POSITIONING

Multiple GNSS Assistance Services

For u-blox GNSS receivers

User Guide

Abstract

This document provides user information for accessing the u-blox Multiple GNSS assistance services designed for u-blox GNSS receivers.

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UBX-13004360 - R05

Document Information		
Title	Multiple GNSS Assistance Services	
Subtitle	For u-blox GNSS receivers	
Document type	User Guide	
Document number	UBX-13004360	
Revision and date	R05	05-Dec-2017
Document status	Advance Information	

Document status explanation	
Objective Specification	Document contains target values. Revised and supplementary data will be published later.
Advance Information	Document contains data based on early testing. Revised and supplementary data will be published later.
Early Production Information	Document contains data from product verification. Revised and supplementary data may be published later.
Production Information	Document contains the final product specification.

This document applies to all u-blox 5 to u-blox 8/M8 GNSS receivers.

Preface

u-blox Technical Documentation

As part of our commitment to customer support, u-blox maintains an extensive volume of technical documentation for our products. In addition to our product-specific technical data sheets, the following manuals are available to assist u-blox customers in product design and development.

- **GPS Compendium:** This document, also known as the GPS book, provides a wealth of information regarding generic questions about GPS system functionalities and technology.
- **Receiver Description including Protocol Specification:** This document describes messages, configuration and functionalities of the Multiple GNSS Assistance Services software releases and receivers.
- **Hardware Integration Manuals:** These manuals provide hardware design instructions and information on how to set up production and final product tests.
- **Application Notes:** These documents provide general design instructions and information that applies to all u-blox GNSS positioning modules.

How to use this Manual

This manual has a modular structure. It is not necessary to read it from beginning to end.

The following symbols highlight important information within the manual:

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

⚠ **A warning symbol indicates actions that should be avoided.**

Questions

If you have any questions about Multiple GNSS Assistance Services integration, please:

- Read this manual carefully.
- Contact our information service on the homepage http://www.u-blox.com.
- Read the questions and answers on our FAQ database on the homepage.

Technical Support

Worldwide Web

Our website (www.u-blox.com) is a rich pool of information. Product information, technical documents and helpful FAQ can be accessed 24h a day.

By E-mail

If you have technical problems or cannot find the required information in the provided documents, contact the closest Technical Support office. To ensure that we process your request as soon as possible, use our service pool email addresses rather than personal staff email addresses. Contact details are at the end of the document.

Helpful Information when Contacting Technical Support

When contacting Technical Support please have the following information ready:

- Receiver type (e.g. NEO-7N-0-000), Datacode (e.g. 172100.0100.000) and firmware version (e.g. ROM1.0)
- Receiver/module configuration
- Clear description of your question or the problem (may include a u-center logfile)
- A short description of the application
- Your complete contact details

Contents

1 Introduction

This user guide provides a description of the methods required to use the u-blox Multiple GNSS Assistance (MGA) services. The document provides information on the following topics:

- MGA services – Describes the MGA services and architecture and gives detailed instructions on how to use the services.
- MGA Server addresses – Lists the endpoint addresses for the MGA servers.
- MGA access tokens – Describes how to get an access token.
- Host software and the MGA library – Describes the functions of the host software required to make use of the MGA services. The section also provides an overview of the u-blox platform-independent MGA library (sample code).
- MGA service migration – Provides guidance for users of MGA services wishing to migrate from u-blox 7 and previous generations to u-blox M8 products.

2 System Overview

2.1 Overview

Due to the relatively slow broadcast data rate from satellites, there can be a significant delay in providing the first position fix from a GNSS receiver after initial switch on. Assisted GNSS (A-GNSS) uses a reference network to collect data, such as ephemeris, almanac, accurate time and satellite status. It passes the data on to the target receiver via any suitable communications link. Such assistance data enables the receiver to compute a position within a few seconds, even under adverse signal conditions when data demodulation is error prone or when satellites are not in view of the receiver.

The u-blox MGA services provide a proprietary implementation of an A-GNSS protocol compatible with u-blox GNSS receivers. When a client device makes an MGA assistance request, the service responds with the requested data using UBX protocol messages. These messages are ready for direct transmission to the receiver communication port without requiring any modification by the client.

Currently, these MGA services consist of AssistNow Online and Offline, each delivered by the HTTP or HTTPS protocols.

AssistNow Online optionally provides satellite ephemerides, health information and time aiding data suitable for GNSS receiver systems with direct internet access.

The AssistNow Offline service benefits u-blox GNSS receivers that only have occasional internet access. Users request data from the service by specifying the time period for which they want coverage (1 to 5 weeks). The data downloaded from the service is organized by date and encoded into a sequence of UBX MGA messages.

In order to access either service, users must be authorized and provided with an access token. This is available by request (see section 8).

u-blox receivers also provide a feature called AssistNow Autonomous. Here the receiver operates without a host, autonomously generating assistance data by accurately modeling the satellite orbits from broadcast ephemerides downloaded from the satellites (or obtained by AssistNow Online)

The u-blox MGA services can provide data for multiple GNSS systems. See section 10 for more details on the supported GNSS constellations.

For more information regarding MGA assistance messages for use with a u-blox M8 receiver, see the u-blox M8 Receiver Description document [1].

2.2 System architecture

The assistance system relies on a set of monitoring stations distributed around the globe to submit satellite broadcast data to the u-blox assistance servers. The system combines all the reports from the submitters and builds a best view of the current broadcast data sets for multi-GNSS constellations. The service makes assistance available to any u-blox customers and optionally filters data based on parameters (e.g. only SVs visible from a given position). The customer application or u-blox cellular module pulls data from the server and pushes it to the receiver.

The AssistNow system architecture is illustrated below.

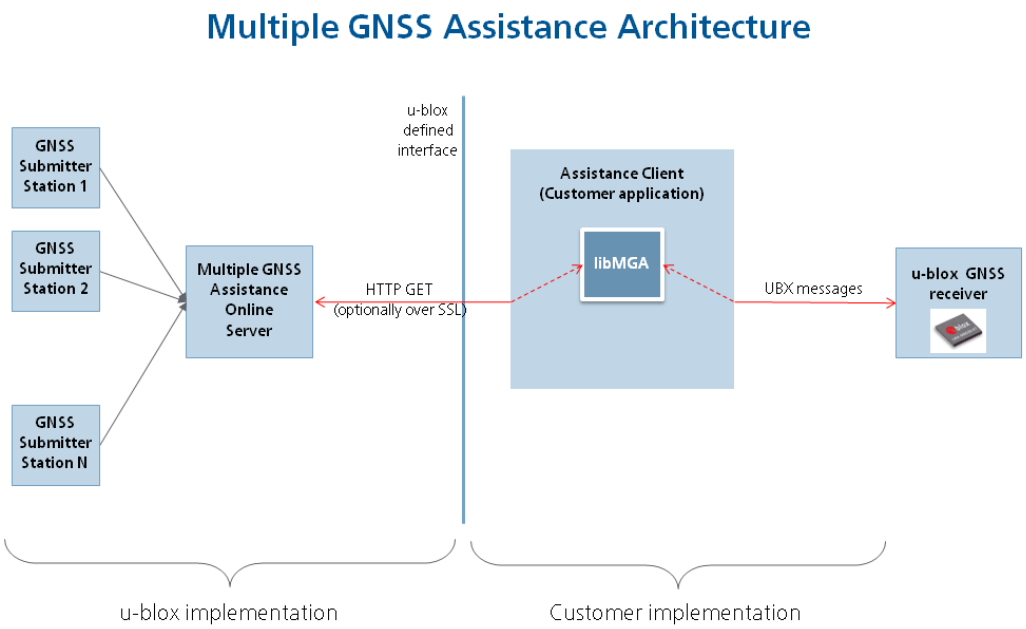

Figure 1: MGA system elements using typical assistance client

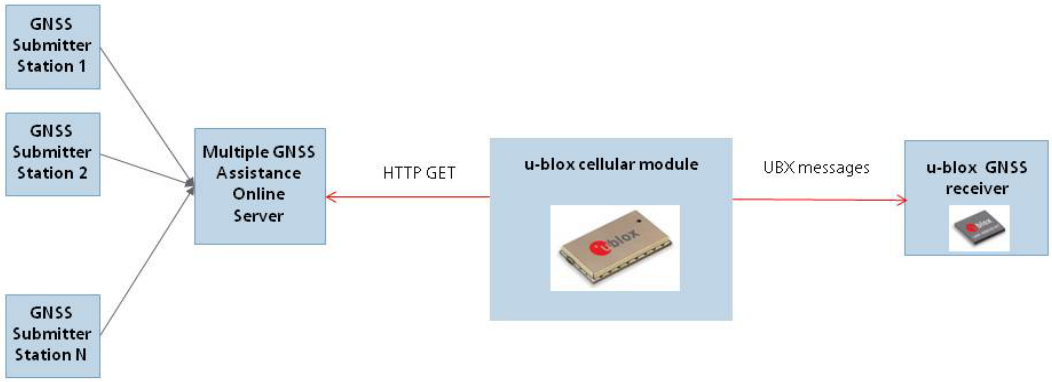

Figure 2: MGA system elements using u-blox cellular technology

Upon making a request, the server delivers a set of u-blox binary messages with class "MGA". These are assistance messages for each constellation type, with message IDs subdivided into types, such as EPH or ALM (the "format" parameter optionally provides support for u-blox 7 and previous generations. In this case, the messages will be of class "AID"). For more information on receiver message types, see the Receiver description and protocol manual [1].

u-blox has designed and implemented the AssistNow Service in a way that provides very high reliability. Nonetheless, there may be rare occasions when a server is not available (e.g. due to a power failure or some form of maintenance activity). In order to protect customers against the impact of such outages, u-blox runs at least two instances of the AssistNow Online and Offline Service, each hosted by independent ISPs. Customers are free to choose to request assistance data from any of these servers, as all servers provide the same information. Should a server fail, it is highly unlikely that the other server(s) will also be unavailable.

2.3 MGA service comparisons

Table 1 shows a comparison overview between the MGA services.

	AssistNow Online	AssistNow Offline	AssistNow Autonomous
Data validity	2 - 4 hours	up to 35 days	up to 3 days
Data load frequency	At every start-up	Daily or less often	Never
Size of downloaded data	1 - 3 kB	125 kB (GPS&GLO 28 days)	None
Acquisition performance (TTFF)	Typ. 3 s	5 - 20 s	13 - 18 s (after 3 days)
Data retrieval at start-up	Data download from server	Pre-downloaded data from local memory	Retrieved from local memory
Server protocol	HTTP/HTTPS	HTTP/HTTPS	None
User access	Registration required	Registration required	None
Standard service	Best effort	Best effort	None
Premium service	Guaranteed service based on service level agreement	Guaranteed service based on service level agreement	None

Table 1: MGA service comparisons

2.4 Typical data volumes and performance

Table 2 shows typical AssistNow Online data volumes for a receiver using the BDS, GAL, GPS, GLONASS and QZSS constellations. For example, the total data size for GPS, GLONASS and QZSS constellations (default) is 3552 bytes.

Message type	Number of messages	Message size (bytes)	Total data size (bytes)
UBX-MGA-BDS	15 (SVs)	88	1320
UBX-MGA-GAL	17 (SVs)	76	1292
UBX-MGA-GPS	32 (SVs)	68	2176
UBX-MGA-GLO	24 (SVs)	48	1152
UBX-MGA-QZSS	3 (SVs)	68	204
UBX-MGA-INI	1	20	20

Table 2: Typical data size for AssistNow Online

Table 3 shows typical AssistNow Offline data volumes for receivers using different GNSS constellations and different validity periods.

Message type (Constellation)	Number of messages	Message size (bytes)	Data size per message set (bytes)	Period / Resolution (days)	Total data size (bytes)
UBX-MGA-ANO (GPS)	32 (GPS SVs) = 32	76	2432	4 / 1	9728
UBX-MGA-ANO (GPS+GLONASS)	32 (GPS SVs) + 24 (GLO SVs) = 56	76	4256	4 / 1	17024
UBX-MGA-ANO (GPS)	32 (GPS SVs) = 32	76	2432	14 / 1	34048
UBX-MGA-ANO (GPS+GLONASS)	32 (GPS SVs) + 24 (GLO SVs) = 56	76	4256	14 / 1	59584

Table 3: Typical data size for AssistNow Offline

Figure 3 and Figure 4 show typical performances of the MGA services.

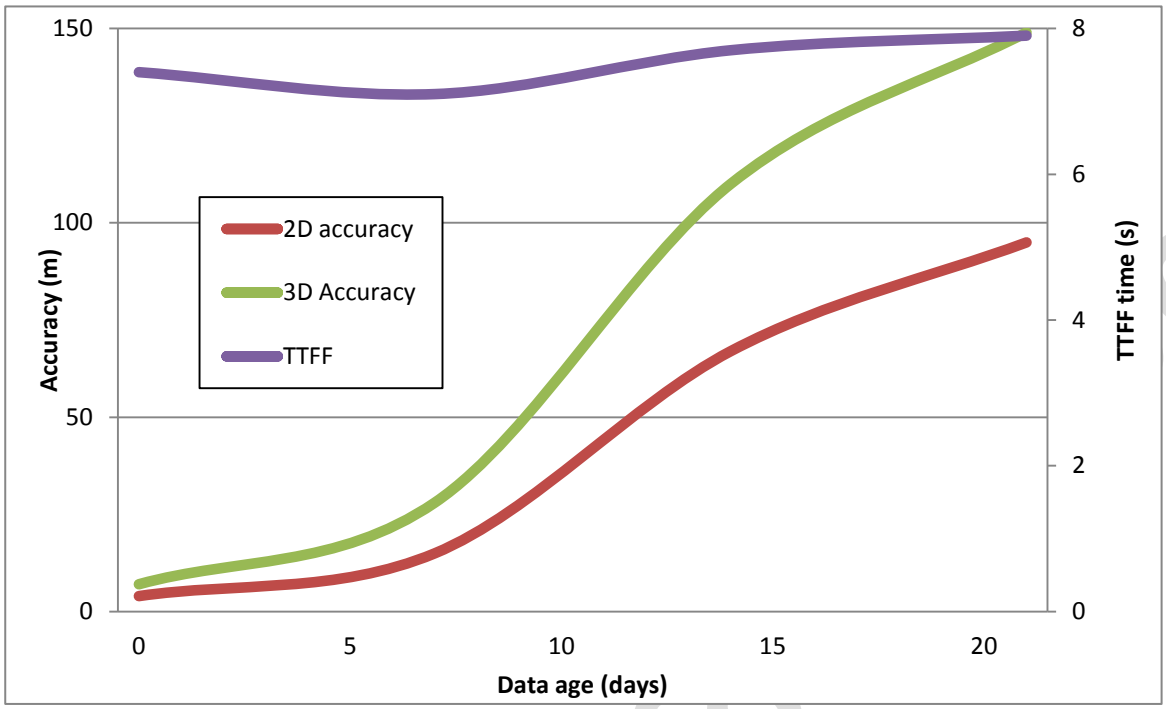

Figure 3: AssistNow Offline Typical performance

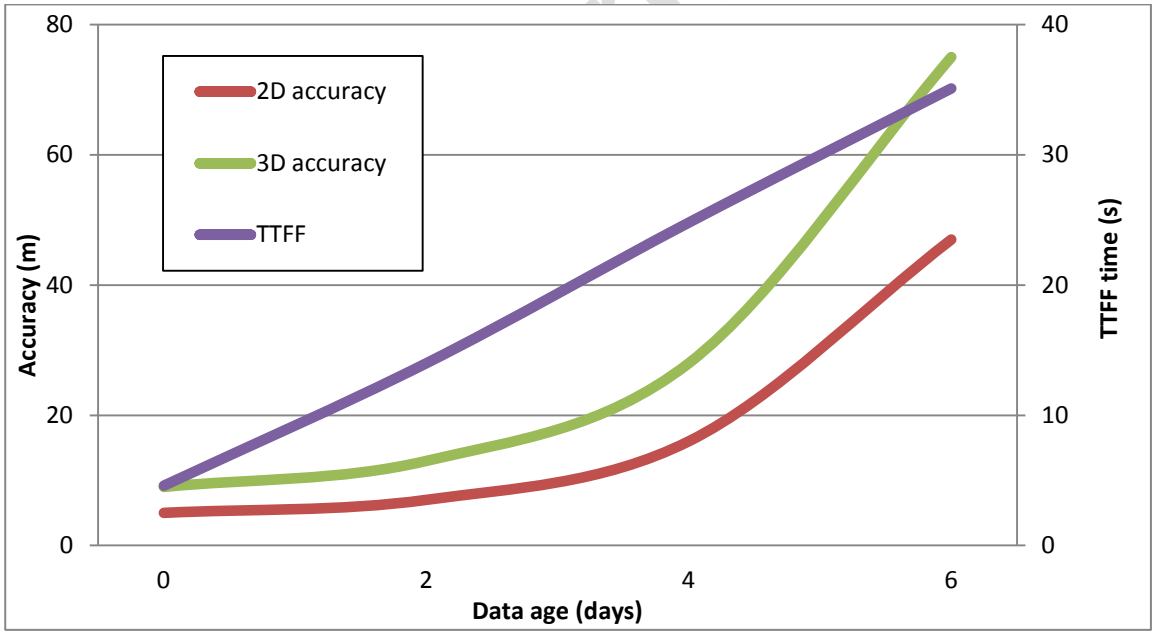

Figure 4: AssistNow Autonomous Typical performance

Although indicative of typical performance, a number of factors (including clock bias/drift prediction, space weather, earth orientation and modeling uncertainties) result in these figures having significantly more variation than conventional TTFF and position accuracy tests.

3 HTTP Protocol

3.1.1 Overview

All MGA services exchange information via the HTTP protocol.SSL can be used to add a security layer to HTTP. SSL is invoked by simply using "https://" instead of "http://" in the URL.

3.1.2 Request format

The HTTP GET request from the client to the server contains a standard HTTP query string in the request URL. The query string consists of a set of key=value parameters in the following form:

```
key=value;key=value;key=value;
```

The following rules apply:

- The order of parameters is not important.
- Keys and values are case sensitive
- Keys and values must be separated by an equals character ("=")
- Key/value pairs must be separated by semicolons (";") or an ampersand ("&")
- If a value contains a list, each item in the list must be separated by a comma (",")

Numeric values must conform to the regular expression: ^-?[0-9]+(\.[0-9]+)?$. This represents in order: an optional negative sign, one or more digits, and optionally a decimal point and one or more digits.

Upon reception of a standard HTTP GET request, the server responds with the required messages in binary format, or an error string in text format. After delivery of all data, the server terminates the connection. If HTTPS is used, all URL data (with the exception of hostname, which is used to establish the connection) is carried solely within this encrypted connection and is protected from man-in-the-middle attacks in the same way that any HTTPS data is.

☞ The easiest method to format a request is to use the GUI provided by the u-blox u-center application and then copy the text shown in the "Server request string" box. To try it out, the request can be pasted into an internet browser.

3.1.3 Overuse restrictions

To avoid overload of the services, overuse restrictions are applied to incoming requests. If the overload limit is reached, the service will respond with HTTP status code 403 (Forbidden). In Table **1**, the row "Data load frequency" shows the expected usage from an individual device. Excessive use of the services will result in some of the requests to the service being blocked.

3.1.4 Access from within a private network

As with most other internet traffic, the requests to the u-blox services are standard HTTP requests. If the requests originate from within a private network, then a standard HTTP proxy or firewall needs to be configured to forward requests and pass back responses between the private network and the u-blox services on the public internet. No special handling is needed, as the requests are all standard HTTP requests. Customers should speak to their local IT/network administrators to correctly enable this access.

If the services are accessed via an HTTP proxy or firewall, all the requests may appear to come from the HTTP proxy or firewall itself. To avoid overuse restrictions being applied in this case, the following must be done:

- u-blox must be informed of the IP address of the HTTP proxy or firewall so that overuse restrictions can be removed for this IP address.
- The HTTP proxy or firewall must be configured to append the actual source IP address of the request to the standard HTTP "X-Forwarded-For" header field.

If both of these conditions are met, then overuse restrictions will be correctly applied to the source device rather than the HTTP proxy or firewall itself. Customers should speak to their local IT/network administrators to ensure this is the case.

3.1.5 Use of multiple service instances

u-blox has designed and implemented the AssistNow Services in a way that provides very high reliability. Nonetheless, there may be rare occasions when a server is not available (e.g. due to a power failure or some form of maintenance activity). In order to protect customers against the impact of such outages, u-blox runs at least two instances of the AssistNow Online and Offline Service, each hosted by independent ISPs. Customers are free to choose to request assistance data from any of these servers, as all servers provide the same information. Should a server fail, it is highly unlikely that the other server(s) will also be unavailable.

☞ For the best possible availability, it is recommended to set short timeouts for an initial request (e.g. timeout after 10 seconds). If the initial request fails, the same request should be sent immediately to the second server, but this time with a longer timeout (e.g. 60 seconds).

4 MGA AssistNow Online

AssistNow Online is u-blox's end-to-end Assisted GNSS (A-GNSS) solution for receivers that have access to the internet. Data supplied by the AssistNow Online Service is used by a u-blox GNSS receiver in order to substantially reduce Time To First Fix (TTFF), even under poor signal conditions. The data provided includes time aiding data, earth orientation parameters and satellite almanacs, ephemerides, and health information.

This section describes the protocol between the u-blox MGA AssistNow Online Server, and the MGA AssistNow Online Client requesting information.

4.1.1 Request parameters

The following parameters are supported:

Key name	Unit/Range	Mandatory/ Optional	Default	Valid values	Comment
token	String	Mandatory	N/A	N/A	The authorization token supplied by u-blox when a client registers to use the service
datatype	String	Optional	N/A	eph, alm, aux, pos	A comma separated list of the data types required by the client. Time data is always returned for each request (even if this parameter is not supplied).
format	String	Optional	mga	mga, aid	Specifies the format of the data returned (mga = UBX-MGA-* (M8 onwards); aid = UBX-AID-* (u7 or earlier))
gnss	String	Optional	gps	gps, qzss, glo, bds, gal	A comma separated list of the GNSS for which data should be returned. gps = GPS qzss = QZSS glo = GLONASS bds = BeiDou gal = Galileo
lat	Numeric [degrees]	Optional	N/A	min: -90, max: 90	Approximate user latitude in WGS 84 in units of degrees and fractional degrees.
lon	Numeric [degrees]	Optional	N/A	min: -180, max: 180	Approximate user longitude in WGS 84 in units of degrees and fractional degrees.
alt	Numeric [meters]	Optional	0	min: -1000, max: 50000	Approximate user altitude above WGS 84 ellipsoid in units of meters.
pacc	Numeric [meters]	Optional	300000	min: 0, max: 6000000	Approximate accuracy of the submitted position (see position parameters note below).
tacc	Numeric [seconds]	Optional	10	min: 0 max: 3600	The timing accuracy (see time parameters note below).
latency	Numeric [seconds]	Optional	0	min: 0 max: 3600	Typical latency between the time the server receives the request, and the time when the assistance data arrives at the GNSS receiver. The server can use this value to correct the time that is transmitted to the client.
filteronpos	(no value required)	Optional	N/A	N/A	If present, the ephemeris data returned to the client will only contain data for the satellites which are likely to be visible from the approximate position provided (see lat, lon, alt and pacc parameters). If an approximate position is not provided, no filtering will be performed.
filteronsv	String	Optional	N/A	N/A	A comma separated list of u-blox gnssId:svId pairs. The ephemeris data returned to the client will only contain data for the listed satellites

Table 4: MGA AssistNow Online parameters

☞ For u-blox M8 and later products, it is recommended to leave the "format" parameter with the default value "mga", because other format values will not be supported in future generations.

For example, all the ephemeris, almanac and auxiliary data for both GPS and GLONASS can be requested as follows (if a valid token is provided):

```
/GetOnlineData.ashx?token=XXXXXXXXXXXXXXXXXXXXX;gnss=gps,glo;datatype=eph,alm,aux;
```

☞ To form a complete URL, the above example requires a valid prefix, such as `http://online-live1.services.u-blox.com` or `https://online-live1.services.u-blox.com`

4.1.2 Best practices

4.1.2.1 Request frequency

Excessive use of the service from the same IP address will result in blocked requests. A device is only expected to request data at startup; the receiver will keep itself updated directly from the satellites thereafter. The data provided by the service is updated when the data from the satellites changes. This is typically every 30-60 min.

4.1.2.2 Position parameters (lat, lon, alt and pacc)

The position parameters (lat, lon, alt and pacc) are optional and are used by the server for two purposes:

1) If the filteronpos parameter is provided, the server determines the currently visible satellites at the user position, and only sends the ephemeris data of those satellites that should be in view at the location of the user. This reduces bandwidth requirements. In this case, the "pacc" value is taken into account, meaning that the server returns all SVs visible in the given uncertainty region.
2) If the datatype "pos" is requested, the server returns the position and accuracy in the response data. When the server supplies this data to the u-blox GNSS receiver, depending on the accuracy of the provided data, the receiver can then choose to select a better startup strategy.
   For example, if the position is accurate to 100 km or better, the u-blox receiver chooses to go for a more optimistic startup strategy. This results in quicker startup time. The receiver decides which strategy to choose, depending on the "pacc" parameter. If the submitted user position is less accurate than what is specified with the "pacc" parameter, then the user experiences prolonged or even failed start-ups.

☞ Use HTTPS to have data carried solely within an encrypted connection and be protected from man-in-the-middle attacks in the same way that any HTTPS data is

4.1.2.3 Time parameters (tacc and latency)

Time data is always returned with each request. The time data refers to the time at which the response leaves the server, corrected by an optional "latency" value. This time data provided by the service is accurate to approximately 10 ms, but by default the time accuracy is +/-10 seconds in order to account for network latency and any time between the client receiving the data and it being provided to the receiver.

If both the network latency and the client latency can safely be assumed to be very low (or are known), then the client can choose to set the accuracy of the time message (tacc) to a much smaller value (e.g. 0.5 s). This results in a faster TTFF. The latency value can also be adjusted as appropriate. However, these parameters should be used with caution: if the time accuracy is not correct when the time data reaches the receiver, the receiver may experience prolonged or even failed start-ups.

For optimal results, the client should establish an accurate sense of time itself (by maintaining local RTC via a backup supply or using a u-blox cellular modem and "RTC sharing" functionality) and then modify the time data received from the service as appropriate.

5 MGA AssistNow Offline

Users of AssistNow Offline are expected to download data from the AssistNow Offline Service, specifying the time period they want covered (1 to 5 weeks) and the type(s) of GNSS to use. This data must be transferred to a u-blox receiver, so that it can estimate the positions of the satellites when no better data is available. Using these estimates does not provide as accurate a position fix as if current ephemeris data is used, but it allows much faster TTFFs in nearly all cases. See Figure 3.

The data obtained from the AssistNow Offline Service is organized by date, normally a day at a time. Consequently the more weeks for which coverage is requested, the larger the amount of data to handle; see Table 3. Similarly, each different GNSS requires its own data. In extreme cases, the service may provide several hundred kilobytes of data. This amount can be reduced by requesting a lower resolution, but this has a small negative impact on both position accuracy and TTFF (Figure 3).

5.1.1 Request parameters

This section describes the protocol between the u-blox AssistNow Offline Server and the AssistNow Offline Client that requests the information.

The information exchange is based on the HTTP protocol. Upon reception of an HTTP GET request, the server responds with the UBX-MGA-ANO messages in binary format, or an error string in text format. After delivery of all of the data, the server terminates the connection.

The response data is ordered by timestamp and then by GNSS. Hence, the response data appears as follows:

```
04/09/2013 [GPS SV1, GPS SV2, GPS SV3....GPS SV32]
04/09/2013 [GLO SV1, GLO SV2, GLO SV3....GLO SV24]
05/09/2013 [GPS SV1, GPS SV2, GPS SV3....GPS SV32]
05/09/2013 [GLO SV1, GLO SV2, GLO SV3....GLO SV24]
.
.
.
09/10/2013 [GPS SV1, GPS SV2, GPS SV3....GPS SV32]
09/10/2013 [GLO SV1, GLO SV2, GLO SV3....GLO SV24]
```

The following parameters are supported:

Key name	Receivers	Unit/Range	Mandatory /Optional	Default	Valid values	Comment
token	All	String	Mandatory	N/A	N/A	The authorization token supplied by u-blox when a client registers to use the service
gnss	All	String	Mandatory	N/A	gps, glo	A comma separated list of the GNSS for which data should be returned.
format	All	String	Optional	mga	mga, aid	Specifies the format of the data returned (mga = UBX-MGA-* (M8 onwards); aid = UBX-AID-* (u7 or earlier))
period	U8 and above	Numeric [weeks]	Optional	4	One of: 1, 2, 3, 4 or 5	The number of weeks into the future that the data will be valid. Data can be requested for up to 5 weeks into the future. If this value is not provided, the server assumes a period of 4 weeks
resolution	U8 and above	Numeric [days]	Optional	1	One of: 1, 2 or 3	The resolution of the data: 1=every day, 2=every other day, 3=every third day
days	U7 and below	Numeric [days]	Optional	14	One of: 1, 2, 3, 5, 7, 10 or 14	The number of days into the future that the data will be valid. If this value is not provided, the server assumes a value of 14 days
almanac	MGA only		Optional		gps, glo, bds, gal, qzss	Added before MGA data is uploaded

Table 5: MGA AssistNow Offline parameters

☞ For u-blox M8 and later products, it is recommended to leave the "format" parameter with the default value "mga", because other format values will not be supported in future generations.

5.1.2 Best Practices

5.1.2.1 Request frequency

Excessive use of the service from the same IP address will result in blocked requests. The offline service typically updates once or twice a day, so frequent requests are not necessary.

5.1.2.2 Almanac Data and GLONASS

The receiver needs a valid set of GLONASS almanac data in order to use the GLONASS offline data. If the receiver does not have this, it can be obtained from the MGA AssistNow Online service (see section 4).

GPS Offline does not need an almanac but using one is highly recommended since it improves the performance significantly.

5.1.2.3 Time, Position and Almanac

While AssistNow Offline can be used on its own, it is expected that the user will provide estimates of the receiver's current position and the current time, and ensure that a reasonably up-to-date almanac is available.

In most cases, this information is likely to be available without the user needing to do anything.

For example, where the receiver is connected to a battery backup power supply and has a functioning real time clock (RTC), the receiver will keep its own sense of time and will retain the last known position and any almanac.

However, should the receiver be completely unpowered before start-up, then it will greatly improve TTFF if time, position and the almanac can be supplied in some form.

Almanac data has a validity period of several weeks and can be downloaded from the AssistNow Offline service.

It can then be stored in the host for uploading on receiver startup, or it can be transferred to the receiver straight away and preserved there (provided suitable non-volatile storage is available).Obviously, where a receiver has a functioning RTC, it should be able to keep its own sense of time, but where no RTC is fitted (or power is completely turned off), providing a time estimate via the UBX-MGA-INI-TIME_UTC message will be beneficial.

Similarly, where a receiver has effective non-volatile storage, the last known position will be recalled, but if this is not the case, then it will help TTFF to provide a position estimate via one of the UBX-MGA-INI-POS_XYZ or UBX-MGA-INI-POS_LLH messages.

Where circumstances prevent the provision of all three of these pieces of data, providing some of them is likely to be better than none at all.

6 AssistNow Autonomous

The assistance scenarios covered by *AssistNow Online* and *AssistNow Offline* require an online connection and a host that can use this connection to download aiding data and provide this to the receiver when required. The *AssistNow Autonomous* feature provides functionality similar to *AssistNow Offline* without the need for a host and a connection. Based on a broadcast ephemeris downloaded from the satellite (or obtained by *AssistNow Online*), the receiver can autonomously (i.e. without any host interaction or online connection) generate an accurate satellite orbit representation that is usable for navigation much longer than the underlying broadcast ephemeris was intended for. This makes downloading new ephemeris or aiding data for the first fix unnecessary for subsequent start-ups of the receiver.

For a more detailed description of AssistNow Autonomous, see the u-blox M8 Receiver Description document [1]

7 MGA server addresses

7.1 AssistNow Online

There are two AssistNow Online servers available, providing redundancy in the event of server unavailability. The 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 provides greater system reliability.

An example request for aiding data requiring GPS and GLONASS ephemeris is as follows (a valid token should be provided):

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

If SSL is required, use https instead of http.

7.2 AssistNow Offline

Like the Online service, two server addresses provide for redundancy:

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

An example request for GPS aiding data for 1 week with resolution = 1 day is as follows (a valid token should be provided):

http://offline-live1.services.u-blox.com/GetOfflineData.ashx?token=XXXXXXXXX;gnss=gps;period=1;resolution=1

If SSL is required, use https instead of http.

8 MGA access tokens

When using MGA services for the first time, obtain an MGA access token from the following URL:

☞ http://www.u-blox.com/services-form.html.

Fill in the form to request a token, which upon approval allows access to the servers. This token can then be used in multiple instances.

9 Host software and the MGA library

This section describes the host software required to make use of MGA services and the u-blox MGA library. References are made to the u-blox M8 UBX message protocol. For a detailed description of the content of these messages, see the u-blox M8 Receiver Description document [1].

9.1 Host software AssistNow Online

As u-blox receivers do not connect directly with the internet, the AssistNow Online system requires the host system that contains the receiver to connect to the internet, download the data from the AssistNow Online Service and forward it to the receiver. This can also be achieved with u-blox cellular modules; see section 9.5.

The simplest case is to fetch the data from the AssistNow Online Service (by means of a single HTTP GET request), and send the resulting data to the receiver. The data returned by the AssistNow Online Service is a sequence of UBX-MGA messages, starting with an estimate of the current time in the form of a UBX-MGA-INI-TIME_UTC message.

☞ It is very important that the receiver has started up fully before sending it any assistance data. The first assistance message provides the receiver with a sense of time. If this message is not received for any reason, the receiver will not use the rest of the assistance data.

9.2 Host software AssistNow Offline

The downloaded Offline data is encoded in a sequence of UBX-MGA-ANO messages, one for every SV for every day of the period covered. Thus, for example, data for all GPS SVs for 4 weeks contains in excess of 900 separate messages, taking up around 70 kilobytes.

For u-blox receivers that have flash storage, all the data can be directly transferred to the flash until it is needed. These receivers automatically select the most appropriate data to use at any time. See section 9.2.1 for further details on flash-based AssistNow Offline.

Receivers without flash storage or with insufficient spare flash memory can also use AssistNow Offline. In this case, the customer's system must store the AssistNow Offline data until the receiver needs it and then transfer only the data needed for immediate use. See section 9.2.2 for further details on host-based AssistNow Offline.

9.2.1 Flash-based AssistNow Offline

Flash-based AssistNow Offline functionality means that AssistNow Offline data is stored in the flash memory connected to the chip (e.g. NEO-M8N).

The user's host system downloads the data from the AssistNow Offline service when an internet connection is available, and then delivers the data to the GNSS receiver. As the total amount of data to be transferred is large (typically around 100 kilobytes) and writing to flash memory is slow, the transfer must be done in blocks of up to 512 bytes, one at a time. The UBX-MGA-FLASH-DATA message is used to transmit each block to the receiver.

AssistNow Offline data stored in flash memory is not affected by any reset of the receiver. To clear the data, completely erase the whole flash memory or overwrite it with a new set of AssistNow Offline data. Transferring a dummy block of data (e.g. all zeros) also has the effect of deleting the data, although this uses a small amount of flash storage.

9.2.1.1 Flash-based storage procedure

The following steps are a typical sequence for transferring AssistNow Offline data into the receiver's flash memory:

- The host downloads a copy of a latest data from the AssistNow Offline service and stores it locally.
- It sends the first 512 bytes of that data using the UBX-MGA-FLASH-DATA message.
- It awaits a UBX-MGA-FLASH-ACK message in reply.
- Based on the contents of the UBX-MGA-FLASH-ACK message, the host sends the next block, resends the last block or aborts the whole process.

- The above three steps are repeated until all the rest of the data has been successfully transferred (or the process has been aborted).
- The host sends an UBX-MGA-FLASH-STOP message to indicate completion of the transfer.
- The host awaits the final UBX-MGA-FLASH-ACK message in reply. Background processing in the receiver prepares the transferred data for use at this stage. Particularly if the receiver is currently busy, this may take many seconds, so the host must be prepared for a delay before the UBX-MGA-FLASH-ACK is seen.

Note that the final block may be smaller than 512 bytes (where the total data size is not perfectly divisible by 512). Also, the UBX-MGA-FLASH-ACK messages are distinct from the UBX-MGA-ACK messages used for other AssistNow functions.

Any existing data will be deleted as soon as the first block of new data arrives, so no useful data will be available until the completion of the data transfer. Each block of data has a sequence number, starting at zero for the first block. In order to guard against invalid partial data downloads, the receiver will not accept blocks that are out of sequence.

9.2.2 Host-based AssistNow Offline

If the u-blox receiver has no embedded Flash (such as in MAX-M8C), it can use host-based AssistNow Offline. The user's host system downloads the data from the AssistNow Offline service when an internet connection is available. The host stores the AssistNow Offline data so that it is available when the u-blox receiver needs it.

When the receiver needs the data, the host transfers just the relevant portion of the data to the receiver, so that the receiver can start using it. This is achieved by reading the date of each message and selecting only those UBX-MGA-ANO messages with a date-stamp nearest the current time. As each message is a complete UBX message, it can be sent directly to the receiver with no extra packaging.

When parsing the data obtained from the AssistNow Offline service, the following points should be noted:

- The data is made up of a sequence of UBX-MGA-ANO messages.
- Customers should not rely on the messages all being a fixed sized, but should read their length from the UBX header to work out where the message ends (and where the next begins).
- Each message indicates the SV for which it is applicable through the svId and gnssId fields.
- Each message contains a date-stamp within the year, month and day fields.
- Midday (UTC) on the day indicated should be considered the time when the data is most applicable.
- The messages will be ordered chronologically, earliest first.
- Messages with same date-stamp will be ordered by ascending gnssId and then ascending svId.

9.2.2.1 Host-based procedure

The following steps are a typical sequence for host-based AssistNow Offline:

- The host downloads a copy of a latest data from the AssistNow Offline service and stores it locally.
- It is recommended to also download a current set of almanac data. These are also available from the AssistNow Offline service.
- It waits until it wants to use the GNSS receiver.
- Transfers any almanac (e.g. UBX-MGA-GPS-ALM for GPS), position estimate (UBX-MGA-INI-POS) and/or time estimate (UBX-MGA-INI-TIME) to the receiver.
- It scans through AssistNow Offline data looking for entries with a date-stamp that most closely matches the current (UTC) time/date.
- It sends each such UBX-MGA-ANO message to the receiver.

☞ When data has been downloaded from the AssistNow Offline service with the (default) resolution of one day, the closest matching date-stamp is selected simply by looking for ones with the current (UTC) date.

9.3 Optional message flow control

u-blox GNSS receivers aim to process incoming messages as quickly as possible, but there will always be a small delay in processing each message. Transferring assistance data to the receiver can involve sending as many as one hundred individual messages to the receiver, one after the other. If the communication link is fast, and/or

the receiver is busy (trying to acquire new signals), it is possible that the internal buffers will overflow and some messages will be lost. To avoid this, u-blox receivers support an optional flow control mechanism for assistance.

☞ If required, the user can select to employ flow control, but in most cases this is likely to prove unnecessary.

Flow control is activated by setting the ackAiding parameter in the UBX-CFG-NAVX5 message. As a result, the receiver will issue an acknowledgement message (UBX-MGA-ACK) for each assistance message it successfully receives. The host software can examine these acknowledgements to establish whether there were any problems with the data sent to the receiver and deduce (by the lack of acknowledgement) if any messages have been lost. It may then be appropriate to resend some of the assistance messages.

The simplest way to implement flow control would be to send one UBX-MGA assistance message at a time, waiting for the acknowledgement, before sending the next. However, such a strategy is likely to introduce significant delays into the whole assistance process. The best strategy will depend on the amount of assistance data that is being sent and the nature of the communications link (e.g. baud rate of serial link). u-blox recommends that when customers are developing their host software they start by sending all assistance messages and then analyze the resulting acknowledgements to see whether there have been significant losses. Adding small delays during the transmission may be a simple but effective way to avoid substantial loss of data.

9.4 MGA library sample code

u-blox can provide a platform-independent library to help customers easily implement clients for accessing the MGA services (both AssistNow Online and Offline). The aim of this library, called libMGA, is to facilitate the easy integration of MGA services into a customer's application, while avoiding the need to have a detailed knowledge of the underlying communication protocols between the application and the MGA service, and between the application and the receiver. Figure 5 shows the intended implementation method when using the library.

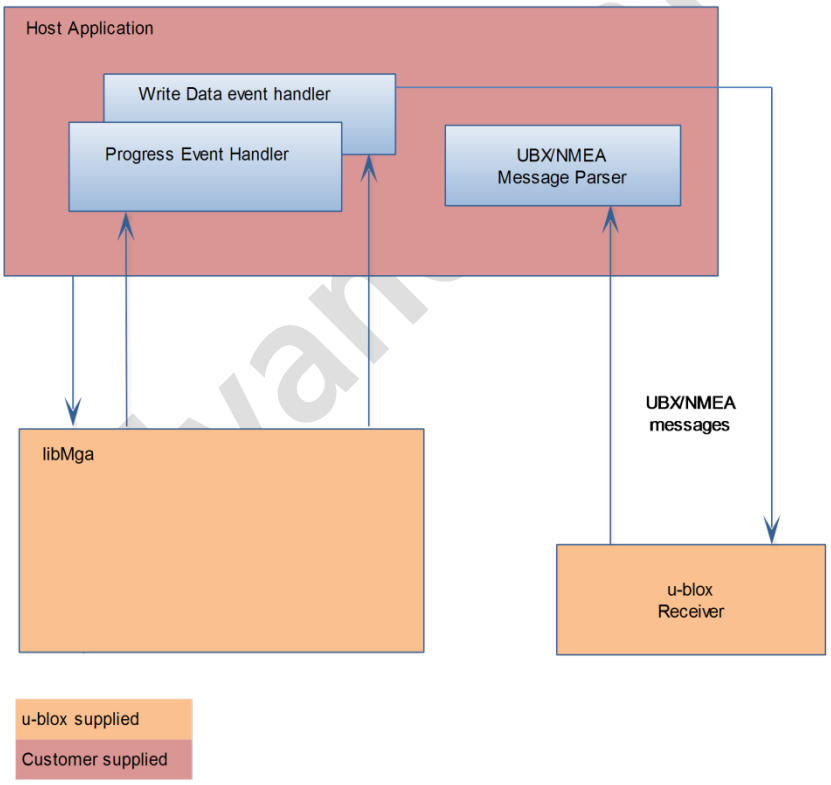

Figure 5: libMGA architecture

During implementation, keep the following points in mind:

1. The user application calls the libMGA API function just like any other library.

2. The data stream to and from the receiver is handled by the user application.
3. The application passes each UBX message individually on to the libMGA.
4. libMGA uses callbacks to:
    - write data to the receiver
    - report on operational progress

☞ For more information, see the libMGA v1.04 Application Note [3]. The libMGA code is available to customers via the local u-blox sales office.

9.5 MGA services used with u-blox cellular modules

Host software for MGA services has been integrated into the u-blox Cellular modules. This removes the need for customers to implement software to communicate with the assistance servers. See the GNSS Implementation application note [5] for further information.

10 MGA service migration

The MGA service has been set up to provide multi-GNSS assistance data over the internet to all u-blox receivers. This section addresses customers currently using u-blox 7 and previous u-blox generations who are migrating to the MGA service. Table 6 summarises the key points required to migrate between services.

Service	Method	Supported GNSS	Receivers	Message Format	Access Control	Server Names
MGA Online	HTTP/HTTPS	GPS/GLO/QZSS/ BDS/GAL	All	UBX-MGA-* or UBX-AID-* (GPS only)	Authorization token	online-live1.services.u-blox.com online-live2.services.u-blox.com
MGA Offline	HTTP/HTTPS	GPS/GLO	M8 and above	UBX-MGA-*	Authorization token	offline-live1.services.u-blox.com offline-live2.services.u-blox.com
Legacy Online	UDP/TCP	GPS	M8 and below	UBX-AID-*	Username and password	agps.u-blox.com
Legacy Offline	HTTP	GPS	U7 and below	UBX-AID-ALP	none	alp.u-blox.com

Table 6: Service migration

Table 7 shows how to migrate the service request parameters from legacy services to the MGA services.

Legacy Online Service	MGA Online Service
user/pwd	token
cmd	gnss/datatype/filteronpos
lat	lat
lon/long	lon
alt	alt
ex,ey,ez	lat/lon/alt
pacc	pacc
latency	latency/tacc

Table 7: Parameter migrations

Table 8 shows how to migrate the contents of the command (cmd) parameter

Legacy Online Service	MGA Online Service
cmd=full	gnss=gps;datatype=pos,eph,alm,aux;filteronpos
cmd=aid	gnss=gps;datatype=pos,eph,aux;filteronpos
cmd=aidfull	gnss=gps;datatype=pos,eph,alm,aux
cmd=eph	gnss=gps;datatype=eph;filteronpos
cmd=ephfull	gnss=gps;datatype=eph
cmd=alm	gnss=gps;datatype=alm

Table 8: Command parameter migrations

In addition to converting the parameters as above, the "format" parameter must be set as follows:
format=aid

Appendix

A Glossary

Abbreviation	Definition
A-GNSS	Assisted Global Navigation Satellite System
API	Application Programming Interface
BeiDou / BDS	Chinese satellite system
Galileo / GAL	European satellite system
GLONASS	Russian satellite system
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
MGA	Multiple GNSS Assistance
QZSS	Quasi-Zenith Satellite System
SSL	Secure Sockets Layer
SV	Space Vehicle (GPS satellite)
TTFF	Time-To-First-Fix
UBX	u-blox (messaging protocol)
WGS	World Geodetic System

Table 9: Explanation of abbreviations used

Related documents

[1] u-blox M8 Receiver Description Including Protocol Specification Docu No UBX-13003221
[2] u-center GNSS evaluation software for Windows User Guide, Docu No UBX-13005250
[3] libMGA v1.11 - Multiple GNSS Assistance Library Application Note, Docu No UBX-15030902
[4] u-blox7 to u-blox M8 Software Migration Guide, Docu No UBX-13003254
[5] GNSS-Implementation Application Note, Docu No UBX-13001849

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

Revision history

Revision	Date	Name	Status / Comments
R01	29-Oct-2014		Objective Specification
R02	06-Mar-2015	hhic	Advance Information; Document restructured and updated.
R03	14-Dec-2015	hhic	Support for Galileo and BeiDou added
R04	04-Aug-2016	jhak	Support for HTTP over SSL added
R05	05-Dec-2017	jhak	Almanac is now available from AssistNow Offline service and recommended to be used.

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