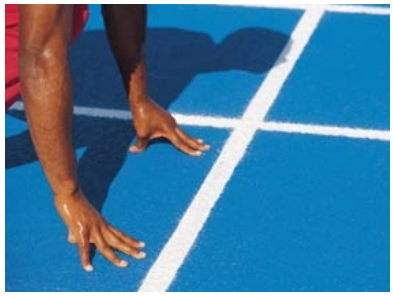
maXbox



maXbox Starter 40

Start with REST API Coding

1.1 Go with OpenWeatherMap

So what is REST? REST (REpresentational State Transfer) is a simple stateless architecture concept that generally runs over HTTPS/TLS. The REST style emphasizes that interactions between clients and services are enhanced by having a limited number of operations, most of them is GET. Flexibility and simplification is provided by assigning resources just their own unique universal resource indicators (URIs).

Now with a few lines of code we build a weather station, just the call:

```
writeln(GetGeoWeather('Bern', UrlWeatherReport25));
```

This RestFul Weather[1] API provides the weather state for a given location, specified by name or code. This service can be accessed using either REST or SOAP calls in XML or Jason format.

You can interact with the REST service by visiting the following URLs:

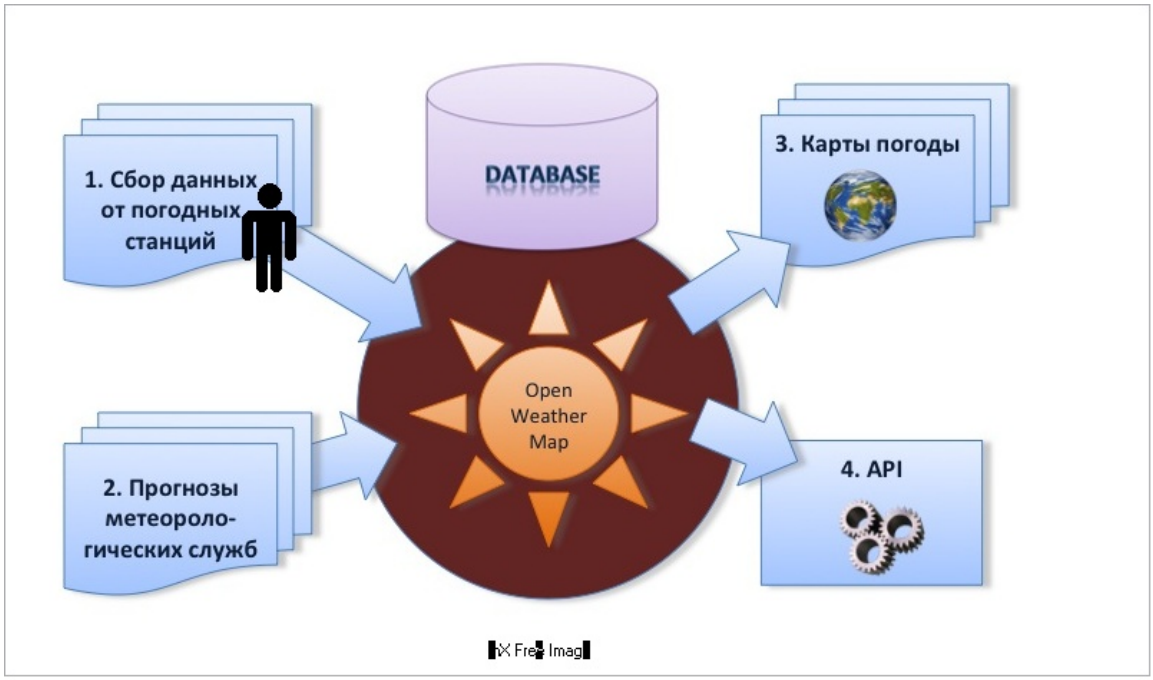
```
api.openweathermap.org/data/2.5/weather?q={city name}
```

You can access current weather data for any location on Earth including over 200,000 cities! Current weather is frequently updated based on global models and data from more than 40,000 weather stations. Data is available in JSON, XML, or HTML format.
First I define a Const:

```
Const
  UrlWeatherReport25=
                'http://api.openweathermap.org/data/2.5/weather?q=%s&units=metric';
```

[1] You find also REST for Weather Forecasting

You can see the version 2.5 in const name and a metric parameter which holds celcius instead of kelvin temperature is added.
Version information is an important thing cause we are dependent from the service providers updates and if something doesn't goes right then go left (just kidding).
Indeed the version information keeps your interface stable and improves the way to find errors, downtimes or bugs. Most of webmasters want to display weather information on their website. So I have decided to provide this tutorial to do this via maXbox or PHP script.



The OpenWeatherMap service provides free weather data and forecast API suitable for any cartographic services like web and smartphones applications, also forecasting is possible.

```
http://api.openweathermap.org/data/2.5/forecast/daily?
id=524901&lang={lang}
```

Ideology is inspired by OpenStreetMap and Wikipedia that make information free and available for everybody but as said dependent.

http://superdevresources.com/weather-forecast-api-for-developing-apps/

For example we are dependent of the availability and should consider most of messages a provider delivers:

"*The Nominatim Search Service will be unavailable on Tuesday, August 18, 2015 due to system maintenance. While it is never our intention to cause service disruptions, the outage is necessary. We apologize for the inconvenience that this will cause to our users of Nominatim*".
As I said you can interact with most of the REST services by visiting the URLs and made some tests, below more URLs:

```
Const
  UrlMapQuestAPICode2='http://open.mapquestapi.com/nominatim/v1/search.php?format=
%s&json_callback=renderBasicSearchNarrative&q=%s';

  UrlMapQuestAPIReverse= 'http://open.mapquestapi.com/nominatim/v1/reverse.php?
format=%s&json_callback=renderExampleThreeResults&lat=%s&lon=%s';

 UrlGeoLookupInfo2  ='http://ipinfodb.com/ip_query.php?timezone=true&ip=%s';
 UrlGeoLookupInfo3 = 'http://api.hostip.info/get_html.php?ip=%s&position=true';
```

Now we jump to the code behind the URL, which is a GET command as a function to fill a stream with the requested data:

```
function GetGeoWeather(const location: string;
                       const UrlRestAPI: string): string;
var IHTTP: TIdHTTP;
    IStream: TStringStream;
begin
  IHTTP:= TIdHTTP.Create(NIL);
  IStream:= TStringStream.Create('');
  try
    try
      IHTTP.Get1(Format(UrlRestAPI,[location]),IStream);
    except
      IHTTP.Get1(Format(UrlGeoLookupInfo2,[location]),IStream);
       //if something wrong try using a backup server.
    end;
    IStream.Seek(0,0);
    result:= 'GEO_Weather_Report: '+IStream.ReadString(IStream.Size);
  finally
    IHTTP.Free;
    IStream.Free;
  end;
end;
```

Call then current weather data for one location by city name or other parameters like this:

```
  //writeln(GetGeoWeather('krumpendorf', UrlWeatherReport25));
     writeln(GetGeoWeather('bern', UrlWeatherReport25));
     writeln(GetGeoWeather('cologne', UrlWeatherReport25));
```

Cologne is an interesting thing cause it delivers a weather report from an Italian city so it seems the English name of Köln has a name conflict. So I recommend to call API by city ID to get unambiguous result for your city. Then I checked with “koeln” and its right now:

```
GEO_Weather_Report: {"coord":{"lon":6.95,"lat":50.93},
```

Description: You can call by city name or city name and country code. API responds with a list of results that match a searching word, in our example a not so well color-formatted json format:

```
GEO_IP Out: Country: SWITZERLAND (CH)
City: Bern
Latitude: 46.9167
Longitude: 7.4667
```

GEO_Weather_Report: *{"coord":{"lon":7.45,"lat":46.95},*"weather":
[{"id":803,"main":"Clouds","description":"broken clouds","icon":"04d"}],"base":"cmc stations","main":
{"temp":19.27,"pressure":1014,"humidity":68,"temp_min":15.56,"temp_max":23.89},"wind":
{"speed":1.5,"deg":20.506},"clouds":*{"all":75}*,"dt":1439805254,"sys":
{"type":1,"id":6013,"message":0.0048,"country":"CH","sunrise":1439785803,"sunset":1439836653},"id":2661552,"name":"Bern","cod":200}

mX3 executed: 17.08.2015 12:07:08 Runtime: 0:0:11.370
Memload: 78% use

☝If you do not see some of the parameters in your API respond it means that these weather phenomena are just not happened for the time of measurement for the city or location chosen. Only really measured or calculated data is displayed in API respond.
Both types of calls are also aimed at WSDL endpoints if needed and can produce different output in different formats.

If you can't find the two files try also direct as a file or at sourceforge:

http://www.softwareschule.ch/examples/640_rest_weather_report.txt

http://www.softwareschule.ch/examples/640_rest_geocode.txt

Next you find an output of a weather data combined with an XML Map as a preparation for next chapter:

<?xml version="1.0" encoding="UTF-8"?>
-<**searchresults** more_url="**http://mq-open-search-ext-la02.ihost.aol.com:8000/nominatim/v1/search?format=xml&exclude_place_ids=705429&q=krumpendorf+strandweg**" **exclude_place_ids**="705429" **polygon**="false" **querystring**="krumpendorf strandweg" **attribution**="Data © OpenStreetMap contributors, ODbL 1.0. http://**www.openstreetmap.org/copyright**" timestamp="**Sun, 16 Aug 15 12:56:58 +0000**">
<**place** icon="**http://mq-open-search-ext-la02.ihost.aol.com:8000/nominatim/v1/images/mapicons/transport_train_station2.p.20.png**" importance="**0.201**" type="**station**" class="**railway**" display_name="**Krumpendorf, Strandweg, Gemeinde Krumpendorf am Wörthersee, Klagenfurt-Land, Region Klagenfurt-Villach, Kärnten, 9201, Österreich**" lon="**14.2218479**" lat="**46.6264738**"**temperature="18.62"** boundingbox="**46.6264738,46.6264738,14.2218479,14.2218479**" place_rank="**30**" osm_id="**247629819**" osm_type="**node**" place_id="**705429**"/>
</**searchresults**>

A last sample query string of a weather forecast follows:

```
http://graphical.weather.gov/xml/sample_products/browser_inter
face/ndfdXMLclient.php?listLatLon=38.99,-77.02 39.70,-104.80
47.6,-122.30&product=time-series&begin=2004-01-
01T00:00:00&end=2013-04-20T00:00:00&Unit=e&maxt=maxt&mint=mint
```

The NDFD data available via the REST service is updated no more than hourly. As a result, we request developers using this REST service only make a request for a specific point no more than once an hour.
The database is currently updated by 45 minutes after the hour.

1.2 The Weather with Maps

One of the questions that comes up when encoding those coordinates is how they can be useful in a script with for example in maXbox:

```
OpenMapX('cathedral cologne');
OpenMapX('50.94134 6.95813'); //string!
```

With a GPS or navigation: The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions. But you need a map to visualize.

☝ Each GPS satellite continuously broadcasts a navigation message at a rate of 50 bits per second. A message takes 750 seconds to complete! Such a record does have as minimum navi information:

```
procedure GPSRecord
begin
 writeln('time,date,latitude,longitude,altitude,nsat,speed,course');
end
```

This isn't very different from a normal weather station clock, isn't it? Now we define our map search to get the map in your standard browser. We use the mapquest API from:

http://open.mapquestapi.com/nominatim/

As many of you know, MapQuest hosts a version of the Nominatim Search Service as a part of our Open Data API and SDK product line, so we wanted to share an important update about this service that will have an impact on users of this service.

The following example demonstrates a simple map search request for “Cathedral Cologne“ using the Nominatim quest. Only three parameters are being requested (menu: View\GEO Map View):

1. format - Output format being called. [html/json/xml]
2. json_callback - Callback function used to display results below.
3. q - Query string being searched for.

We set first a const in the script to send the request:

```
Const
   AMAPFILENAME2= 'maxmapfile.html';

UrlMapQuestAPICode2='http://open.mapquestapi.com/nominatim/v1/search
.php?format=%s&json_callback=renderBasicSearchNarrative&q=%s';
```

How are these 3 arguments linked together:

- format=%s
- json_callback=renderBasicSearchNarrative
- q=%s

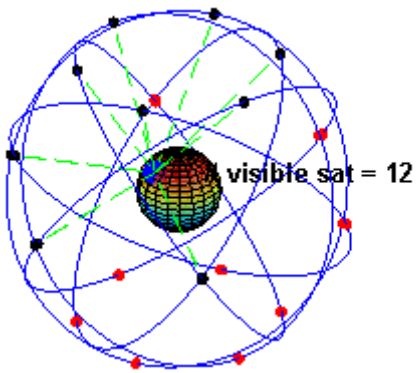
You'll notice that the json_callback parameter is already set. The format and the query string indeed is up to you. We use a html format to prepare open a browser with the map, se here's the call:

```
 if GetMAPX('html',ExePath+'cologne2mapX.html','cathedral cologne')
       then writeln('Cologne Map found');
```

By the way: Most of GPS and data formats is found by the NMEA.
The NMEA is the National Marine Electronics Association. It is to be a worldwide, self-sustaining organization committed to enhancing the technology and safety of electronics used in marine applications and you see also a standard for GPS data formats.

How it works: The GPS satellites transmit signals to a GPS receiver. These receivers passively receive those signals; they do not transmit and require a clear view of the sky, so they can only be used effectively outdoors, or from time to time in trains or gadgets;-).

```
Type
  TReceive_Func = TGPS.SerialRxChar(Sender: TObject);
```



Lets back to our easy call

```
GetMAPX('html',ExePath+'cologne2mapX.html','cathedral cologne')
OpenMap('ubs ag burgdorf');
```

You also find a procedure with same meaning

```
GetGeoMAP('html',ExePath+AMAPFILENAME2,'dom cologne')
```

Note: in both cases, this code is assuming D2007 or earlier as maXbox follows. In D2009 and later, String is Unicode now, so you need to know the Encoding of the `TStream` contents ahead of time in order for the bytes to be interpretted as, or converted to, Unicode correctly.

Otherwise, you would have to change to operate on AnsiString or the new RawByteString instead.

1.2.1 The Dark side of the Code

Obviously the most important device required for this software to work, is the map from the internet provider *OpenStreetMap*. All browser devices with a Java Script ECMA compatible connection are supported.

The Java Script code which sends the request and displays the result can be viewed here as an XML output for example:

```
Test mX4 Ref:  XML, JSON, HTML
<reversegeocode timestamp="Thu, 12 Sep 14 20:52:32 +0000" attribution="Data
© OpenStreetMap contributors, ODbL 1.0.
http://www.openstreetmap.org/copyright"
querystring="format=html&json_callback=renderExampleThreeResults&lat=47.039
7826&lon=7.62914761277888"><result place_id="15120759" osm_type="node"
osm_id="1378799522" ref="UBS AG" lat="47.0398676" lon="7.6291424">UBS AG,
Bahnhofstrasse, Oberstadt, Burgdorf, Verwaltungskreis Emmental,
Verwaltungsregion Emmental-Oberaargau, Bern, 3414,
Switzerland</result><addressparts><atm>UBS
AG</atm><road>Bahnhofstrasse</road><neighbourhood>Oberstadt</neighbourhood>
<town>Burgdorf</town><county>Verwaltungskreis
Emmental</county><state_district>Verwaltungsregion Emmental-
Oberaargau</state_district><state>Bern</state><postcode>3414</postcode><cou
ntry>Switzerland</country><country_code>ch</country_code>
</addressparts></reversegeocode>
```

From the result let's go back to the code behind.

As you already know the tool is split up into the toolbar across the top, the editor or code part in the centre and the output window at the bottom. Change that in the menu /view at our own style.

☝ Before this starter code will work you will need to download maXbox from a website. You'll get it from `http://www.softwareschule.ch/maxbox.htm` . Once the download has finished, unzip the file, making sure that you preserve the folder structure as it is. Test it with **F9** / F2 or press Compile and you should hear a test sound. So far so good now we'll open the examples:

`509_GEOMap3.txt`

If you can't find the two files try also direct as a file

http://www.softwareschule.ch/examples/509_GEOMap3.txt

Now let's take a look at the code of this app. One of our first line is creating the object `mapStream` and the encoded URL we use first methods to configure our `HTTPGet()` calling Port and IP of the *mapquest* API with the help of `HTTPEncode`. The object makes a bind connection with the Active method by passing an encoded URL with a memory stream:

```
procedure GetMapScript(C_form,apath: string; const Data:string);
var encURL: string;
    mapStream: TMemoryStream;
begin
  encURL:= Format(UrlMapQuestAPICode2, [c_form,HTTPEncode(Data)]);
  mapStream:= TMemoryStream.create;
  try
    HttpGet(EncURL, mapStream);    //WinInet
    mapStream.Position:= 0;
    mapStream.Savetofile(apath)
    OpenDoc(apath);
  finally
    mapStream.Free;
  end;
end;
```

The `OpenDoc()` procedure is used in this context to get a rich browser open, you remember the call above:

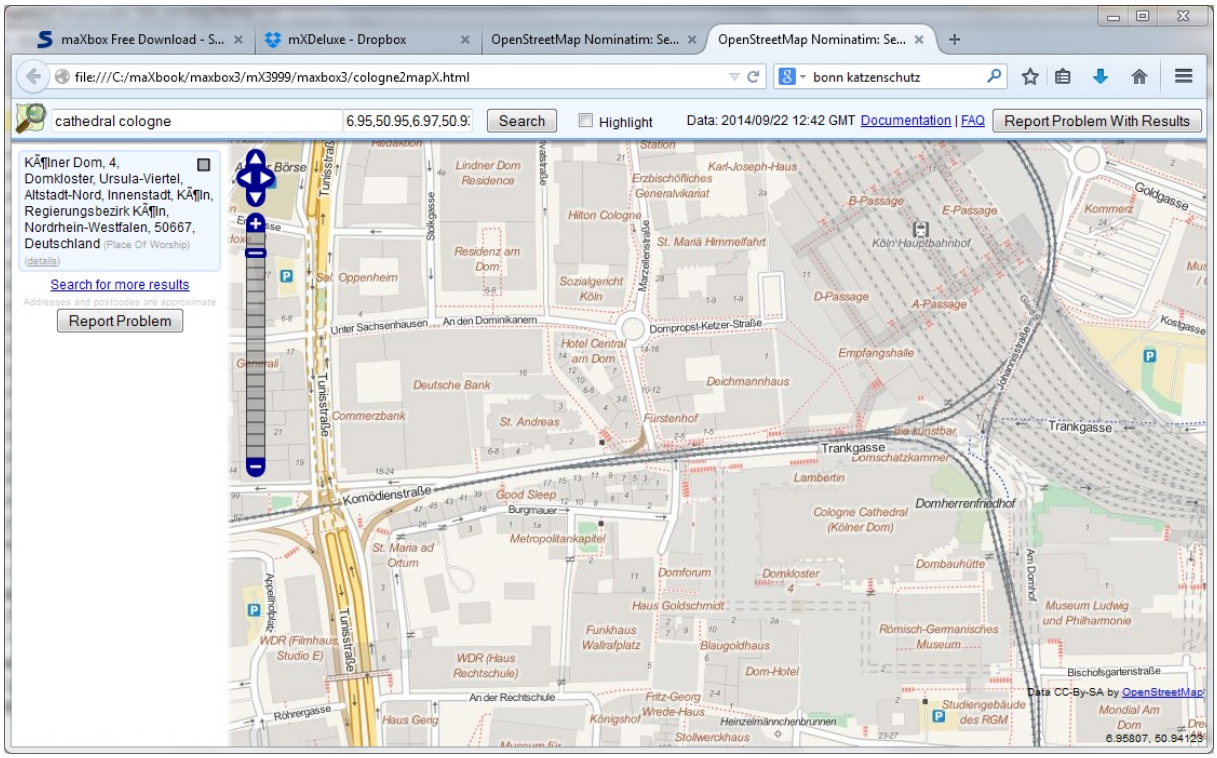
```
  GetMAPScript('html',ExePath+'cologne2mapX.html',
                                  'cathedral cologne')
```

As we decode this with Format like above:

- `format=html`
- `json_callback=renderBasicSearchNarrative`
- `q=cathedral cologne`

And this is how another function with download works:

```
function GetMapXScript(C_form,apath: string; const Data: string): boolean;
var encodedURL: string;
begin
  encodedURL:= Format(UrlMapQuestAPICode2,[c_form,HTTPEncode(Data)]);
  try
   //instead HttpGet(EncodedURL, mapStream);  //WinInet
  Result:= UrlDownloadToFile(Nil,PChar(encodedURL),PChar(apath),0,Nil)= 0;
    OpenDoc(apath);
  finally
    encodedURL:= '';
  end;
end;
//ShellExecute3('http://maps.google.com/maps?
q=+50.94133705,+6.95812076100766','',seCMDOPen)
```



This function is shorter than the first one because we use no streams in between. Working with streams in Free Pascal or Delphi you have to include some units to be able to use or code your functions direct in the script as you like:

```
function DownloadFile(SourceFile, DestFile: string): Boolean;
begin
  //TCIPStatus TBindStatus TURLTemplate of URLMon
  try
    Result:=
        UrlDownloadToFile(Nil,PChar(SourceFile),PChar(DestFile),0,Nil)= 0;
  except
    Result:= False;
  end;
end;
```

In maXbox those units and many others are pre-compiled and included on demand. As long as the API is stable we don't have change calls.

```
UrlMapQuestAPICode2='http://open.mapquestapi.com/nominatim/v1/search
.php?format=%s&json_callback=renderBasicSearchNarrative&q=%s';
```

After these steps, we can start with programming the rest of the GEO code called reverse GEO code.

☝ Reverse geocoding is the process of back (reverse) coding of a point location (latitude, longitude) to a readable address or place name.
GeoNames for ex. offers a wide range of reverse geocoding web services.
This permits identification of nearby street addresses, places, stations and/or areal subdivisions such as county, state or country.

1.2.2 Reverse GEO Code

The interesting point is now that we store no data on a file we just use a memory stream to get data direct on the console of maXbox.

Those data can be used with any console or script receiver to make further investigations. This may however vary depending on what data sentence the coordinates find or delivers, for ex. the cathedral at cologne:

```
writeln(GetMapXGeoReverse('XML','50.94134','6.95813'))
```

or more accurate:

```
GetMapXGeoReverse2('XML',topPath,'50.94133705','6.95812611100766')
then
```

```
<?xml version="1.0" encoding="UTF-8"?>
-<reversegeocode
querystring="format=XML&json_callback=renderExampleThreeResults&lat=50.9413
3705&lon=6.95812611100766" attribution="Data © OpenStreetMap contributors,
ODbL 1.0. http://www.openstreetmap.org/copyright" timestamp="Mon, 22 Sep 14
13:36:43 +0000">
  <result lon="6.95812611100766" lat="50.94133705" ref="Kölner Dom"
    osm_id="4532022" osm_type="way" place_id="40406499">Kölner Dom, 4,
      Domkloster, Ursula-Viertel, Altstadt-Nord, Innenstadt, Köln,
      Regierungsbezirk Köln, Nordrhein-Westfalen, 50667,
      Deutschland</result>-
      <addressparts>
            <place_of_worship>Kölner Dom</place_of_worship>
            <house_number>4</house_number>
            <pedestrian>Domkloster</pedestrian>
            <neighbourhood>Ursula-Viertel</neighbourhood>
            <suburb>Altstadt-Nord</suburb>
            <city_district>Innenstadt</city_district>
            <county>Köln</county>
            <state_district>Regierungsbezirk Köln</state_district>
            <state>Nordrhein-Westfalen</state>
            <postcode>50667</postcode>
            <country>Deutschland</country>
            <country_code>de</country_code>
      </addressparts>
</reversegeocode>
```

Reverse geocoding can be carried out systematically by services which process a coordinate similarly to a geocoding process.

For ex., when a GPS coordinate is entered the street address is interpolated from a range assigned to the road segment in a reference dataset that the point is nearest to.

```
osm_id="4532022" osm_type="way" place_id="40406499">Kölner Dom, 4,
     Domkloster, Ursula-Viertel, Altstadt-Nord, Innenstadt, Köln,
     Regierungsbezirk Köln, Nordrhein-Westfalen, 50667,
     Deutschland</result>-
```

Each table has a way column containing the geometry for the object in the chosen projection. Two indices are created for each table: one for the way column and one for the osm_id column, see above.

Geometry uses coordinates in the EPSG:900913 AKA G00GlE projection and can be easily used in e.g. OpenLayers based JavaScript.
Now for the code behind the call. We need another *mapquest* API of the get request service:

```
  UrlMapQuestAPI3:= 'http://open.mapquestapi.com/nominatim/v1/reverse.php?
format=%s&json_callback=renderExampleThreeResults&lat=%s&lon=%s';
```

As you can see it's a PHP server side service:
encodedURL:
http://open.mapquestapi.com/nominatim/v1/reverse.php?

The function maps a stream to a string and is similar to above, except we don't save a file, but you can save the stream as an XML or Json file:

```
  mapstream.savetofile(apath) and OpenDoc(apath);
```

```
function GetMapXGeoReverse2(C_form,apath: string; const lat,long:
                                                    string):boolean;
 var encodedURL, UrlMapQuestAPI, bufstr: string;
    mapStream: TMemoryStream;
 begin
  UrlMapQuestAPI:= 'http://open.mapquestapi.com/nominatim/v1/reverse.php?
format=%s&json_callback=renderExampleThreeResults&lat=%s&lon=%s';
  encodedURL:= Format(UrlMapQuestAPI,[c_form, lat, long]);
   mapStream:= TMemoryStream.create;
   try
     HttpGet(EncodedURL, mapStream);  {WinInet}
     mapStream.Position:= 0;
     writeln('stream size: '+inttostr(mapstream.size)); //mapStream.memory;
     bufstr:= StreamToString(mapstream);
     writeln('stream back: '+bufstr)
   finally
     encodedURL:= '';
     mapStream.Free;
  end;
end;
```

Two ways to map a stream to a string:
1. Read the available Size of the TStream, allocate a String of that length, and then Read() the TStream contents into the String:

```
 function StreamToString2(Stream: TStream): String;
 var
   len: Integer;
 begin
   len:= Stream.Size - Stream.Position;
   SetLength(Result, len);
   if len > 0 then Stream.ReadBuffer(Result, len);
     writeln('test - buffer read check!')
 end;
```

2. Create an intermediate TStringStream, CopyFrom() the TStream to the TStringStream, and then read the TStringStream.DataString property:

```
{code:maXbox}
 function StreamToString3(Stream: TStream): String;
 begin
    with TStringStream.Create('') do
    try
      CopyFrom(Stream, Stream.Size-Stream.Position);
      Result:= DataString;
    finally
      Free;
    end;
 end;
```

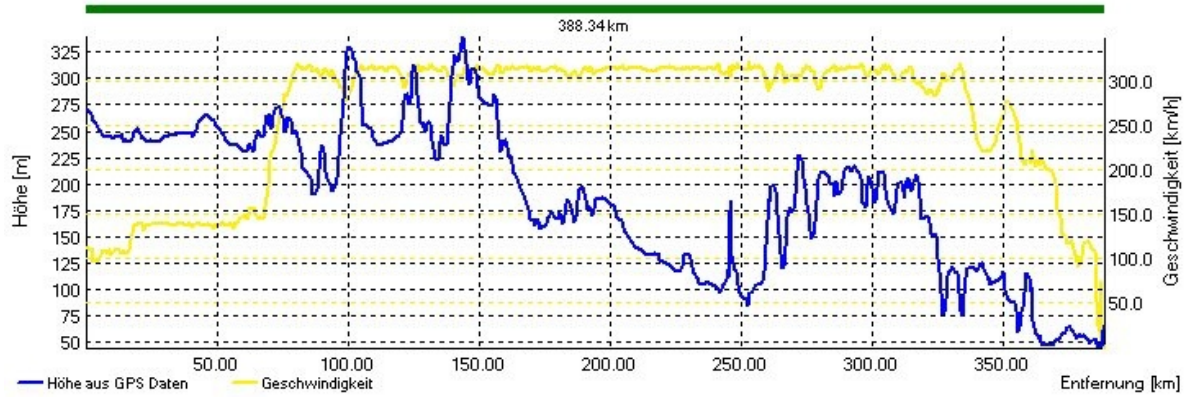
☝ `TMemoryStream` and `TFileStream` are both decendants of `TStream` and they work exactly the same way.

The problem I mostly found is that if we write one stream to another, we have to reset the origins before using it again like
`(MS.Seek(0,soFromBeginning);.`

Another point is to direct test a pair of coordinates. You can also convert coordinates (lat and long) to a map on the internet (Appendix).
http://www.gps-coordinates.net/

You can find the address corresponding to GPS coordinates or latitude, longitude and address of any point on OpenStreetMap.

Hope you did already work with the Starter 34 on GPS topics:
http://sourceforge.net/p/maxbox/wikimax/main/
At least we see a picture over a distance of 388 km. This image below is my sight of a track: the yellow line is the speed and the blue one marks the altitude point.



☝ **Almanac** data is data that describes the orbital courses of the satellites. Every satellite will broadcast almanac data for EVERY satellite. Your GPS receiver uses this data to determine which satellites it expects to see in the local sky; then it can determine which satellites it should track.

1.3 GPS and Arduino Conclusion

I would also recommend the book “Arduino Cookbook” by Michael Margolis. Here are a few ideas of more complicated projects that I have seen made with an Arduino.

- A box that will only open when it is at a certain location in the world (It connects a GPS to the Arduino. Search on “Reverse Geo-cache” to see some examples.)
- Or a controller for a 3D printer to print out the landscape the GPS or `OpenMAPX()` has just scanned!

Feedback @
max@kleiner.com
Literature: Kleiner et al., Patterns konkret, 2003, Software & Support

www.openweathermap.com

http://en.wikipedia.org/wiki/Reverse_geocoding
http://www.kleiner.ch/kleiner/gpsmax.htm
http://www.softwareschule.ch/examples/475_GPS_mX2.txt

Stream Ref:
http://embarcadero.newsgroups.archived.at/public.delphi.vcl.components.using/200907/0907292775.html

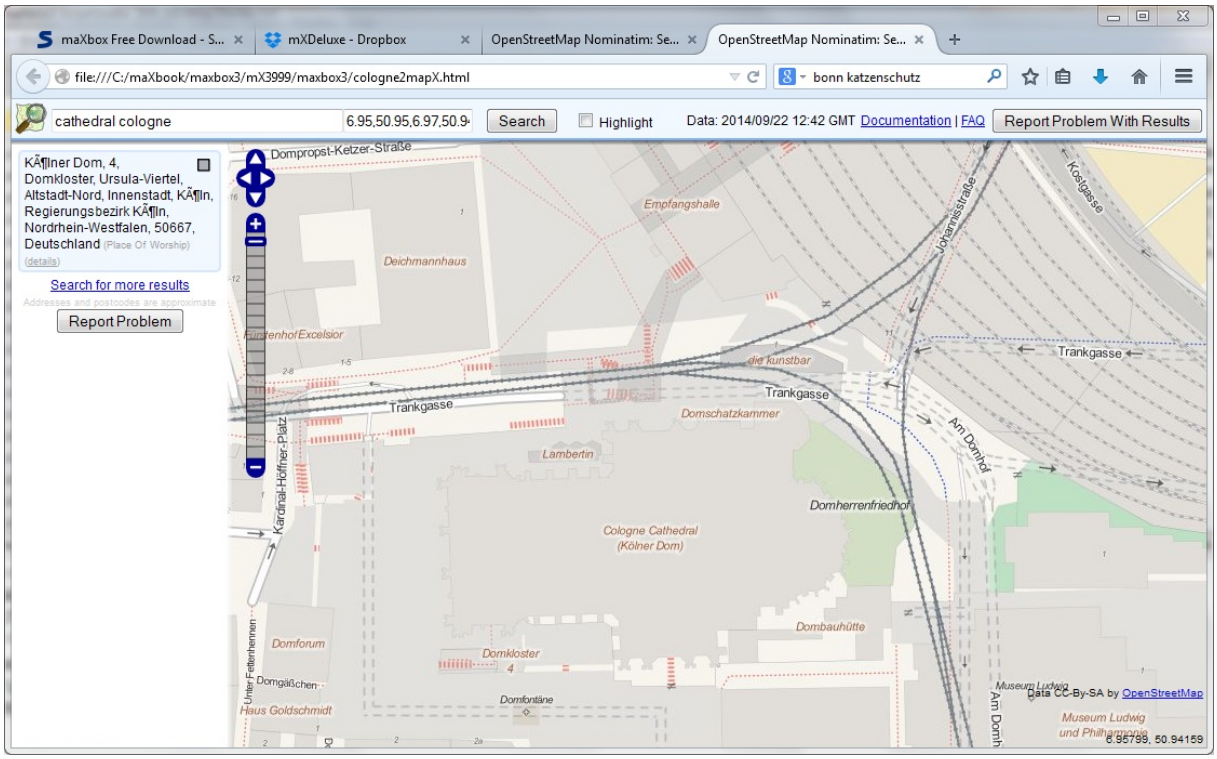
• Arduino Example.
http://www.softwareschule.ch/download/Arduino_C_2014_6_basta_box.pdf
http://sourceforge.net/projects/maxbox

1.4 Appendix Map Study

maXmap

DD (decimal degrees)*
Latitude 48.725447N (48.656280963566495)
Longitude 7.143274E (6.991813648492098)
1 Rue du Canal, 57405 Guntzviller, France
Latitude : 48.725447 | **Longitude :** 7.143274 **Altitude :** 287 meters

Here another map search zoom of OpenMAPX:



RTClock: Arduino by Silvia Rothen http://www.ecotronics.ch/ecotron/arduinocheatsheet.htm