

## New sp-mode Functions —Providing Location Information Using Base-station Data—

*Smartphone subscribers are proliferating in the market, and we have developed a new sp-mode function for smartphones, providing location information based on NTT DOCOMO base station data.*

*This function has advantages over GPS-based positioning because the use of location data for NTT DOCOMO base stations allows positioning to be done more quickly, and to be used indoors and underground. This development provides an environment allowing terminal applications to use location information more easily than before. Positioning operations using base stations also consume less power than GPS positioning, so the function should contribute to increasing battery life for smartphone terminals.*

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### 1. Introduction

Many smartphone terminals are currently equipped with a GPS function used to obtain the current location, allowing services relevant to the current location to be provided. However, it can be difficult to receive satellite signals, particularly in cities, where there are many large buildings and underground areas, and it can even be difficult to receive good signals from multiple GPS satellites for small buildings that are sandwiched between other buildings. This makes it difficult to

obtain accurate positioning information using GPS. As a result, the many location-related services have not been well received in cities, where smartphone use is very popular.

There are also schemes that use Wi-Fi<sup>\*1</sup> device serial numbers and databases of equipment locations obtained beforehand to provide positioning information, but these are not widely usable due to accuracy and granularity issues.

To resolve these issues, we have developed a mechanism that allows smartphone terminals subscribing-to

and using sp-mode to obtain network location information based on the locations of NTT DOCOMO base stations (hereinafter referred to as “base-station-based location information”)(**Figure 1**).

The function enables users to use location-based services, even when it is difficult to acquire GPS information, by obtaining approximate location information. Also, it is relatively expensive in terms of time and power to acquire GPS information on a mobile terminal, making it a factor in power consumption, and thus battery time, for the mobile terminal. This new function per-

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\*1 **Wi-Fi**<sup>®</sup>: A registered trademark of the Wi-Fi Alliance.

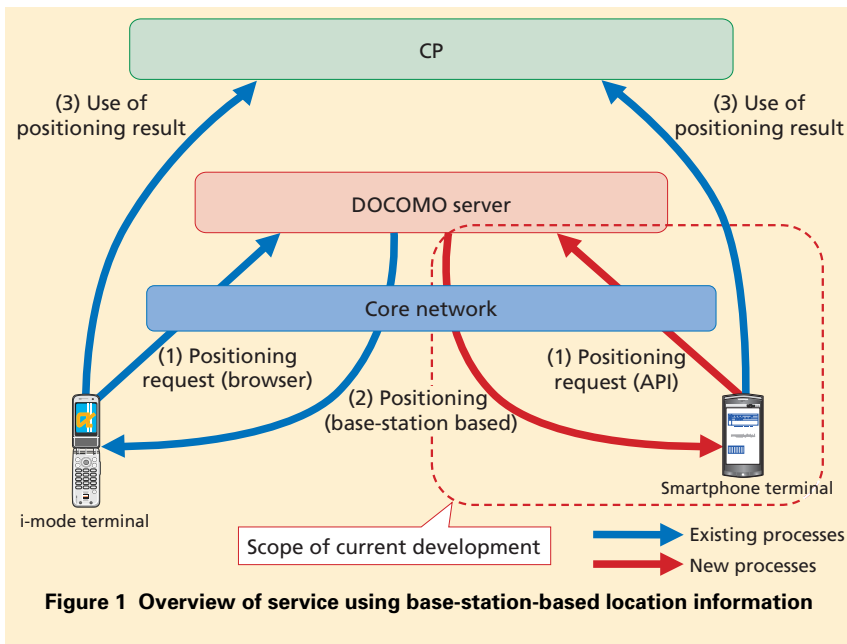


Figure 1 Overview of service using base-station-based location information

forms positioning process based on base station locations and using less power than GPS, so it also promises to increase the battery operating time for terminals.

In this article, we describe how position information is obtained, security measures and the process of introducing a service that will make use of base-station-based positioning.

## 2. Service Overview

We have provided an Application Program Interface (API)<sup>\*2</sup> on the NTT DOCOMO Multi-Access Platform System (MAPS)<sup>\*3</sup> server, which enables an application downloaded onto a smartphone terminal (hereinafter referred to as “terminal appli”) to request base-station-based positioning information from the NTT DOCOMO network (Figure 2).

A Terminal positioning process for i-mode terminals has been offered in the form of the Open i-area<sup>\*4</sup> service since 2002, and this service uses base-station-based positioning [1][2]. We have developed an API called Open i-area for enabling such positioning requests so that terminal appli can also use the service. Till now, the functionality of the open i-area service has been restricted, and i-appli could not perform positioning operations. The new function allows terminal appli to obtain location information directly from the service.

To use the API, a terminal appli developer must first obtain an authentication key (API key<sup>\*5</sup>) from NTT DOCOMO. Then, each time the appli uses the API, it must use this key to authenticate with MAPS, verifying that NTT DOCOMO has approved the

appli. This makes it possible to prevent falsification of terminal appli.

A terminal appli can then use the location information itself or send it to other Content Provider (CP)<sup>\*6</sup> sites, allowing a variety of location-related services to be offered. For example, a terminal appli for a mapping service could retrieve the current location and send it to the mapping server to obtain map information for the surrounding area, or a service could add location information to SMS messages or blog entries being submitted.

Note that when a smartphone is connected by Wi-Fi, it is not connected to the NTT DOCOMO network, so it cannot use this service. An exception to this is if it is connected using sp-mode (including terminals being used for tethering<sup>\*7</sup>), in which case terminals of any type can use the service.

## 3. Location Information Positioning

We now show how positioning is done based on base station location data.

A pre-installed terminal appli supporting the positioning function sends a positioning request to the MAPS location server using the location information retrieval API. The positioning process sequence is shown in Figure 3, and we give an overview of the process below.

(1) HTTP request analysis

The positioning request from

\*2 API: Libraries and other functions that can be used from an application, provided in a programming language.

\*3 MAPS: A platform that provides Internet connection and corporate system connection to various access circuits including FOMA.

\*4 Open i-area: The function provided by i-mode for obtaining location information. “i-area” is the name of both the service provided on i-mode as well as the function itself. “Open i-area” refers to the open specification for functionality using “i-area.”

\*5 API key: A key used for authentication when using the base-station-based location function.

\*6 CP: An enterprise that provides content over the Internet.

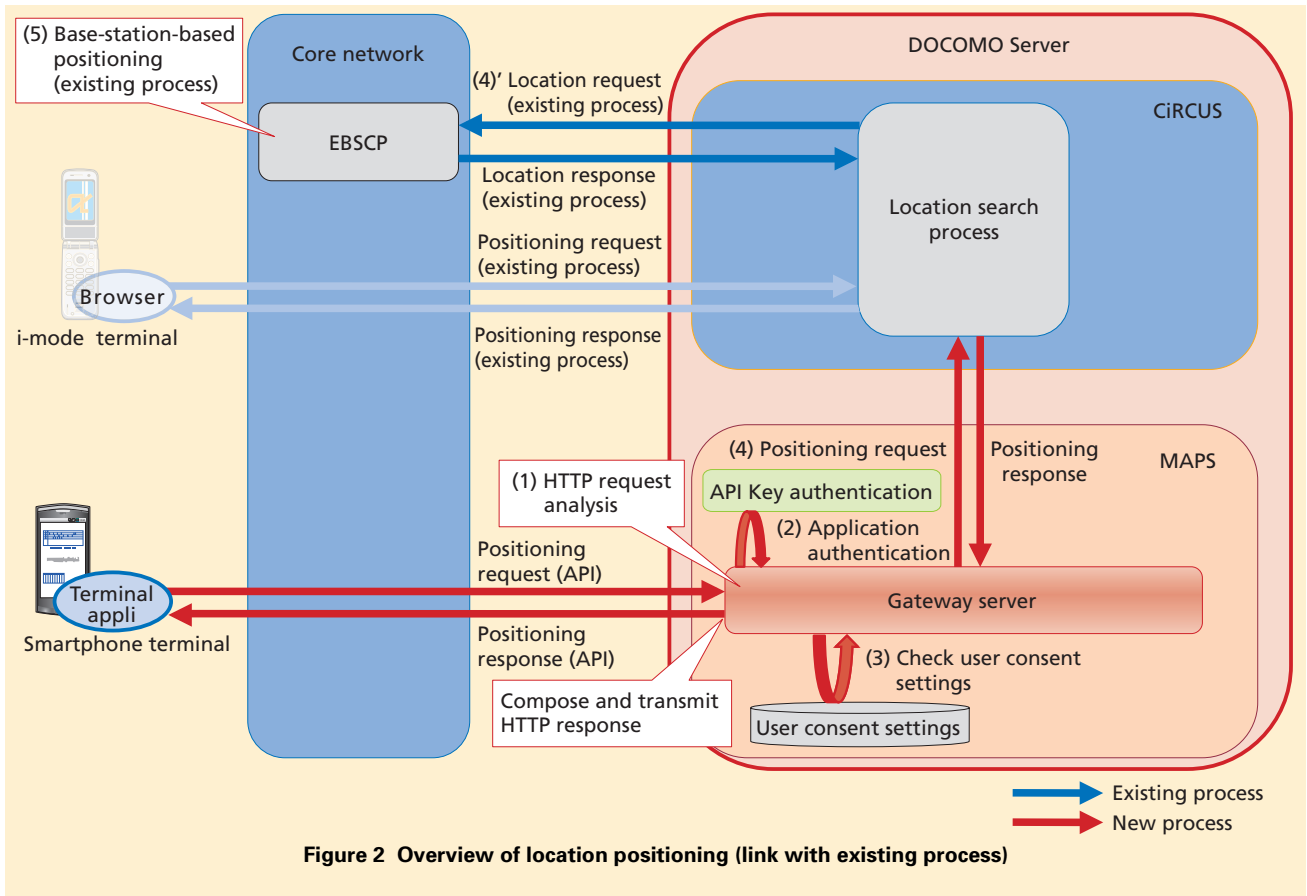


Figure 2 Overview of location positioning (link with existing process)

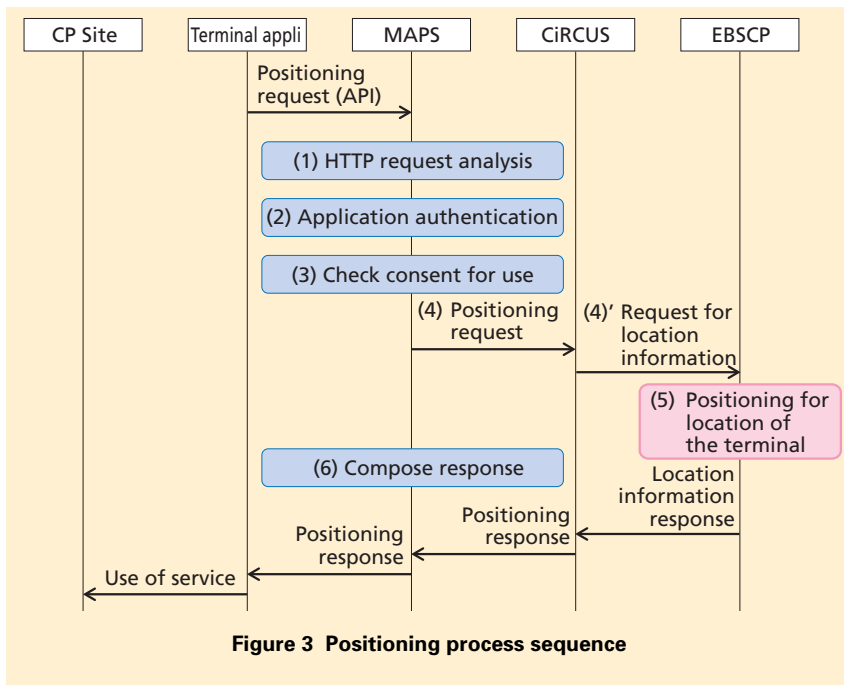


Figure 3 Positioning process sequence

the terminal is received by the gateway server within MAPS.

The received HTTP (Hyper-Text Transfer Protocol)<sup>\*8</sup> request is analyzed by this server, which checks the API key information and the location information items (Table 1) specified in Extensible Markup Language (XML)<sup>\*9</sup> by the application, through the API.

(2) Application authentication

MAPS uses the API key sent by the terminal appli to check that the terminal appli is valid. If the authentication fails due to invalid API key or other reason, a response

\*7 **tethering**: A function which enables a smartphone to be used as an external modem, so that Wi-Fi devices such as game machines or PCs can connect to the Internet through the mobile phone's connection.

\*8 **HTTP**: A communications protocol used between Web browsers and Web servers to send and receive HyperText Markup Language (HTML) and other content.

\*9 **XML**: A markup language proposed by the World Wide Web Consortium (W3C) for describing the meaning and structure of documents and data. It can be extended by user-defined tags.

**Table 1 Location information positioning items**

Required/optional	Item	Overview	Example
Required elements	Latitude	Latitude (including north/south) (world geodetic system, WGS84) Format: YYYY.ZZZZZ (deg.)	N036.06500
	Longitude	Longitude (including east/west) (world geodetic system, WGS84) Format: YYYY.ZZZZZ (deg.)	E136.06500
	Measurement time	Positioning time Format: yyyy-mm-ddThh:mm:ss+time zone (T is a delimiter)	2011-05-14T23:59:59+09:00
Optional elements (selectable in location request)	Area name	Area name corresponding to the area code for the current location	Chiyoda ward
	Area code	Current location area code (defined by NTT DOCOMO)	00001
	Address	Current location address * Text string concatenating "state name," "city/town/village name," "area name," and "sub-area name."	2 Nagatacho, Chiyoda ward, Tokyo
	Address code	Current location address code (codes managed by Japan Geographic Data Center)	12345678901
	Postal code	Current location postal code	1006150

is returned to the terminal appli indicating that positioning is not possible. MAPS also, checks the current Access Point Name (APN)<sup>\*10</sup> and whether access is through the FOMA network to ensure that the currently connected circuit can support positioning requests.

(3) Checking consent

Positioning on the terminal appli can only be done if permission has been granted by the user. Permissions are maintained on a per-terminal-appli basis, are checked whenever positioning is attempted, and positioning only proceeds if permission has been granted.

(4) Requests for location information

For positioning requests that were authenticated in the previous step, a request to search for location information is sent through the trea-

sure Casket of i-mode service, high Reliability platform for CUSomer (CiRCUS)<sup>\*11</sup> system, to the External Business user Service Control Point (EBSCP)<sup>\*12</sup>.

(5) Terminal positioning process

The EBSCP performs user positioning within the core network<sup>\*13</sup> based on base station locations and returns the terminal position result to CiRCUS.

(6) Compose and transmit HTTP response

An HTTP response for the terminal is generated based on the positioning result returned from the EBSCP. Responses for optional request items are returned based on the positioning request received in step (1). As with the HTTP request, the response to the mobile terminal is transmitted in XML format within the HTTP response body.

An example of using the positioning API is shown in **Figure 4**.

Location information API requests and responses from a terminal appli are implemented using the general-purpose HTTP, and keep data in XML format. This reduces the difficulty of developing application.

## 4. Security Measures

The location-positioning request API for terminal appli enables terminals to obtain location information, but it also creates the need to prevent malicious application developers from obtaining user location information without authorization. The ability to temporarily disable positioning operations when the user has given permission is also desirable, for cases such as terminal appli that perform positioning in the background. We have developed and implemented these capabilities in the new positioning function.

\*10 **APN**: The name of a connection point; the name of a network connection point prepared by a corporate user as a connection destination.

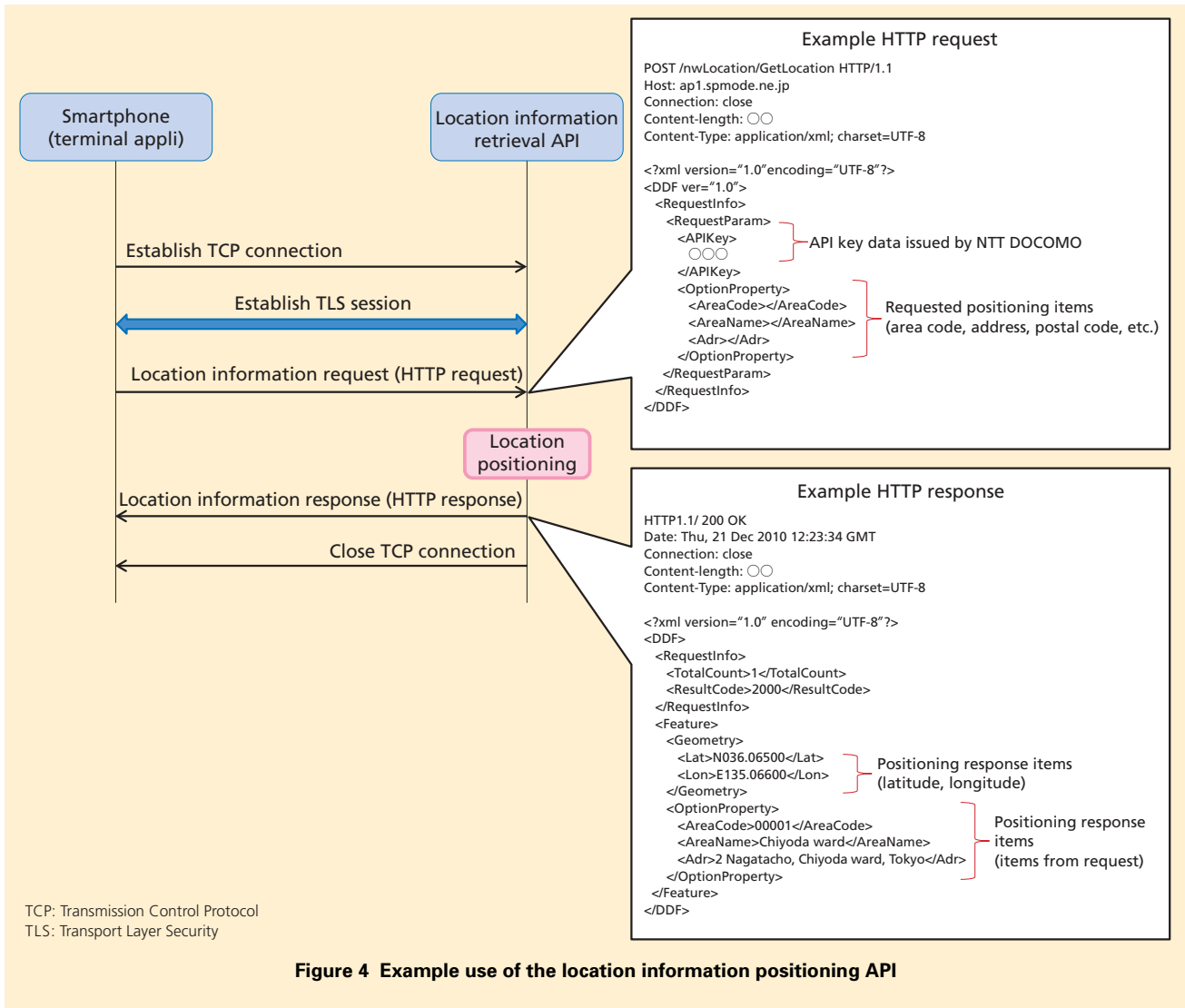
\*11 **CiRCUS**: A device that serves as an interface between the NTT DOCOMO core network and the Internet, provides i-mode mail, i-mode

menu, ordinary Internet access, and other functions.

\*12 **EBSCP**: A device that maintains profile data of each provider such as the name and IP address, handles authentication with each provider and connection management in the

FOMA network.

\*13 **core network**: A network consisting of switches and subscriber-information management equipment. Mobile terminals communicated with the core network via the radio access network.



1) User Consent Settings

User location is personal information, so a terminal appli requires authorization before retrieving it. To fulfill this, user consent settings for this function allow the overall positioning function to be enabled and disabled, as well as allowing the function to be enabled or disabled individually for each terminal appli that the user downloads.

Note that if these permissions have

not been set, as with the first time a terminal appli is used after being downloaded, the user is presented with a permission screen, making it easy for users to set individual terminal appli permissions. Settings can also be enabled or disabled after starting to use a terminal appli by accessing the sp-mode configuration site.

2) Centralized Terminal Appli Management Function

It is conceivable that terminals could unintentionally generate a large number of positioning requests due to malfunction of a terminal appli, or a malicious developer could attempt to obtain location data for anti-social reasons. Anticipating cases such as these, when it is necessary to immediately stop a terminal appli from obtaining

location information, the API key for the application can be suspended on the NTT DOCOMO server, allowing all requests by that terminal appli to be enabled or disabled at once.

## 5. Procedure for Initiating a New Service

We now describe the procedures and processes required for a developer to develop a terminal appli using the location-positioning request API. As described in the preceding sections, the API authenticates using an API key when performing positioning operations. When NTT DOCOMO issues the API key for each terminal appli, it requires the terminal appli developer to submit developer profile information and an outline of the terminal appli to be developed. **Figure 5** shows the overall process from registration of the terminal appli developer profile to use of the service by users.

### 1) Register CP Information

A terminal appli developer desiring to use the NTT DOCOMO base-station-based positioning function must register CP information on the NTT DOCOMO service registration Web site, including a service provider name (company name, etc.), and contact address, telephone number and e-mail address. NTT DOCOMO reviews the registered CP information, checking the validity

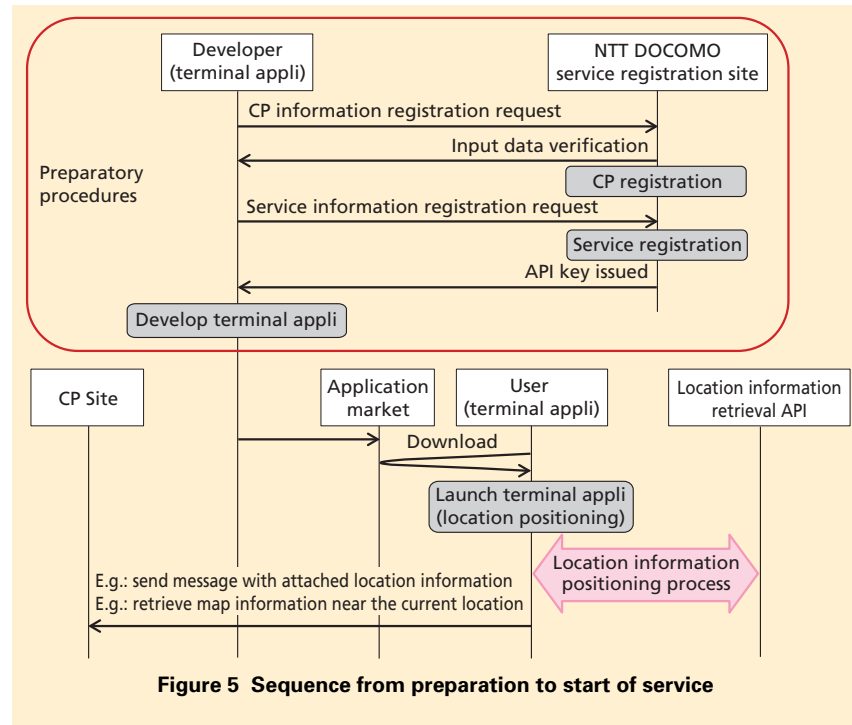


Figure 5 Sequence from preparation to start of service

of the address and e-mail address.

### 2) Register Service Information

After registering the CP information, an API key is issued upon registration of service information (service name, service outline) for the terminal appli that will use the positioning function.

## 6. Conclusion

We have described a base-station-based positioning service, including how position information is obtained, security measures provided, and the process for introducing services that use it.

The new service enables terminal appli on smartphone terminals to obtain

approximate location information, even in environments where GPS cannot be used. In the future, we plan to enhance location-based functions and services further, constantly extending functionality in an effort to improve convenience for NTT DOCOMO users.

### REFERENCES

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