware Integration Manual [2] for details. Due to the nature of the GLONASS broadcast ephemerides, it will only predict GLONASS orbits once it has observed a satellite long enough, currently more than four hours. For GPS satellites, the prediction quality improves if a suitable flash memory is available and the satellite has been observed multiple times. Without a suitable flash memory, the GPS prediction quality remains at the level of a prediction based on one single broadcast ephemeris. Using multiple GPS ephemerides is now only available with a suitable flash memory.

Refer to the Multiple GNSS Assistance Services User Guide [4] for further information when using the u-blox assistance services.

5.1 Assistance data messages

The u-blox 8 / u-blox M8 GNSS receiver can accept the following types of assistance data:

5.1.1 Position

Estimated receiver position can be submitted to the receiver using the `UBX-MGA-INI-POS_XYZ` or `UBX-MGA-INI-POS_LLH` messages.

5.1.2 Time

The current time can either be supplied as an inexact value via the standard communication interfaces, thus suffering from latency depending on the baud rate, or using hardware time synchronization where an accurate time pulse is connected to an external interrupt pin. The preferred option is to supply UTC time using the `UBX-MGA-INI-TIME_UTC` message, but times referenced to some GNSS can be delivered with the `UBX-MGA-INI-TIME_GNSS` message.

5.1.3 Clock drift

An estimate of the clock drift can be sent to the receiver using the `UBX-MGA-INI_CLKD` message.

5.1.4 Frequency

It is possible to supply hardware frequency aiding by connecting a periodic rectangular signal with a frequency up to 500 kHz and arbitrary duty cycle (low/high phase duration must not be shorter than 50 ns) to an external interrupt, and to provide the applied frequency value using the `UBX-MGA-INI_FREQ` message.

5.1.5 Current orbit data

Each different GNSS constellation transmits orbit data in slightly different forms. For each system there are separate messages for delivering ephemeris and almanac. For example, the GPS ephemeris is delivered to the receiver using the `UBX-MGA-GPS-EPH` message, whereas the GLONASS almanac is delivered with the `UBX-MGA-GLO-ALM` message.

5.1.6 AssistNow Offline data

`UBX-MGA-ANO` messages contain AssistNow Offline data and are targeted at receivers that only have occasional Internet access. These messages can be obtained from the AssistNow Offline Service and allow a receiver to improve its TTFF even when it is no longer connected to the Internet.

5.1.7 Auxiliary information

Each GNSS transmits some auxiliary data (such as SV health information or UTC parameters) to the receiver. A selection of messages exists for providing such information to the receiver, such as `UBX-MGA-GPS-IONO` for ionospheric data from GPS.

5.1.8 Navigation database

u-blox receivers can be instructed to dump the current state of their internal navigation database with the `UBX-MGA-DBD-POLL` message. Sending this information back to the receiver (e.g. after a period when the receiver was turned off) restores the database to its former state, and thus allows the receiver to restart rapidly.

5.2 MGA service protocols

5.2.1 AssistNow Online

The MGA Online service protocols now use an HTTP GET request for aiding data from the service. It will reply with messages in standard UBX binary protocol for the u-blox 8 / u-blox M8 receiver.

There are two endpoints available for the service to provide redundancy in the event of server unavailability. These two URLs are:

- `online-live1.services.u-blox.com`
- `online-live2.services.u-blox.com`

Users may obtain data from either address. A strategy involving trying the other address in case of failure should provide greater system reliability.

For example, a request for aiding data requiring GPS and GLONASS ephemeris is as follows:-

`http://online-live1.services.u-blox.com/GetOnlineData.ashx?token=XXXXXXXXX;gnss=gps,glo;datatype=eph`

5.2.2 AssistNow Offline

As with the Online service, the Offline service uses an HTTP GET request which responds with the required UBX binary messages. Like the Online service, two endpoint addresses are provided for redundancy:

- `offline-live1.services.u-blox.com`
- `offline-live2.services.u-blox.com`

A request for GPS aiding data for 1 week with resolution 1 day would conform to:

<http://offline-live1.services.u-blox.com/GetOfflineData.ashx?token=XXXXXXXXXX;qnss=gps;period=1;resolution=1>

Objective Specification

6 Power management

6.1.1 Power state control

A new version of `UBX-RXM-PMREQ` is now implemented which enables the user to force the receiver into back-up mode when the USB interface is connected and active. In this circumstance, the user now has an option flag to force the receiver into back-up mode causing the USB interface to be disabled. In addition, the new version allows the user to nominate the communication port pins required to signal a wake-up event, i.e. any combination of UART RX, EXTINT0, EXTINT1 or the SPI CS pin.

Prior to FW SPG3.01, commanding a power down was only allowed when the USB interface was disconnected and wake up was signaled via a logic transition on the EXTINT pins or RXD1 line.

Both versions of this message are applicable with FW SPG3.01.

6.1.2 Power Save Mode improvements

Power save modes are now implemented for all GNSS constellations providing less risk of a fall-back to continuous operation under more challenging signal conditions.

A new message (`UBX-CFG-PMS`) is available for pre-selecting common power usage scenarios. This introduction makes commonly used modes easier to configure and includes the following settings:

- Continuous balanced mode (~8 to 18% improvement compared to FW2.01) - Default option
- Full power: no compromises on power consumption
- A 1Hz Cyclic tracking mode for aggressive power reduction
- A choice of 2 or 4 Hz Cyclic tracking modes for typical wearable applications
- ON/OFF interval mode

There is also a new version of the `UBX-CFG-PM2` message that includes two new parameter fields:

`maxStartupStateDur`: This specifies a maximum allowable time (seconds) to spend in the acquisition state

`extintInactivityMs`: This allows presetting the maximum allowable time (seconds) spent in the Inactive state when controlled (On/Off) by an EXTINT pin.

In addition, the time grid periods are now dependant on UTC time as the function works with all GNSS constellations.



Users are strongly recommended to use the new message version (Ver.2) as the earlier version is likely to be removed in any future products.

Related documents

- [1] u-blox 8 / u-blox M8 Receiver Description Including Protocol Specification, Doc. No UBX-13003221 (Public version), Docu. No. UBX-13002887 (Confidential version)
- [2] UBX-G8020 / UBX-M8030 Hardware Integration Manual, Docu No UBX-15031474
- [3] Radio Resource LCS Protocol (RRLP), (3GPP TS 44.031 version 11.0.0 Release 11)
- [4] Multiple GNSS Assistance Services User Guide, Doc. No. UBX-13004360

Revision history

Revision	Date	Name	Status / Comments
R01	20-June-2016	byou	Objective Specification



For regular updates to u-blox documentation and to receive product change notifications, please register on our homepage (www.u-blox.com).

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