# Loading Map Tiles from Google Maps

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# The Google Maps Problem

Until recently, Google Maps could be used without fee to fetch map tiles. Applications could load map tiles anonymously or using a key; when used anonymously, the number of tiles that could be loaded per day and the rate at which tiles could be loaded was throttled to make the API practical only for development purpose. With an application key, the number of tiles available per day was much higher, and there was no rate limiting. This was usually sufficient for Altos Metrum customer use.

However, this has changed and now there is no way to load map tiles anonymously, and any application key must be tied to a credit card. The tile cap for free usage is now monthly instead of daily. Because the key is tied to a credit card, we should not ship it with the application any longer. And because the cap is monthly instead of daily, we need some way to control usage by our applications.

## The Proposed Solution — An Intermediate Service

To give us some measure of control over tile loading, we will want to interpose a server controlled by us between the application and Google Maps. This will let us store the Google Maps key in a secure location, and also control tile loading by each user.
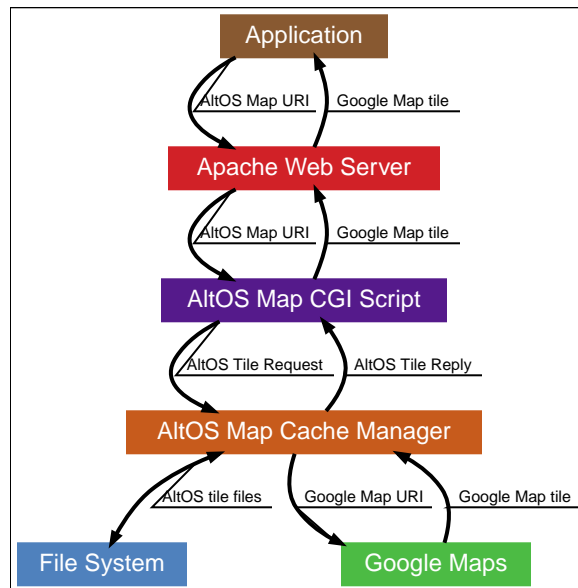


## AltOS Map Service

This service receives a URL request and replies with either a map tile or an error. It is functionally equivalent to the Google Maps service, except that it can control use of the Google Maps API.

## AltOS Map CGI Script

The AltOS Map CGI Script is a straightforward script which connects to the AltOS Map Cache Manager, transmits a URL describing the desired map tile and receives back a filename (or

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error), then sends the contents of that file back through Apache to the requesting application. The name of the script is 'altos-map'.

## Inputs

The AltOS Map CGI Script will parse the provided AltOS Map URI or AltOS Version URI.

## Outputs

For AltOS Map URLs, the CGI Script will return either the contents of the associated Google Map tile or an error indicating what failed:

*200 OK*: The map tile image data or version information

*400 Bad Request*: The URL is malformed or not compatible with the version supported by the service

*403 Forbidden*: The map tile is outside the areas supported by the current AltOS Map service area

*408 Request Timeout*: Attempts to fetch the tile from Google Maps timed out.

*503 Service Unavailable*: The service is temporarily refusing to satisfy this request due to resource limitations.

# AltOS Map Cache Manager

This is a service running on the local machine and available over a local network socket. It translates an AltOS Map URL into a local filename containing the contents of the associated Google Maps tile. The name of the cache manager is 'altos-mapd'. It will listen for requests on port 16717.

# AltOS Map URI

AltOS uses a limited subset of the Google Maps, and the AltOS Map URIs only encode those elements which we currently use. This specification describes AltOS Map URI format version 1.0.0. The application is required to provide URIs compatible with the format supported by the server. The elements of the elements are:

- Latitude of center point
- Longitude of center point
- Zoom level (from bushes to planets)

Encoding this in a URI is straightforward:

```
altos-map?lat=<lat>&lon=<lon>&zoom=<zoom>
```

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Latitude and longitude are both encoded using decimal degrees with 6 digits following the decimal point.

Zoom levels can range from 1 (world) to 20 (buildings). Higher zoom levels show smaller areas at greater detail.

The only Google Map type supported by version 1.0.0 of the service is "hybrid", which combines road graphics on top of satellite images.

Version 1.0.0 always returns images which are 512x512 pixels.

If we need additional elements in the URL, we can add them in the future and bump the supported version number.

## AltOS Version URI

To allow applications to discover what AltOS Map URI version is supported by the AltOS Map service, the application may query the version of the API supported using the Version URI. The application provides the version that it supports and the AltOS Map service returns a version not greater than the client version:

```
altos-map?version=<client-major>.<client-minor>.<client-revision>
¬
<server-major>.<server-minor>.<server.revision>
```

## AltOS Tile Request

The AltOS Map CGI Script parses the Map URI and passes that information to the AltOS Map Cache Manager using the AltOS Tile Specifier syntax. This is a JSON representation of the same data provided by the URI:

```
{
    "lat": <latitude>,
    "lon": <longitude>,
    "zoom": <zoom-level>,
    "remote_addr": "<IPv4 or IPv6 address of requesting client>"
}
```

Latitude and longitude are both encoded using decimal degrees with 6 digits following the decimal point.

## AltOS Tile Reply

Sent back from the Cache Manager to the CGI Script, this encodes the status of the request and the filename of any tile data available. It is encoded in JSON format:

```
{
    "status": <HTTP status>,
    "filename": "<absolute path to image file>",
    "content_type": "<HTTP content-type>"
}
```

The "filename" and "content-type" elements are only included when the status is *200 OK*.

## AltOS Tile Filename

While the current AltOS Map URI version only supports a limited subset of the Google Maps functionality, we'll encode more of that data in filenames to allow for easy expansion of functionality in the future. The elements of an AltOS Tile filename consist of :

- Latitude, with N/S indicator (instead of a sign)
- Longitude, with E/W indicator (instead of a sign)
- Map type.
- Zoom level
- Scale factor. Scale, and the preceding hyphen are omitted for a scale factor of 1.
- Image format suffix. '.jpg' for JPEG files and '.png' for PNG files.

Latitude and longitude are both encoded using decimal degrees with 6 digits following the decimal point.

Map type is one of :

*hybrid*: Road graphics over satellite images *roadmap*: Symbolic road map *satellite*: Un-annotated satellite images *terrain*: Topographic map

Here's what map filenames look like:

```
map-{N,S}<lat>,{E,W}<lon>-<type>-<zoom>[-<scale>].<format>
```

```
map-N36.508532,W107.823944-hybrid-18.jpg
```

To transmit this name from the AltOS Map Cache Manager back to the Altos Map CGI script, the filename will be wrapped in a JSON string

## Implementation

The AltOS Map CGI Script and AltOS Map Cache Manager will both be implemented in Java as much of the required Google Maps infrastructure is already available in that language.

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## Access Control

No access control to the service is planned at this point. If necessary, we could implement username/password access control for each user of the service.

## Location Restrictions

To avoid unbounded usage, and confine the utility of this service to AltOS users, the service will only offer map tiles whose center location is within 10 miles of one of the sites registered in our launch sites database.

To allow testing of the registered launch site database, a database of privileged clients will be supported. Privileged clients will have unlimited access to the service.

## Per-Client Restrictions

We should implement a per-day limit on the number of tiles provided to a particular requesting client. We can also rate limit clients to a certain number of tiles per minute to reduce the bandwidth consumed out of our server.

## Cache Lifetime Restrictions.

The Google Maps API allows for caching of map data for no more than 30 days. To honor this, the Cache Manager will re-fetch any requested tiles when the cached version is older than this. If the fetch fails, the cache manager will continue to serve the data from the cached version of the file.