



Qualcomm Technologies, Inc.

# Qualcomm Aware™ Positioning Service User Beacon API

Reference Manual

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# Revision history

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Revision	Date	Description
AD	October 2024	Updated the product name from Qualcomm Terrestrial Positioning Service (TPS) to Qualcomm Aware™ Positioning Service in the entire document.
AC	December 2023	Updated legal statements and legends
AB	November 2023	<ul style="list-style-type: none"><li>Updated the document to conform to current documentation standards.</li><li>Added Section 3.3 <i>Support for expiration date and TTL</i>.</li></ul>
AA	June 2022	Initial release

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# 1 Introduction to user beacon API

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Qualcomm Aware™ Positioning Service API, formerly known as Skyhook Precision Location API, provides access to positioning information derived from analyzing positioning anchors such as Wi-Fi access points and cell IDs in known locations.

The user beacon API is used to submit beacons, such as Wi-Fi access points or cellular base stations, and their associated known reference locations to the positioning service. These beacon locations can be used for positioning in subsequent location calls.

The submitted user beacons will effectively override any known, crowd-sourced reference location for that beacon in the positioning service database. The positioning service may tune the beacon locations so that the users can receive more accurate location information. Beacon locations may be tuned at an individual API key level, and are not accessible publicly.

## **API limitations**

Opting for the API approach has benefits pertaining to server-side features, but is less robust than client-side implementations. Few SDK or embedded client features such as smoothing between location sources, fast time-to-fix, MAC address deduplication, power optimization, and offline location are not available with the API method.

Tuning of user beacons is applicable to both API and SDK implementations. In SDK implementations, beacons tuned by the positioning service user beacon API are transmitted to devices via tiles specific to the API key or project to which they have been applied.

In addition, an application or device-specific code must be created to enable the collection of Wi-Fi and cell radio scans. For recommendations in these areas to optimize the use of cloud API, contact the Qualcomm Aware™ Positioning Service team at [support.tps@qti.qualcomm.com](mailto:support.tps@qti.qualcomm.com).

## **Scope**

This document provides an overview of the positioning service user beacon API, its implementation to determine the geographic location of connected devices, and API requests and responses.

## **Technical assistance**

For assistance or clarification, write to [support.tps@qti.qualcomm.com](mailto:support.tps@qti.qualcomm.com).

## 2 Positioning service user beacon API implementation

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The positioning service user beacon API corrects the geographic location that has been previously reported by a Location call. This API call corrects the known position of the access points and cell towers so that subsequent Location calls are placed at the location provided by the user.

There is no validation performed on the location provided by the user. If an incorrect location is provided, then the Location call will be equally inaccurate. A positioning service user beacon API call overrides any previous calls, and corrects the access points and position of cell towers to the latest location submitted by the user.

### API key

An evaluation license agreement is required to obtain an API key for the positioning service. For more information on the license agreement, contact the Qualcomm Aware™ Positioning Service team at [sales.tps@qti.qualcomm.com](mailto:sales.tps@qti.qualcomm.com).

### Unique device ID

With each unique location request, it is recommended to submit a unique device ID or `user` for the end-user device. This enables more accurate location results and impacts the redundancy of how location data is processed and weighted for optimization. If `user` is not provided, reporting and API performance may be impacted.

**NOTE** Individual device IDs are not stored permanently in Qualcomm's system, but are stored with a rotating hash in accordance with Qualcomm user and commercial privacy policies.

### Endpoint URL

The positioning service user beacon API endpoint URL of JSON-formatted requests is <https://global.skyhook.com/wps2/json/user-beacon>.

### HTTP authentication methods

The positioning service user beacon API request can be authenticated using:

- **HTTP headers:** Provide the authorized key in the `Skyhook-Auth-Key` header and the username associated with the key in `Skyhook-Auth-User`.
- **HTTP URL parameters:** Provide the authorized key and username associated with the key at the end of the user beacon API endpoint URL.

```
https://global.skyhook.com/wps2/json/user-beacon?key="<API  
KEY>&user=<USERNAME>"
```

# 3 Positioning service user beacon API request

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## Description

Provides a list of user beacons (Wi-Fi access points and cell towers) scanned by the client.

## Endpoint URL

The positioning service user beacon API endpoint URL of JSON-formatted requests is <https://global.skyhook.com/wps2/json/user-beacon>.

## HTTP method

POST

## Syntax

```
{  
  "wifiAccessPoints": [...],  
  "cellTowers": [...],  
}
```

## Parameters

Parameter	Values	Description
wifiAccessPoints	–	List of entries corresponding to Wi-Fi access points and their associated locations.
cellTowers	–	List of entries corresponding to cell towers and their associated locations. The contents of each entry depend on the type of cell tower: GSM, LTE, UMTS, WCDMA, CDMA, NB-IoT, NR.

## 3.1 Wi-Fi access points

### Description

Provides a list of entries corresponding to the Wi-Fi access points scanned by the client.

### Syntax

```
{  
  "macAddress": "00:0C:41:82:D8:8C",  
}
```

```

"ssid": "network",
"frequency": 2484,
"location": {
  "lat": 42.351052,
  "lon": -71.049292,
  "alt": 35
}

```

## Parameters

Parameter	Values	Description	
macAddress	–	A string of hexadecimal characters representing a 6-byte MAC address. Pairs of hexadecimal characters are separated by colon (:).	
ssid	–	(Optional) Service Set Identifier (SSID) of the access point.	
frequency	–	(Optional) Frequency of scanned Wi-Fi access point, in MHz.	
location	–	Location of the Wi-Fi access point.	
	lat	–	Latitude expressed in decimal degrees using floating point values, using the WGS84 datum.
	lon	–	Longitude expressed in decimal degrees using floating point values, using the WGS84 datum.
	alt	–	(Optional) Altitude of the Wi-Fi access point, in meters.

## 3.2 Cell tower group

### Description

The following syntax shows the fields that each cell tower can have in general, and each field may have a different meaning depending on the `radioType`. Each cell tower must contain either a `centroid` or an `antenna` location element, which corresponds to the location of the cell tower.

### Syntax

```

{
  "radioType": "gsm",
  "mobileCountryCode": 722,
  "mobileNetworkCode": 310,
  "locationAreaCode": 8022,
  "cellId": 32508,
  "neighborId": 230,
  "channel": 40,
  "band": "GSM 480",
  "coverage": 35,
  "centroid": {
    "lat": 42.351052,
    "lon": -71.049292,
    "alt": 35
  }
}

```



```

},
"antenna": {
  "lat": 42.358452,
  "lon": -71.044692,
  "alt": 25,
  "azimuth": 35.5,
  "vertTilt": 8.9,
  "beamWidth": 5.3,
  "vendor": "skyhook",
  "repeaterId": 1234
}
}

```

## Parameters

Each `centroid` element can contain the following fields.

Parameter	Values	Description
lat	–	Latitude of the centroid expressed in decimal degrees using floating point values, using the WGS84 datum.
lon	–	Longitude of the centroid expressed in decimal degrees using floating point values, using the WGS84 datum.
alt	–	(Optional) Altitude of the cell tower location, in meters.

Each `antenna` element can contain the following fields.

Parameter	Values	Description
lat	–	Latitude of the centroid expressed in decimal degrees using floating point values, using the WGS84 datum.
lon	–	Longitude of the centroid expressed in decimal degrees using floating point values, using the WGS84 datum.
alt	–	(Optional) Altitude of the cell tower location, in meters.
azimuth	Range: 0° to 360°	(Optional) Horizontal orientation of the antenna.
vertTilt	Range: 0° to 360°	(Optional) Vertical tilt of the antenna.
beamWidth	Range: 0° to 360°	(Optional) Beam width of the antenna.
vendor	–	(Optional) Vendor of the antenna; string.
repeaterId	–	(Optional) ID of the antenna repeater; integer.

An additional optional field `antennaPos` can be submitted to indicate that the location is an antenna-based location. The `antennaPos` element can contain the following fields.

**NOTE** If `antennaPos` is not supplied, the location is considered as centroid-based location.

Parameter	Values	Description
azimuth	Range: 0° to 360°	(Optional) Horizontal orientation of the antenna.
vertTilt	Range: 0° to 90°	(Optional) Vertical tilt of the antenna.

Parameter	Values	Description
beamWidth	Range: 0° to 360°	(Optional) Beam width of the antenna.
vendor	–	(Optional) Vendor of the antenna; string.
repeaterId	–	(Optional) ID of the antenna repeater; integer.

### 3.2.1 GSM cell tower

#### Description

Provides a list of entries corresponding to the GSM cell towers scanned by the client.

#### Syntax

```
{
  "radioType": "gsm",
  "mobileCountryCode": 722,
  "mobileNetworkCode": 310,
  "locationAreaCode": 8022,
  "cellId": 32508,
  "neighborId": 230,
  "channel": 40,
  "band": "GSM 480",
  "coverage": 1000
}
```

#### Parameters

Parameter	Values	Description
radioType	–	Type of the cell tower.
mobileCountryCode	–	Indicates the mobile country code.
mobileNetworkCode	–	Indicates the mobile network code.
locationAreaCode	–	Indicates the local area code.
cellId	–	Indicates the cell ID.
neighborId	Range: 0 to 63	(Optional) GSM BSIC composed of a 3-bit network color code (NCC) and a 3-bit base station color code (BCC).
channel	–	(Optional) 16-bit GSM channel number (ARFCN).
band	GSM 480	(Optional) GSM band.
coverage	–	Radius of cell tower coverage, in meters.

### 3.2.2 UMTS/WCDMA cell tower

#### Description

Provides a list of entries corresponding to the UMTS/WCDMA cell towers scanned by the client.

**Syntax**

```
{
  "radioType": "UMTS",
  "mobileCountryCode": 730,
  "mobileNetworkCode": 2,
  "locationAreaCode": 63010,
  "cellId": 132105,
  "neighborId": 230,
  "channel": 40,
  "coverage": 1000
}
```

**Parameters**

Parameter	Values	Description
radioType	UMTS or WCDMA	Type of the cell tower.
mobileCountryCode	–	Indicates the mobile country code.
mobileNetworkCode	–	Indicates the mobile network code.
locationAreaCode	–	(Optional) Indicates the local area code.
cellId	–	UMTS UC_ID (combination of RNDId and Cell_ID) with a total of 28 bits as per 3GPP Technical Specification 25.401.  <b>NOTE</b> Populating cell ID with 16 bits may result in incorrect tower information.
neighborId	Range: 0 to 511	(Optional) UMTS local cell ID (PSC).
channel	–	(Optional) 16-bit UMTS channel number (UARFCN).
coverage	–	Radius of cell tower coverage, in meters.

**3.2.3 LTE cell tower****Description**

Provides a list of entries corresponding to the LTE cell towers scanned by the client.

**Syntax**

```
{
  "radioType": "lte",
  "mobileCountryCode": 730,
  "mobileNetworkCode": 2,
  "locationAreaCode": 63010,
  "cellId": 132105,
  "neighborId": 230,
  "channel": 40,
}
```

```

    "coverage": 1000
  }

```

### Parameters

Parameter	Values	Description
radioType	–	Type of the cell tower.
mobileCountryCode	–	Indicates the mobile country code.
mobileNetworkCode	–	Indicates the mobile network code.
locationAreaCode	–	(Optional) Indicates the LTE tracking area code (TAC).
cellId	–	LTE E-CGI (EUCID); 28 bits.
neighborId	Range: 0 to 503	(Optional) ID of LTE local cell (PCI).
channel	–	(Optional) 18-bit 3GPP channel number (EARFCN).
coverage	–	Radius of cell tower coverage, in meters.

## 3.2.4 CDMA cell tower

### Description

Provides a list of entries corresponding to the CDMA cell towers scanned by the client.

### Syntax

```

{
  "radioType": "cdma",
  "mobileNetworkCode": 2,
  "locationAreaCode": 63010,
  "cellId": 132105,
  "neighborId": 230,
  "channel": 40,
  "band": "CDMA 1800",
  "coverage": 1000
}

```

### Parameters

Parameter	Values	Description
radioType	–	Type of the cell tower.
mobileNetworkCode	–	Indicates the CDMA system identifier (SID).
locationAreaCode	–	Indicates the CDMA network identifier (NID).
cellId	–	Indicates the CDMA base system identifier (BSID).
neighborId	Range: 0 to 511	(Optional) ID of CDMA local cell (PNCODE).
channel	–	(Optional) 16-bit CDMA channel number.

Parameter	Values	Description
band	–	(Optional) CDMA band; string.
coverage	–	Radius of cell tower coverage, in meters.

### 3.2.5 NB-IoT cell tower

#### Description

Provides a list of entries corresponding to the NB-IoT cell towers scanned by the client.

#### Syntax

```
{
  "radioType": "nbiot",
  "mobileCountryCode": 730,
  "mobileNetworkCode": 2,
  "locationAreaCode": 63010,
  "cellId": 132105895657897,
  "neighborId": 230,
  "channel": 40,
  "coverage": 1000
}
```

#### Parameters

Parameter	Values	Description
radioType	–	Type of the cell tower.
mobileCountryCode	–	Indicates the mobile country code.
mobileNetworkCode	–	Indicates the mobile network code.
locationAreaCode	–	(Optional) Indicates the NB-IoT tracking area code (TAC).
cellId	–	NB-IoT cell ID; 28 bits.
neighborId	Range: 0 to 503	(Optional) ID of NB-IoT local cell (NCID).
channel	–	(Optional) 18-bit 3GPP channel number (EARFCN).
coverage	–	Radius of cell tower coverage, in meters.

### 3.2.6 NR tower (5G, New Radio)

#### Description

Provides a list of entries corresponding to the 5G NR cell towers scanned by the client.

#### Syntax

```
{
  "radioType": "nr",
```

```

"mobileCountryCode": 730,
"mobileNetworkCode": 2,
"locationAreaCode": 63010,
"cellId": 132105,
"neighborId": 230,
"channel": 40,
"coverage": 1000
}

```

### Parameters

Parameter	Values	Description
radioType	–	Type of the cell tower.
mobileCountryCode	–	Indicates the mobile country code.
mobileNetworkCode	–	Indicates the mobile network code.
locationAreaCode	–	(Optional) Indicates the 5G tracking area code (TAC).
cellId	–	5G NR cell ID (NCI); 36 bits.
neighborId	Range: 0 to 1007	(Optional) 5G local cell ID (PCI).
channel	–	(Optional) 24-bit 3GPP channel number (NRARFCN).
coverage	–	Radius of cell tower coverage, in meters.

## 3.3 Support for expiration date and TTL

The positioning service user beacon API now supports expiration date and time-to-live (TTL). This functionality is implemented both at the top level of JSON request and beacon level (AP or cell tower).

**NOTE** OEMs can choose to use either expiration date or TTL for a beacon type but not both.

### Syntax

```

{
  "apExpirationDate": "2023-03-17",
  "apTtl": 30,
  "cellExpirationDate": "2023-03-17",
  "cellTtl": 100,

  "wifiAccessPoints": [
    {
      "macAddress" : "00:0C:41:82:D8:8C",
      "ssid": "network",
      "frequency": 2484,
      "location": {
        "lat": 42.351052,
        "lon": -71.049292,
        "alt": 35
      }
    }
  ]
}

```

```

    },
    "expirationDate": "2023-03-17"
    "ttl": 60 #
  }
],
"cellTowers": [
  {
    "radioType": "gsm",
    "mobileCountryCode": 722,
    "mobileNetworkCode": 310,
    "locationAreaCode": 8022,
    "cellId": 32508,
    "neighborId": 230,
    "channel": 40,
    "band": "GSM 480",
    "coverage": 35,
    "antenna": {
      "lat": 42.351052,
      "lon": -71.049292,
      "alt": 35,
      "azimuth": 35.5,
      "vertTilt": 8.9,
      "beamWidth": 5.3,
      "vendor": "skyhook",
      "repeaterId": 1234
    },
    "expirationDate": "2023-03-17"
    "ttl": 60
  },
  ...
]
}

```

## Parameters

Parameter	Value	Description
apExpirationDate	–	The date on which all the APs in the request expire, unless explicitly overridden on a per AP level. Unit is <code>DATE</code> and the format is <code>yyyy-mm-dd</code> .
apTtl	–	The number of days until all the APs in the request expire, unless explicitly overridden on a per AP level. Unit is <code>days</code> .
cellExpirationDate	–	The date on which all the cell towers in the request expire, unless explicitly overridden on a per cell tower level. Unit is <code>DATE</code> and the format is <code>yyyy-mm-dd</code> .
cellTtl	–	The number of days until all the cell towers in the request expire, unless explicitly overridden on a per cell tower level. Unit is <code>days</code> .

Parameter	Value	Description
expirationDate	–	The date on which the individual beacons (APs or cell towers) in the request expire. Unit is <code>DATE</code> and the format is <code>yyyy-mm-dd</code> . This value overrides the expiration date or TTL of all APs and cell towers.
ttl	–	The number of days until the individual beacons (APs or cell towers) in the request expire. Unit is <code>days</code> . This value overrides the expiration date or TTL of all APs and cell towers.



## 4 Sample positioning service user beacon API for testing

---

A sample request of the positioning service user beacon API is as follows:

```
{
  "wifiAccessPoints": [
    {
      "macAddress": "00:0C:41:82:D8:8C",
      "ssid": "network",
      "frequency": 2484,
      "location": {
        "lat": 42.351052,
        "lon": -71.049292,
        "alt": 35
      }
    },
    {
      "macAddress": "00:0C:41:82:D8:8D",
      "ssid": "network",
      "frequency": 2484,
      "location": {
        "lat": 42.351082,
        "lon": -71.049592,
        "alt": 30
      }
    },
    {
      "macAddress": "00:0C:41:82:D8:5D",
      "ssid": "network",
      "frequency": 2484,
      "location": {
        "lat": 42.361082,
        "lon": -72.049592,
        "alt": 25
      }
    }
  ],
  "cellTowers": [
```

```
{
  "radioType": "gsm",
  "mobileCountryCode": 722,
  "mobileNetworkCode": 310,
  "locationAreaCode": 8022,
  "cellId": 32508,
  "neighborId": 230,
  "channel": 40,
  "band": "GSM 480",
  "coverage": 35,
  "antenna": {
    "lat": 42.351052,
    "lon": -71.049292,
    "alt": 35,
    "azimuth": 35.5,
    "vertTilt": 8.9,
    "beamWidth": 5.3,
    "vendor": "skyhook",
    "repeaterId": 1234
  }
},
{
  "radioType": "lte",
  "mobileCountryCode": 730,
  "mobileNetworkCode": 2,
  "locationAreaCode": 63010,
  "cellId": 132105,
  "neighborId": 230,
  "channel": 40,
  "coverage": 35,
  "centroid": {
    "lat": 42.358052,
    "lon": -71.044292,
    "alt": 25
  }
},
{
  "radioType": "cdma",
  "mobileNetworkCode": 2,
  "locationAreaCode": 63010,
  "cellId": 132105,
  "neighborId": 230,
  "channel": 40,
  "band": "CDMA 1800",
  "coverage": 35,
  "centroid": {
    "lat": 42.358452,
```

```
        "lon": -71.044692,  
        "alt": 25  
    }  
},  
{  
    "radioType": "nbiot",  
    "mobileNetworkCode": 2,  
    "locationAreaCode": 63010,  
    "cellId": 132105,  
    "neighborId": 230,  
    "channel": 40,  
    "coverage": 35,  
    "antenna": {  
        "lat": 42.358452,  
        "lon": -71.044692,  
        "alt": 25,  
        "azimuth": 35.5,  
        "vertTilt": 8.9,  
        "beamWidth": 5.3,  
        "vendor": "skyhook",  
        "repeaterId": 1234  
    }  
},  
{  
    "radioType": "nr",  
    "mobileCountryCode": 730,  
    "mobileNetworkCode": 2,  
    "locationAreaCode": 63010678487623,  
    "cellId": 132105,  
    "neighborId": 230,  
    "channel": 40,  
    "coverage": 35,  
    "antenna": {  
        "lat": 42.358452,  
        "lon": -71.044692,  
        "alt": 25,  
        "azimuth": 35.5,  
        "vertTilt": 8.9,  
        "beamWidth": 5.3,  
        "vendor": "skyhook",  
        "repeaterId": 1234  
    },  
    "centroid": {  
        "lat": 42.358452,  
        "lon": -71.044692,  
        "alt": 25  
    }  
}
```

```
    }  
  ]  
}
```

# 5 Positioning service user beacon API response

---

A successful positioning service user beacon API request yields an HTTP 200 response status with no body in the response.

## Error responses

An improperly formatted API request yields an HTTP 400 response status with a response body as follows:

```
{
  "error":
  {
    "errors": [
      {
        "domain": "global",
        "reason": "parseError",
        "message": "Parse Error"
      }
    ],
    "code": 400,
    "message": "Parse Error"
  }
}
```

### Where:

- **domain** provides the classification for the associated error response. Most observed domains are `global`, `geolocation`, `usageLimits`, and `internalServer`.
- **reason** describes the particular error type.
- **message** provides the short description of the error.

# References

---

### Acronyms and terms

Acronym or term	Definition
CDMA	Code Division Multiple Access
GPS	Global Positioning System
GPS	Global Positioning System
GSM	Global System for Mobile
LTE	Long-Term Evolution
NB-IoT	Narrowband Internet of things
NR	New Radio
SSID	Service Set Identifier
UMTS	Universal Mobile Telecommunications Service
WCDMA	Wideband Code Division Multiple Access

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