

# **Introduction**

## **OpenCelliD – BigData Presentation**

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OpenCellID is BigData collection of Cell Towers and WiFi Aps.

This database is built by the community and is free available for download.

The row count is 39,374,666, *Last updated on : 2018-02-14*

*Database link in CSV format*

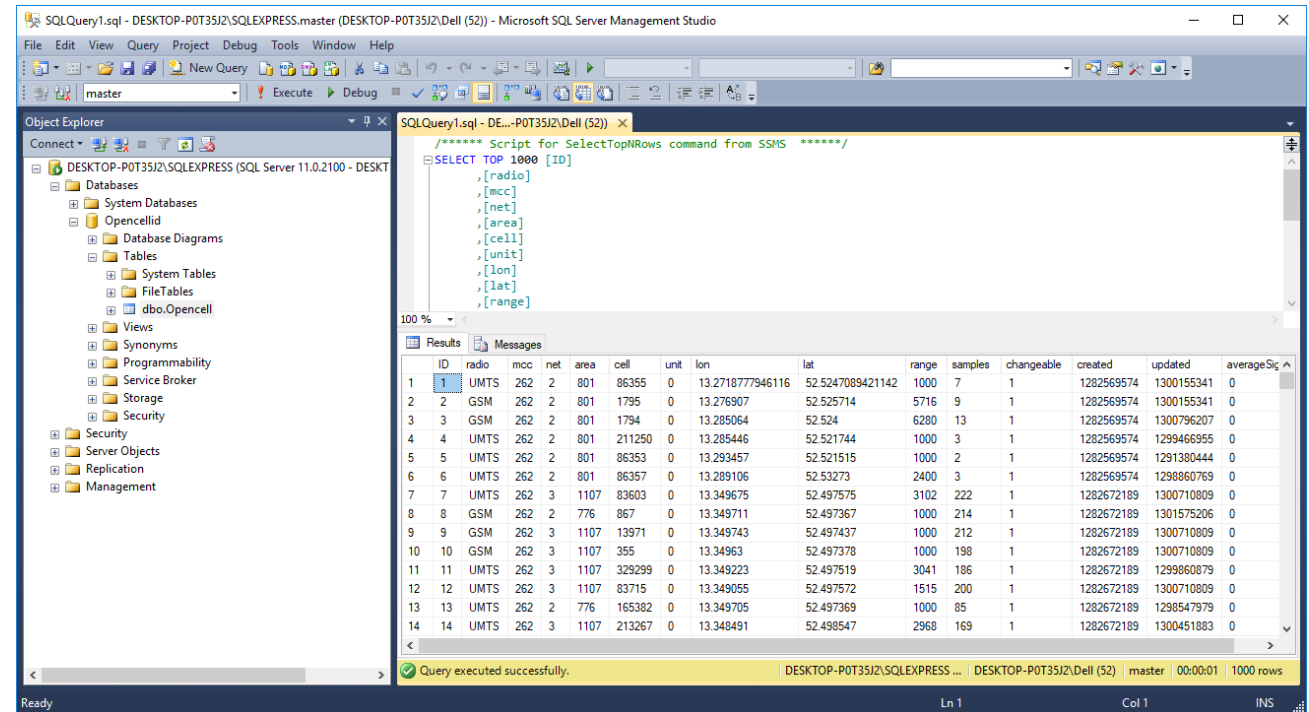
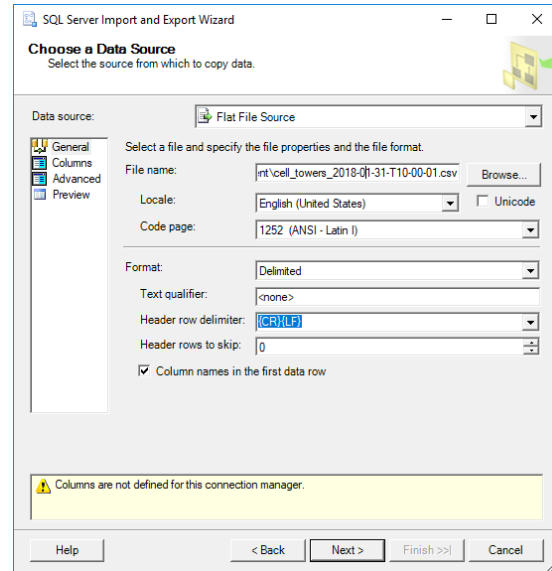
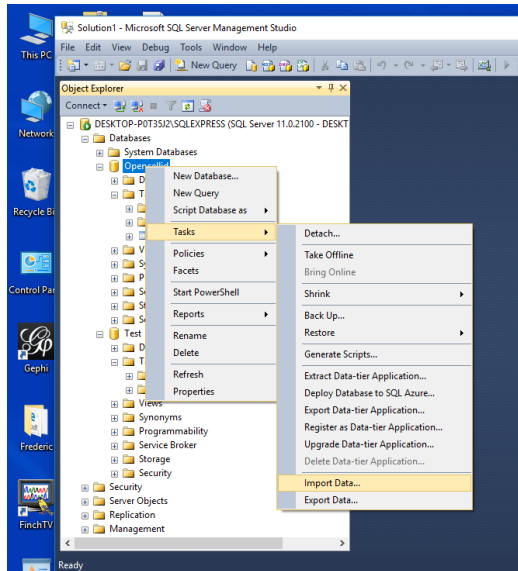
<https://opencellid.org/downloads>

# Database

# Data Base Structure

Field	Description (based on official documentation where available)
<b>ID</b>	This field is auto Incremented.
<b>Radio</b>	UMTS/ GSM /LTE
<b>Area</b>	Location Area Code
<b>Cell</b>	Cell ID represents the ID of Cell for which you want to display the data.
<b>Range</b>	Estimated Range of the cell in meters
<b>Samples</b>	Total number of readings taken from that cell tower
<b>Latitude</b>	GPS latitude of the measurement
<b>Longitude</b>	GPS longitude of the measurement
<b>Mcc</b>	Mobile Country Code
<b>Mnc</b>	Mobile Network Code
<b>Created</b>	Date the Cell tower was added
<b>Updated</b>	Date the Measurement is Updated

# Import CSV in SQL Server



Import

Configuration

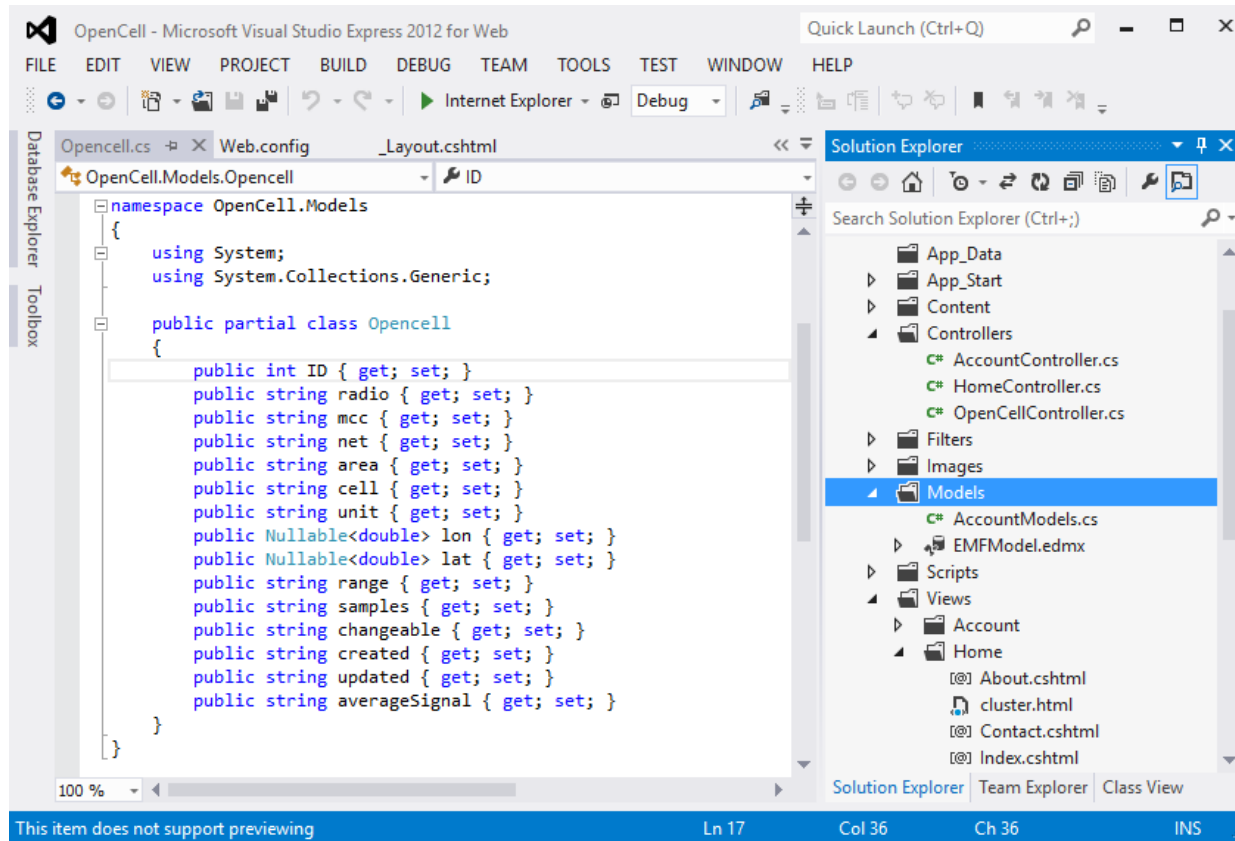
Query

# Application

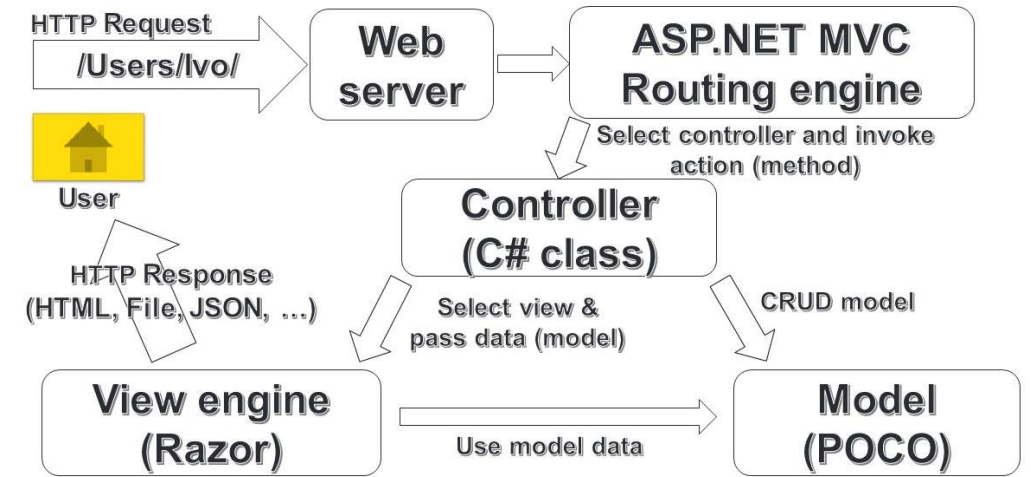
Source Code available at : <https://github.com/mimm1/OpenCell>

- ✓ The Application provides a simple interface for requesting geo-registered map images from one or more distributed geospatial databases.
- ✓ The interface is developed in Visual Studio and Model-View-Controller is used to create interfaces. The map is integrated in the application using Asynchronous JavaScript and XML (AJAX) and the JavaScript Object Notation (JSON) format has been used to serialize and transmit the structured data.
- ✓ A utility library has been created to interact with Bing Maps to display a map with location markers. The feature is added to determine the geographic location of the users from their IP addresses.
- ✓ The geospatial features of SQL Server are implemented to perform a location-based radius search. The overlay objects are tied to the latitude and longitude coordinates to display markers and relevant information on the map.

# Model View Controller (MVC)



OpenCell Class



← Controllers

← Model

← View



- ✓ The OpenCell view in the Razor view engine and the strongly-typed view is selected for the model class. The scaffold template is used for creating list, details, edit, and delete views based on the master layout.
- ✓ The related information is stored in the database and passed to the map and appears on the info window on the Mouse Click event on the Markers. The geographic locations of OpenCell towers are stored in the SQL table with latitude and longitude values received from the maps.
- ✓ Partial views are used to create, edit, or view the geographic locations of the Cell towers. The mapping functionality is utilized in several places within the application; therefore a shared Map functionality has been utilized within a single partial template to reuse in multiple controllers and views. The callback event handler function is used; this adds a pin to the map for location identification. Draggable pushpins are used on the map for location identification of Cell towers.

# Bing MAP V8 API

Shared -> \_Layout.cshtml

```
<script type='text/javascript' src='https://www.bing.com/api/maps/mapcontrol?branch=experimental&key=KeyHere&callback=onMapLoaded' async defer></script>
```

Callback function

Bing Maps V8 API

Required for clustering

View -> \_Index.cshtml

Loop to generate  
dynamic pins from the  
database

Call Clustering Function

```
function onMapLoaded() {  
  
    var map = new Microsoft.Maps.Map(document.getElementById('theMap'), {  
        /* No need to set credentials if already passed in URL */  
        center: new Microsoft.Maps.Location(39.393486, -98.100769),  
        zoom: 3 });  
    Microsoft.Maps.loadModule('Microsoft.Maps.Clustering', function () {  
        // Creating sample Pushpin data within map view  
        var pins = [];  
  
        @foreach (var item in Model) {  
  
            <text>  
                var pin = new Microsoft.Maps.Pushpin(new Microsoft.Maps.Location(@item.lat, @item.lon));  
                pin.metadata = item;  
                pins.push(pin);  
            </text>  
  
        }  
  
        //var pushpins = Microsoft.Maps.TestDataGenerator.getPushpins(1000, map.getBounds());  
        var clusterLayer = new Microsoft.Maps.ClusterLayer(pins, { gridSize: 100 });  
        map.layers.insert(clusterLayer);  
    });  
}
```

- ✓ The application is created in ASP.NET C# using Visual Studio and SQL Server. The Model-View-Controller Version 4 is used to enable desktop and mobile views.
- ✓ The Razor is used as a view engine because its syntax is compact and reduces typing.
- ✓ The controllers are created employing a scaffolding template "read, write, actions, and views" using Razor view and the OpenCell. The controller is responsible for controlling how a user interacts with an MVC application.
- ✓ Entity Framework (EF) approach applied as the database was already created using OpenCell CSV file, when the database is already created, the EF automatically generates a data model that consists of classes and properties

# OpenCell.js

## MAP Function Scripts

```
OpenCell.LoadMap = function (latitude, longitude, onMapLoaded) {

    OpenCell._map = new Microsoft.Maps.Map(document.getElementById('theMap'), {});
    // Create draggable Pin in the center
    var center = OpenCell._map.getCenter();
    var Location = Microsoft.Maps.Location;
    var Pushpin = Microsoft.Maps.Pushpin;

    if (latitude != null && longitude != null) {
        this._map.setView({
            center: new Microsoft.Maps.Location(latitude, longitude),
            zoom: 15
        });
        OpenCell._pins = new Pushpin(new Location(latitude, longitude), { color:
            '#00f', draggable: true });
    }
    else {
        OpenCell._pins = new Pushpin(new Location(center.latitude,
            center.longitude), { color: '#00f', draggable: true });
    }

    OpenCell._map.entities.push(OpenCell._pins);
    // Binding the events
    OpenCell.EnableCallback();
}
```

```
OpenCell.LoadPins = function (latitude, longitude) {

    OpenCell._map = new Microsoft.Maps.Map(document.getElementById('theMap'), {});
    // Create draggable Pin in the center
    var center = OpenCell._map.getCenter();
    var Location = Microsoft.Maps.Location;
    var Pushpin = Microsoft.Maps.Pushpin;

    if (latitude != null && longitude != null) {
        this._map.setView({
            center: new Microsoft.Maps.Location(latitude, longitude),
            zoom: 15
        });
        OpenCell._pins = new Pushpin(new Location(latitude, longitude), { color: '#00f',
            draggable: false });
    }
    else {
        OpenCell._pins = new Pushpin(new Location(center.latitude, center.longitude), {
            color: '#00f', draggable: false });
    }

    OpenCell._map.entities.push(OpenCell._pins);
    // Binding the events
    //OpenCell.EnableCallback();
}
```

## Events Handlers

```
OpenCell.EnableCallback = function () {

    var Events = Microsoft.Maps.Events;
    Events.addHandler(OpenCell._pins, 'drag', function (e) { onMouseUp(e); });
}
```

```
function onMouseUp(e) {
    var loc = e.location;
    $("#lat").val(loc.latitude.toString());
    $("#lon").val(loc.longitude.toString());
}
```

# Runtime

## CRUD Functionality

List top 10 rows

OpenCell.Controllers

```
public ActionResult Index()  
{  
    return View(db.Opencells.Where(x=>x.ID<=10).ToList());  
}
```

your logo here

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Home About OpenCell Contact

### Index

[Create New](#)

ID	radio	mcc	net	area	cell	unit	lon	lat	
80231	GSM	262	2	287	23911	0	7.12846	51.352983	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80232	GSM	262	2	409	28641	0	10.815953	53.703795	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80233	GSM	262	2	409	2321	0	10.693506	53.642236	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80234	GSM	262	2	409	20341	0	10.675443	53.628435	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80235	GSM	262	3	365	47015	0	8.651039	50.22132	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80236	GSM	262	3	365	64475	0	8.635353	50.212129	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80237	GSM	262	3	365	64585	0	8.651157	50.205659	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80238	GSM	262	3	365	6425	0	8.65683	50.232699	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80239	GSM	262	3	365	57905	0	8.641859	50.216457	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80240	GSM	262	3	365	64575	0	8.657642	50.21569	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>

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←→

http://localhost:64789/OpenCell/Create

Search...

⌂ ☆ ⚙ 😊

Add a Tower - My ASP.NET ...

### Add a New Tower

ID

80246

radio

UMTS

mcc

123

net

400

area

800

cell

1234

unit

1

lon

50.19426636385215

lat

26.396693648314787

range

100

samples

1

changeable

1

created

updated

averageSignal

Save

Aerial

+

-

Dragging of Pin Auto updates Longitude and Latitude

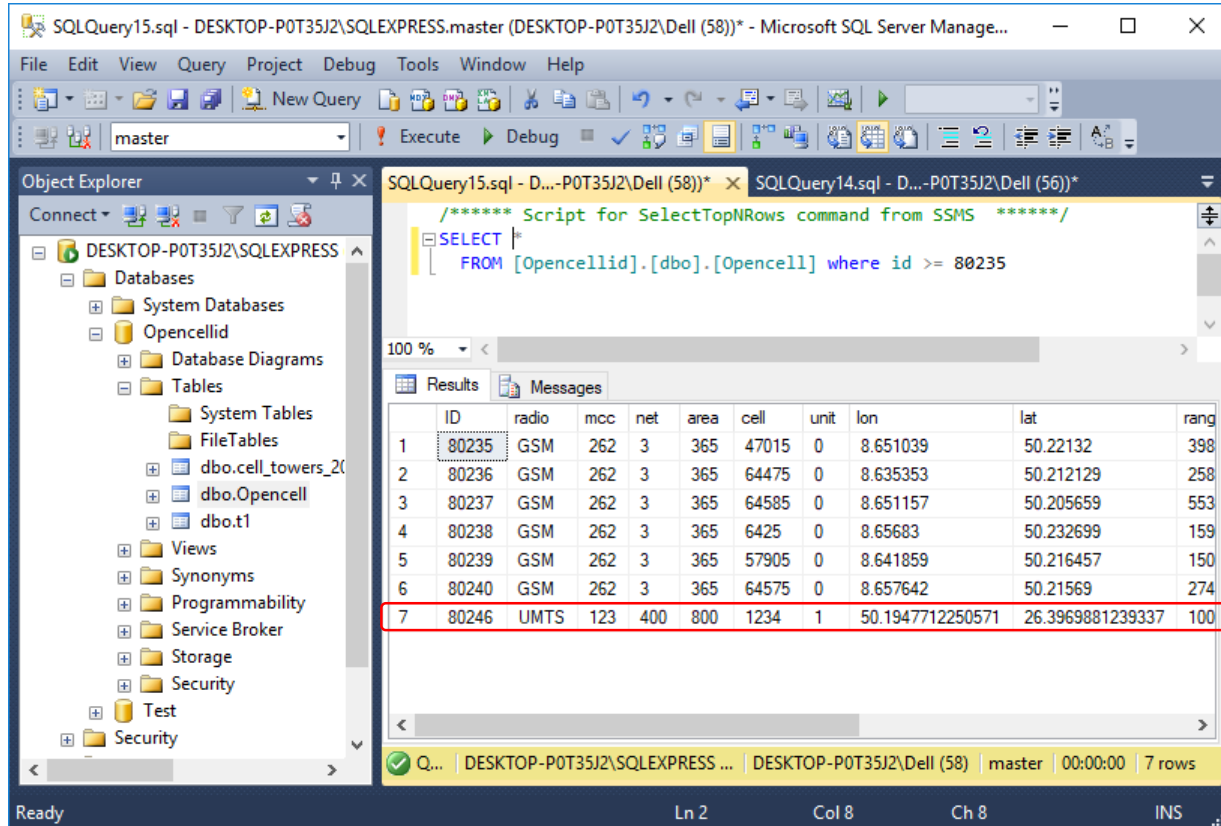
New Draggable Pin

Create New

Save New Tower  
ID "80246"  
In Database



## Locate New ID



SQLQuery15.sql - DESKTOP-P0T35J2\SQLEXPRESS.master (DESKTOP-P0T35J2\ Dell (58))\* - Microsoft SQL Server Manage...

File Edit View Query Project Debug Tools Window Help

Object Explorer

Connect

DESKTOP-P0T35J2\SQLEXPRESS

Databases

System Databases

OpenCellid

Database Diagrams

Tables

System Tables

FileTables

dbo.cell\_towers\_20

dbo.OpenCell

dbo.t1

Views

Synonyms

Programmability

Service Broker

Storage

Security

Test

Security

SQLQuery15.sql - D....-P0T35J2\ Dell (58))\* SQLQuery14.sql - D....-P0T35J2\ Dell (56))\*

/\*\*\*\*\* Script for SelectTopNRRows command from SSMS \*\*\*\*\*/

```
SELECT *
FROM [OpenCellid].[dbo].[OpenCell] where id >= 80235
```

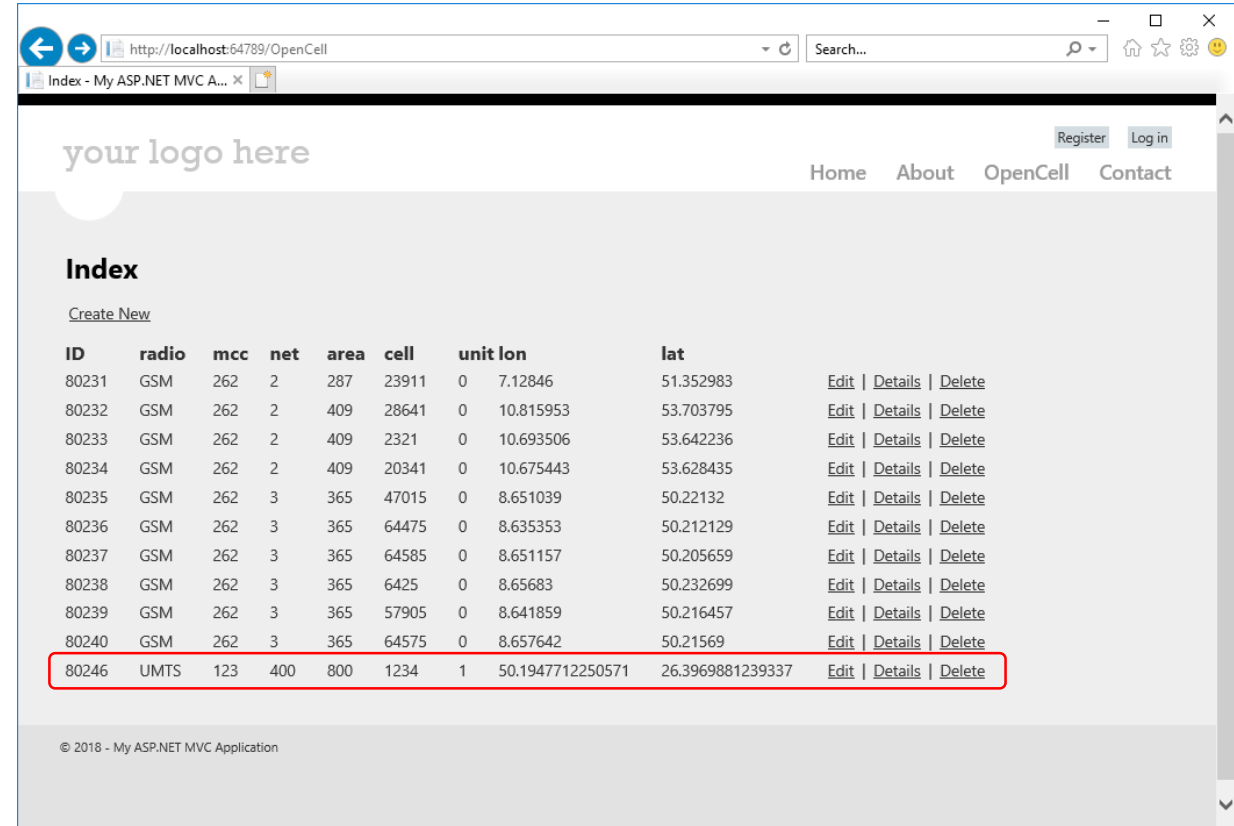
Results Messages

	ID	radio	mcc	net	area	cell	unit	lon	lat	rang
1	80235	GSM	262	3	365	47015	0	8.651039	50.22132	398
2	80236	GSM	262	3	365	64475	0	8.635353	50.212129	258
3	80237	GSM	262	3	365	64585	0	8.651157	50.205659	553
4	80238	GSM	262	3	365	6425	0	8.65683	50.232699	159
5	80239	GSM	262	3	365	57905	0	8.641859	50.216457	150
6	80240	GSM	262	3	365	64575	0	8.657642	50.21569	274
7	80246	UMTS	123	400	800	1234	1	50.1947712250571	26.3969881239337	100

Q... DESKTOP-P0T35J2\SQLEXPRESS ... DESKTOP-P0T35J2\ Dell (58) master 00:00:00 7 rows

Ready Ln 2 Col 8 Ch 8 INS

**New ID “80246”  
In the Database**



http://localhost:64789/OpenCell

Search...

Index - My ASP.NET MVC A...

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### Index

Create New

ID	radio	mcc	net	area	cell	unit	lon	lat	
80231	GSM	262	2	287	23911	0	7.12846	51.352983	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80232	GSM	262	2	409	28641	0	10.815953	53.703795	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80233	GSM	262	2	409	2321	0	10.693506	53.642236	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80234	GSM	262	2	409	20341	0	10.675443	53.628435	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80235	GSM	262	3	365	47015	0	8.651039	50.22132	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80236	GSM	262	3	365	64475	0	8.635353	50.212129	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80237	GSM	262	3	365	64585	0	8.651157	50.205659	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80238	GSM	262	3	365	6425	0	8.65683	50.232699	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80239	GSM	262	3	365	57905	0	8.641859	50.216457	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80240	GSM	262	3	365	64575	0	8.657642	50.21569	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>
80246	UMTS	123	400	800	1234	1	50.1947712250571	26.3969881239337	<a href="#">Edit</a>   <a href="#">Details</a>   <a href="#">Delete</a>

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**New ID “80246”  
In the View**




http://localhost:64789/OpenCell/Edit/80246

Edit: 80246 - My ASP.NET ...

### Modify a Tower

ID	80246
radio	UMTS
mcc	123
net	401
area	801
cell	1234
unit	1
lon	50.192252095136126
lat	26.395335542695157
range	100
samples	1
changeable	1
created	
updated	
averageSignal	

Save



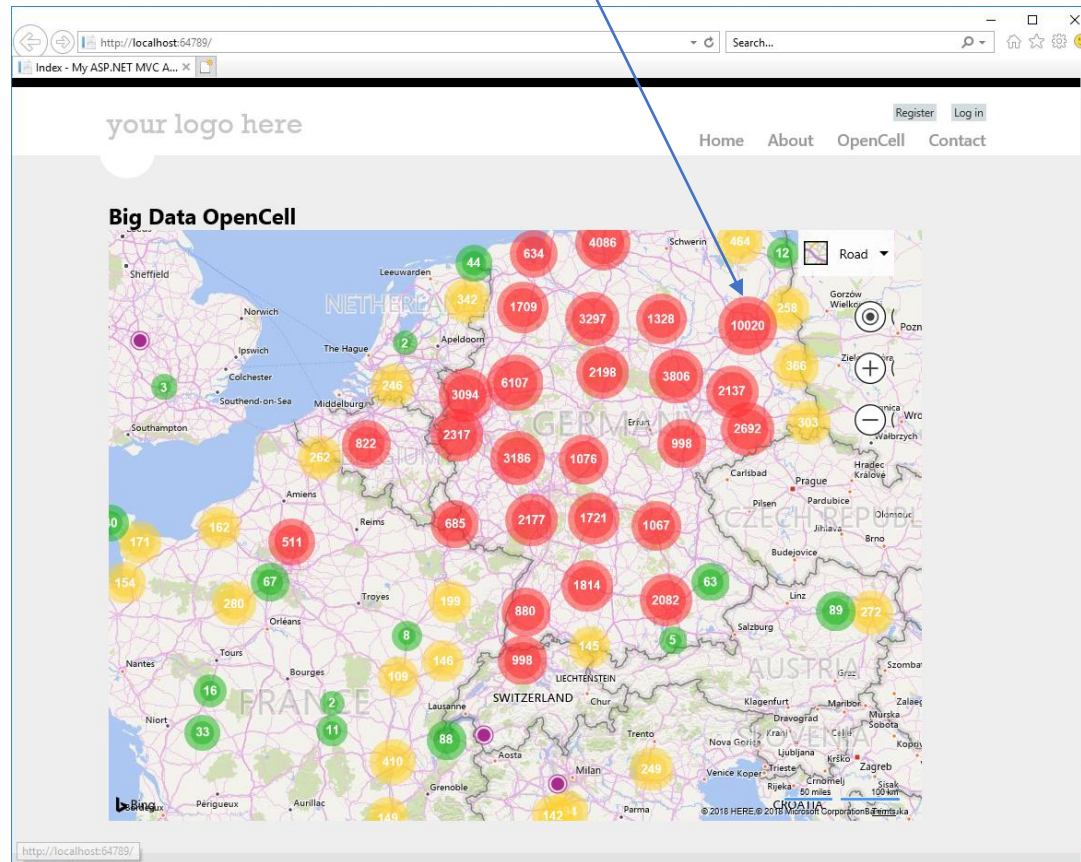
Drag the Pin to new Location to update new location

Modify the Location

Load Tower ID "80246" From the Database

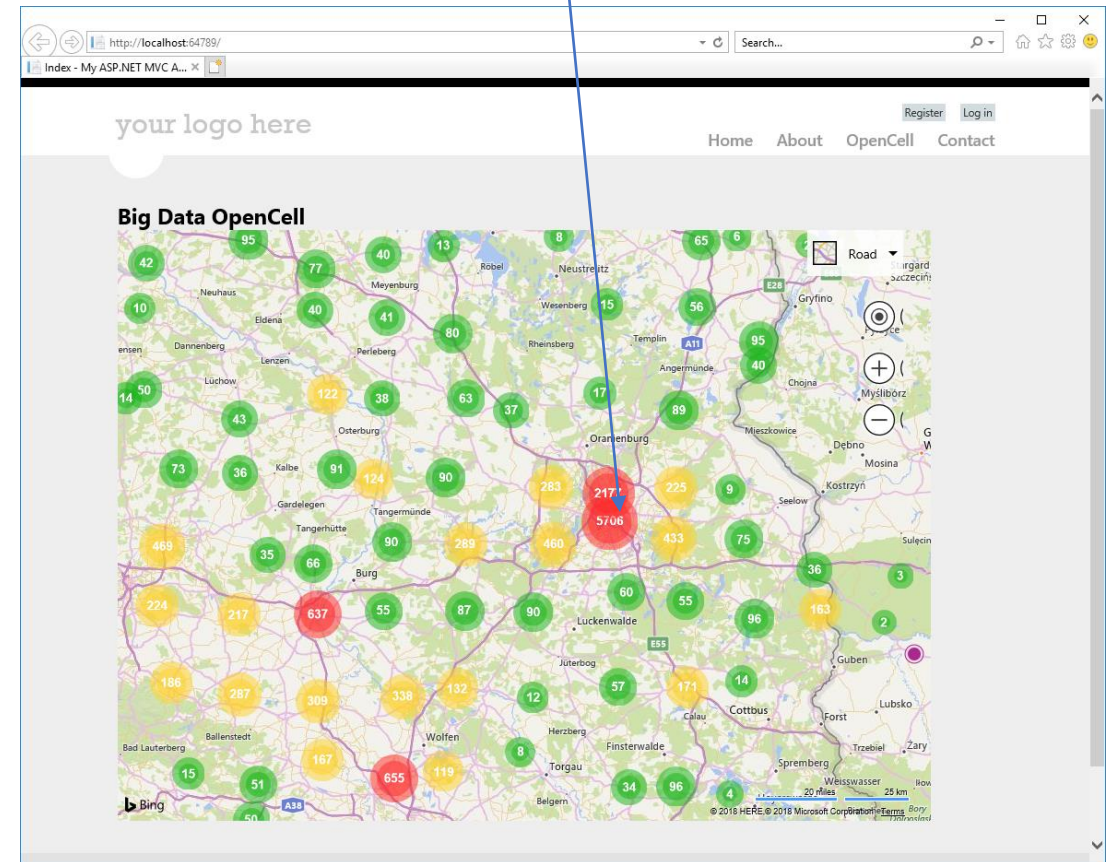
Update Tower ID "80246" In the Database

**Germany : Largest  
cluster size “10020”**



**Germany Zoom Level : 4**

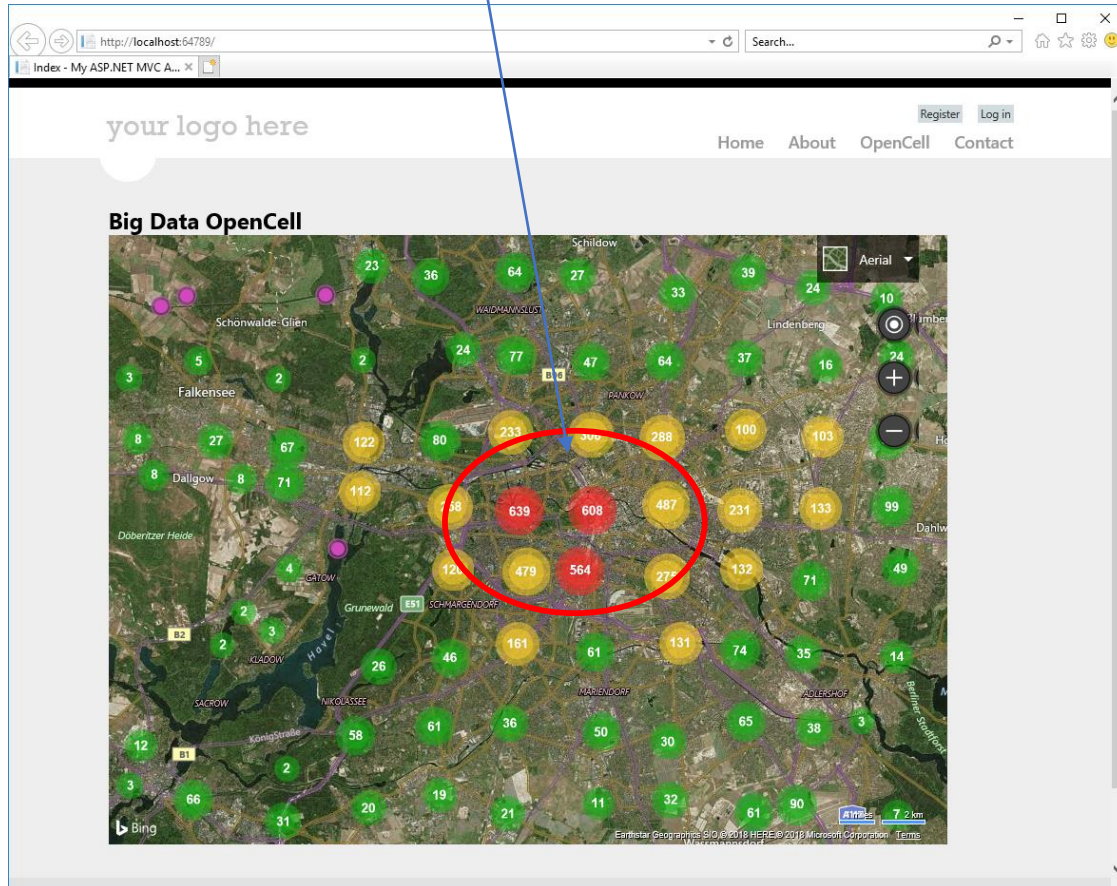
**‘Oranienburg’ region  
Largest cluster size “5706”**



**Germany Zoom Level : 6**

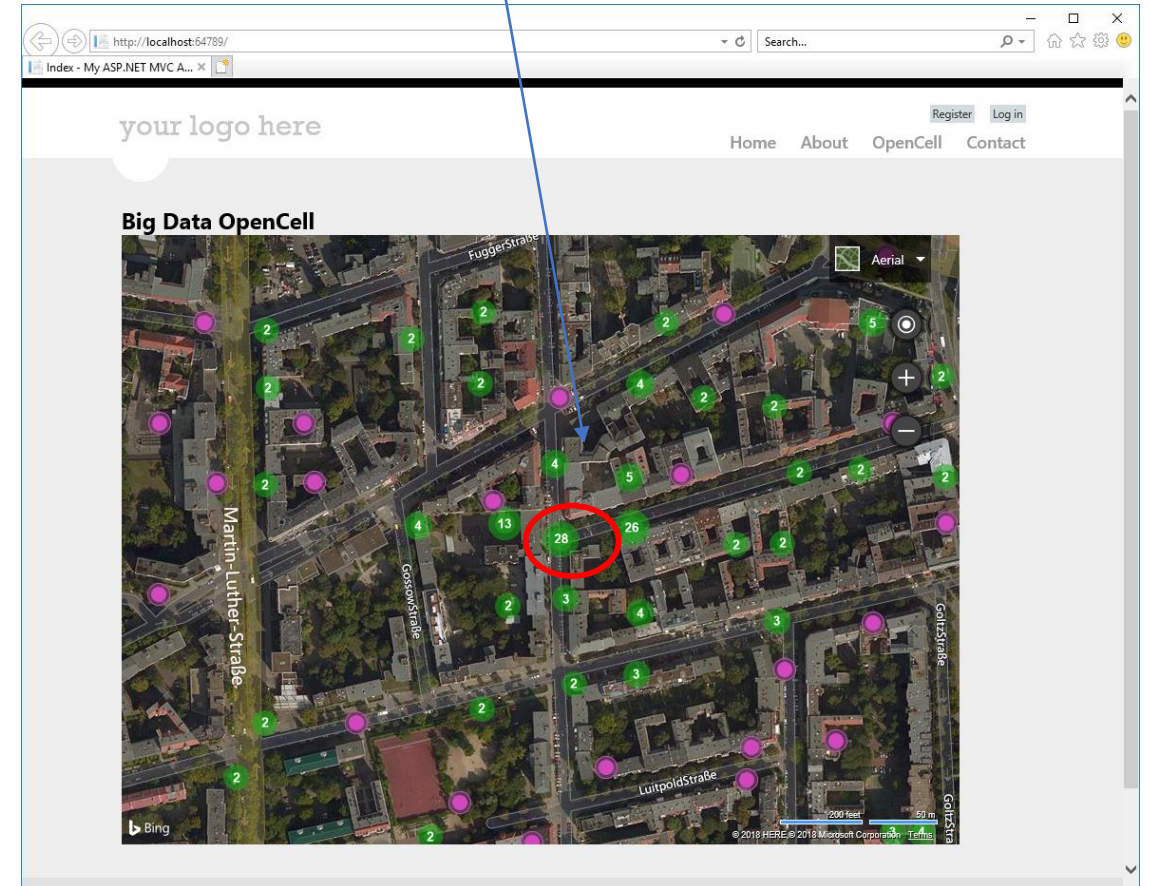


Dense Cluster in  
Wilmersdorf Area



City View

Dense Cluster in Eisenacher  
Straße "28" Measurements



Street View

**Thanks**