Protocol Specification

Combain Positioning Service

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Combain Mobile AB

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Background

Combain positioning service is a web service API that enables developers and mobile service providers to locate mobile phones and other mobile devices connected to the GSM, WCDMA and Wifi networks.

The cell information is sent via the API, and Combain returns the most likely position by look-up in the positioning database and using positioning algorithms. The database is global with very good coverage and includes cells-id from more than 200 countries and more than 1000 operators. The Wifi database can also be used, mainly in urban areas, and will drastically improve the accuracy of the positions. The database together with Combain's global hybrid positioning technology give best coverage, accuracy and performance possible.

This is a specification of the protocol to use Combain positioning service through the production web service API. Difference from location-API.com API is that the performance and quality of this API is higher since it runs directly on production servers. Load is constantly monitored and capacity adjusted as required.

Combain Positioning Service

Initiate the service - Key

The service can be initiated by obtaining a key from Combain. This key is unique and must be kept confidential to avoid misuse.

Depending on license, the key will enable cell id positioning and/or wifi positioning. If key is only for cell ID positioning and arguments for wifi is submitted, the wifi arguments are disregarded.

Multiple keys can be enabled to an account to distinguish between different services, different models, etc.

URL

http://cps.combain.com

or

https://cps.combain.com

for encrypted requests and responses.

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Request format

The format of the request is:

http://cps.combain.com/?key=<key>&id=<id>&nr=<nr>&gps=<gpsobj>&reqCity=<0or1>&fb=
<0or1>&reqCredits=<0or1> &cell=<scell>;<ncell1>; <ncell2>;<ncell3>...
&wifi=<wifi1>;<wifi2>;<wifi3>...

Arguments

key   The unique key for the account, received from Combain. Mandatory parameter.

id   A unique device id. Recommended to be the IMEI number, but can be something else. Possible to submit to Combain a range of allowed device id's. Important to be truly unique for the account, otherwise devices may not receive the correct position. Mandatory parameter, max 20 characters in length.

nr   Request number set by the device. First request should have 1 and then value should be increased by 1 for each request. Mandatory parameter, integer.

gps   Latest GPS information. Optional parameter. Improves positioning requests with latest GPS position, for example indoor. If GPS position is older than 600s, it does not add any value and should be omitted.

<gpsobj>   GPS object. Information about latest GPS position. Optional, can be omitted.

reqCity   Request City. Disregarded if omitted or 0. If set to 1, the request returns the closest populated city in text form, country and country code. If set to 1 and any indoor wifi submitted the response will also include building, floor and room. Optional parameter.

fb   Fallback solution. Disregarded if omitted or 0. If set to 1, the request will check different fallback solutions to create a position if none of the submitted cells or wifis are found. This parameter should be with care since it could potentially return wrong coordinates. Optional parameter.

reqCredits   Check number of credits left for prepaid keys. The number of credits will be returned in the parameter credits in the response.

cell   Information about the mobile cells in range. Optional parameter. Can be omitted if only wifi positioning is used, but improves performance even for wifi positioning.

<scell>   Serving cell object. Information about the cell the device is connected to. Can only be one cell and must be the first cell object in the cell list.

<ncellX>   Neighbouring cell X object. Information about other cells within range but not connected to. Can be several cells.

wifi   Information about the wifi access points in range. Optional parameter, can be omitted if only cell positioning is used.

<wifiX>   Wifi access point object X. Information about a wifi access point.

ip   If ipfallback is enabled (ipf=1) then GeoIP positioning will use this parameter. If omitted, then GeoIP will use the ip address of the remote ip address making the request.

GPS object

Each GPS object (<gpsobj>) has the following parameters separated by a ',':

<lat>,<lon>,<hAcc>,<posAge>,<elev>,<vAcc>,<heading>,<speed>

<lat>   Latitude of the position in decimal degrees (+/-XXX.YYYYYY). Mandatory parameter. WGS84.

<lon>   Longitude of the position in decimal degrees (+/-XXX.YYYYYY). Mandatory parameter. WGS84.

 <hAcc>   Horizontal accuracy of the position in meters (integer). Mandatory parameter.

<posAge>   Time in seconds since the GPS position was valid (integer). Mandatory parameter.

<elev>   Elevation of the position in meters (integer). Optional parameter.

<vAcc>   Vertical accuracy of the position in meters (integer). Optional parameter.

<heading>   The heading in degrees when the position was calculated (integer). Optional parameter.

<speed>   Speed in m/s (integer). Optional parameter.

Cell objects for GSM, WCDMA, LTE, NB-IoT and NR

Each cell object (<scell> and <ncellX>) has the following parameters separated by a ',':

<rat>,<mcc>,<mnc>,<lac>,<cid>,<rxLev/sCode>,<tA/rscp>

<rat>   Radio access technology. 'G' for GSM, 'W' for WCDMA, 'L' for LTE, 'I' for NB-IoT and 'N' for NR (5G). Mandatory parameter.

<mcc> Mobile Country Code. Integer, 200 – 901. Mandatory.

<mnc> Mobile Network Code. Integer, 0 – 999. Mandatory.

<lac>   Location Area Code. Hexadecimal number. Length is always 4.

Mandatory.

<cid>   Cell ID. Hexadecimal number. Length is 4 for GSM, 8 for WCDMA, LTE and NB-IoT, 9 for NR. Mandatory.

<rxLev/sCode/rssi>   Received signal strength level in dBm (-110 <= rxLev <= -40) for GSM and (-140 <= rssi <= -44) for LTE, NB-IoT and NR.

sCode is the primary scrambling code for WCDMA networks. Optional, but improves performance of positioning. Integer.

<tA/rscp>   Timing advance (0 <= tA <= 63) for GSM networks. Received signal code power in dBm (-120 <= rscp <= -25) for WCDMA. Optional but improves performance of positioning. Integer.

Cell objects for CDMA

Each cell object (<scell> and <ncellX>) has the following parameters separated by a ',':

<rat>,<sid>,<nid>,<bid>,<rssi>

<rat>   Radio access technology. 'C' for CDMA Mandatory parameter.

<sid>   System ID. Integer, 0 – 32767. Mandatory.

<nid>   Network ID. Integer, 0 – 65535. Mandatory.

<bid>   Basestation ID. Interger, 0-65535. Mandatory.

<rssi> Received signal strength level in dBm (-110 <= rssi <= -40) for CDMA. Optional, but improves performance of positioning. Integer.

Wifi objects

Each wifi object (wifiX) has the following parameters separated by a ',':

<bssid>,<ssid>,<rssi>

<bssid>   MAC address, for example 00:1a:a2:82:aa:60. Mandatory.

<ssid>   Service Set Identifier. Name of the wifi access point. Since it could be a string that contains comma (,) or other characters, it is advised to put SSID always within quotes ("ssid"). Still SSID without quotes is accepted. Optional, but strongly advised to include for accurate wifi positioning. Max 32 characters in length.

<rssi> The received signal strength in dBm. Optional but improves performance of positioning. Integer.

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Response

Response format

The response is in semicolon separated format:

status=<status>;nr=<nr>;lat=<lat>;lon=<lon>;acc=<acc>;cc=<cc>;cn=<cn>;city=<city>;dist=<dist>;fb=<fb>

<status>

'0' = successful positioning

'1' = unsuccessful positioning, cells and wifi access points not found

'2' = request quota exceeded

'3' = invalid key

'4' = invalid device id

'5' = invalid request number

'6' = invalid input parameters (e.g. mcc in hex or mcc out of valid range)

'7' = Licensing Error

'8' = Not found within country border

'9' = Blocked by Speed filter

<nr>   The request number for the corresponding request

<lat>   The latitude of the estimated position. WGS84.

<lon>   The longitude of the estimated position. WGS84.

<acc>   Horizontal accuracy of the position in meters.

              The accuracy, as the radius in a circle, creates a circle with 95% confidence
                   level.

              If the accuracy can not be determined, the accuracy is returned as zero.

<fb>   Fallback solution used. Only returned if fb=1.

              '0' = no fallback used.

              See available fallback codes and their descriptions below.

              Each of the fallback codes can be used to specify which fallback methods
that shall be used.

Example: fb=1   (All of above methods used except cidxf)

Example: fb=1&lacf=0 (All of the above except cidxf and lacf)

Example: fb=0&lacf=1 (All of the above off. Only lacf used)

Following parameters are only returned if the reqCity parameter is set to 1.

<cc>	Country code of the country (e.g. SE for Sweden)
<cn>	Country name in text format (e.g. Sweden)
<city>	Closest city with population
<dist>	District, part of city, etc

Following parameters are only returned if the reqCity parameter is to 1 and if any submitted wifi is marked as indoor wifi.

<building>	Name of building for indoor location (e.g. "Lund Hospital")
<floor>	Integer value of floor plan for indoor location (e.g. 2)
<room>	Name of room for indoor location (e.g. "Room 262")

Fallback codes

Fallback code	Name	Description
w4f	WCDMA with just 4 CID	To support mobile units only able to read a 4 CID Hex digits. Search the CID but just compare the 4 less significant hex digits.
lac01f	WCDMA with LAC 0 - just one	If the cell is not found, look for LAC = 0 and same CID. No other LACs to choose from.
lac0xf	WCMDA with LAC 0 - several	If the cell is not found, look for LAC = 0 and same CID. Several other LACs to choose from. Select the one with best accuracy.

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lacf	LAC fallback	If the CID is not found, return the center and accuracy for the LAC.
cid1f	CID fallback - just one	If the cell is not found, look for another LAC != 0 and same CID. No other LACs to choose from.
cidxf	CID fallback - several	If the cell is not found, look for another LAC !=0 and same CID. Several other LACs to choose from. Select the one with best accuracy.
nbcidf	Neighbouring CID	If the cells is not found, it will search for a slightly similar CID.
mncf	MNC not found	If the MNC is not found, search for just MCC, LAC and CID.
ipf	GeoIP fallback	If not cells found, make geo positioning based on IP address. Either the remote IP address from requesting server or the IP address in the IP request parameter

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Request and response examples

Single GSM cell:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=1&cell=
G,240,01,1397,3ab6,-74,

status=0;nr=1;lat=55.72052;lon=13.20250;acc=5280

Single GSM cell and reqCity:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=2&reqCi
ty=1&cell=G,240,01,1397,3ab6,-74,

status=0;nr=2;lat=55.72052;lon=13.20250;acc=5280;cc=SE;cn=Sweden;city=Lund

Check credits left:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=1&cell=
G,240,01,1397,3ab6,-74,&reqCredits=1

status=0;nr=1;lat=55.72052;lon=13.20250;acc=5280;credits=1432

WCDMA serving cell with one neighbor cell:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=3&cell=
W,240,5,71,71ea76,-50;W,240,5,71,71ea78,,-89

status=0;lat=61.303084;lon=17.066108;acc=545

WCDMA serving cell with one neighbor cell using sCode (sCode = 4):

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=3&cell=
W,240,5,71,71ea76,-50;W,240,5,,,4,-89

status=0;lat=61.303084;lon=17.066108;acc=545

Single wifi access point:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=4&wifi=0
0:1b:2f:47:8d:c6,combain,-70

status=0;nr=4;lat=55.71362;lon=13.21493;acc=195

Combined cell and wifi request:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=5&cell=
W,240,05,001F,001F02AB,,-64;W,240,05,001F,001F02A1,,-80&wifi=00:1b:2f:47:8d:c6,"comb
ain",-70;00:19:5b:88:72:93,"perspektiv",-90

status=0;nr=5;lat=55.71361;lon=13.21493;acc=195

Valid new GPS position in request:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=6&gps=
55.71123,13.21412,8,72,10,0,0,0&cell=G,240,01,1397,3abb,-74,

status=0;nr=6;lat=55.71123;lon=13.21412;acc=8

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Old GPS position in request:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=7&gps=
55.71123,13.21412,8,72,10,0,0,600&cell=G,240,01,1397,3abb,-74,

status=0;nr=7; lat=55.72052;lon=13.20250;acc=5280

Cell and wifis not found in data base or error in request:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=8&cell=
G,240,01,1397,3abb,-74,

status=1;nr=8

Invalid key:

http://cps.combain.com/?key=xinvalidx&id=35780303-044733-4&nr=9&cell=G,240,01,1397,3
abb,-74,

status=3;nr=9

Invalid device ID:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=idinvalid
&nr=10&cell=W,240,05,001F,001F02AB,,-64;W,240,05,001F,001F02A1,,-80&wifi=00:1b:2f:4
7:8d:c6,combain,-70;00:19:5b:88:72:93,perspektiv,-90

status=4;nr=10

Invalid request number: (assuming last request number =10)

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4
&nr=20&cell=W,240,05,001F,001F02AB,,-64;W,240,05,001F,001F02A1,,-80&wifi=00:1b:2f:4
7:8d:c6,combain,-70;00:19:5b:88:72:93,perspektiv,-90

status=5;nr=20

Single GSM cell with wrong lac and fallback:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=2&reqCi
ty=1&fb=1&cell=G,240,01,0000,3ab6,-74,

status=0;nr=2;lat=55.72052;lon=13.20250;acc=5280;fb=cid;cc=SE;cn=Sweden;city=Lund

WCDMA serving cell with short cid (only 2 bytes) and fallback:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=3&fb=1&
cell=W,240,05,0019,5f73,,-64

status=0;nr=3;lat=55.71337;lon=13.21474;acc=639;fb=w4f

Indoor multi wifi request:

http://cps.combain.com/?
key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=2&wifi=00:26:3e:0c:71:44,,-74,00:
26:3e:0c:71:55,,-78&reqCity=1

status=0;lat=55.710833;lon=13.206719;acc=5;cc=SE;cn=Sweden;dist=Lund;building="MH";f
loor=4;room="corridor"

GeoIP look-up:

http://cps.combain.com/?key=x4dis16xuo6wd87s90e2&id=35780303-044733-4&nr=3&ipf=1&ip=213.155.94.22

status=0;lat=48.2054;lon=11.6238;acc=0;fb=ipf

Integration - Best Practice

Avoid unnecessary requests - If you not receive a successful result, you receive status = 1, then the cell or wifi does not exist in our database. It makes no sense to send the exact same query directly again. We suggest you wait at least 24h hours before trying the exact same query again. The database grows with around 3 million observations per day.

Avoid unnecessary costs - to avoid unnecessary costs (normally charged per successful request) you are allowed to cache the result from a successful request in your devices and on your own servers, for up to normally seven days. Check your license agreement for how long caching period you are allowed to have. But note, multi cell requests are hard to cache since neighboring cells and signal strength is never the same, and you will always have better quality of data if you request the API since locations and accuracy figures is continuously updated in the online database.

Avoid infinite loops - to avoid unnecessary load on your own servers and on our servers, make sure your code do not end up in an infinite loop if you not receive a successful result from the Combain server.

Be flexible - never hardcode an URL to cps.combain.com in any devices you ship to end-customers. The recommendation is that you setup your own subdomain cps.yourcompanyname.com that redirects to cps.combain.com by using proper DNS settings or by using a relaying server. If you for some reason need to modify your requests to us, and you do not have access to the software in the shipped devices, you can then do that on your own server before sending the requests to us.

Sharing is caring - for best results and for best contribution to build up the database, make sure you always send all your neighboring cells in the request. Include both cell-id and wifi cells in the same request. If you have access to active GPS coordinates as well you are welcome to submit these as well. See the GPS Object in the spec.

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Document history

Version	Date	Changes description
A	2012-01-25	Production API spec based on c10-529
B	2012-05-03	Added fallback parameter, removed w4f parameter
C	2012-05-09	SSID within quotes supported since it may contain comma GPS parameter <elev> changed to <altitude> for clarity
D	2012-09-06	GPS parameter order changed and additional fallbacks added.
E	2012-09-17	Added the last '/' in http://cps.combain.com/? request examples.
F	2012-10-05	Table with fallback codes and fallback descriptions added in section 2.5
G	2013-02-22	Added support for positioning of CDMA and LTE cells.
H	2013-03-14	Updated and added mutli-cell examples of WCDMA. Now also with usage of sCode parameter (Primary Scambling Code for neighbors) Chapter 3 - Integration Best Practice added.
J	2013-11-21	Unit of Accuracy now specified as meters. New return code - 06 as "invalid input parameters". Minor editorial changes in 3 - Integration - Best Practice.
K	2014-09-04	reqCredits=1 parameter added to check number of credits left for prepaid keys.
L	2014-11-21	Change valid range of MCC. MCC should be 200-901. Response parameters for indoor location added (building, floor, room). GeoIP fallback method added.
M	2021-01-05	Definitions for response codes 7-9 added
N	2023-11-27	Added support for NB-IoT and NR cells.

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