

# Android

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## - poloha

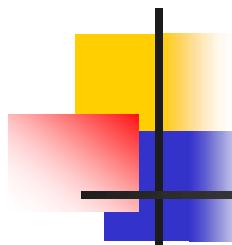
Peter Borovanský

KAI, I-18

MS-Teams: [2sf3ph4](#), [List](#), [github](#)

borovan 'at' ii.fmph.uniba.sk

- **GSM**
- **WiFi**
- **GPS**
  - **Location Provider,**
  - **ProximityListener,**
  - **Geocoder**



# Ako zistit', kde sa nachádzam ?

... resp. kam smerujem...

Ak pominieme rady „starých mám“ a ešte starších moreplavcov, tak máme:

- satelity (technológia GPS a jej modernejšie klony)
- mobilnú siet' (technológia GSM, ...)
- siete (veľmi) krátkeho dosahu (napr. WiFi, Bluetooth, RFID, NFC)

Načo nám slúži/môže slúžiť informácia o polohe ?

- nájdeme sa, resp. nájde nás to, na mape ☺
- informácia, čo je okolo, POI – points of interest (v kategóriach záujmov), kam na obed, do kina, ...,
- navigácia: ako sa mám dostať na iné miesto,
- hľadanie pokladov (tzv. geocaching),
- cielená reklama ☹
- GPS tracking ☺
- SOS calling ☺

# Týmto by sme mohli dnes začať aj skončiť

```
lateinit var lm: LocationManager  
...  
lm = getSystemService(Context.LOCATION_SERVICE) as LocationManager  
  
val provider = LocationManager.GPS_PROVIDER // GPS locator  
        = LocationManager.NETWORK           // GSM locator  
  
val loc : Location = lm.getLastKnownLocation(provider)  
    loc.latitude          - zem. šírka  
    loc.longitude         - zem. dĺžka  
    loc.altitude          - nadmorská výška, elevácia  
    loc.accuracy          - presnosť nameraného údaju  
    loc.provider          - info o provideri polohy (GPS/GSM)  
    loc.speed              - rýchlosť v m/s (len ak sa hýbeme)  
    loc.bearing            - azimut, ale musíme sa hýbať !!  
    loc.time                - milisec od 1970
```

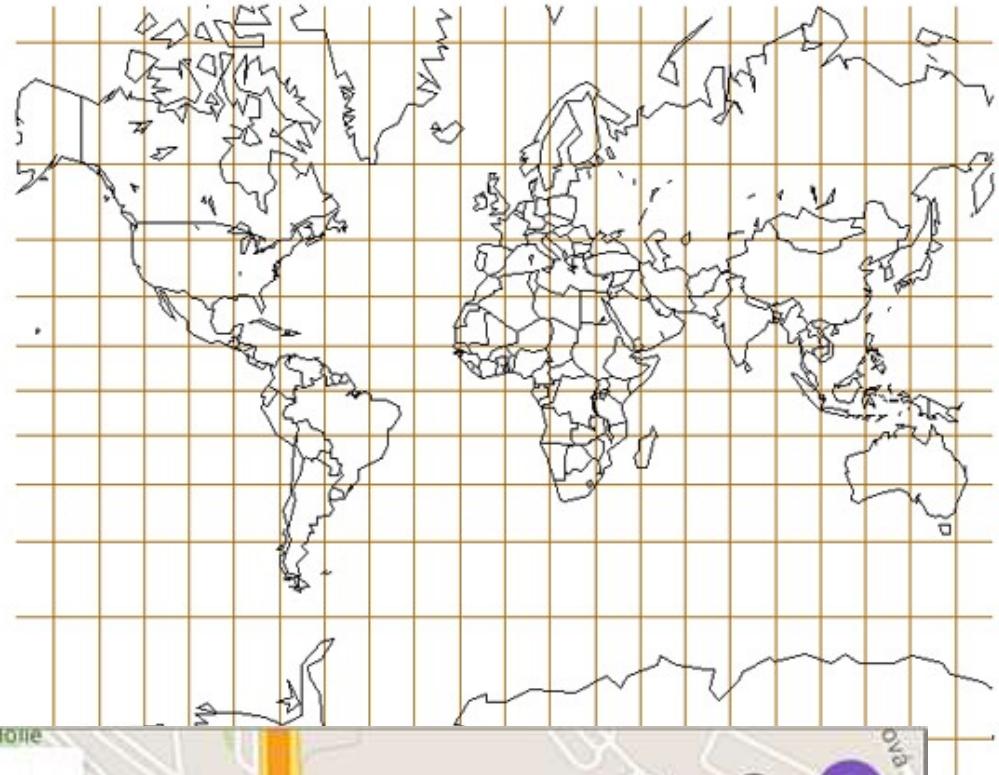
<https://stuff.mit.edu/afs/sipb/project/android/docs/training/basics/location/locationmanager.html>

Prednáška je o veciach súvisiacich s polohou

# Ujasnenie

- Latitude – zem.šírka
- Longitude – zem.dĺžka

<https://www.google.sk/maps/@48.151019,17.0707008,15z?hl=sk>



Hľadať v Mapách Google

Fakulta informatiky a informačných...

E65

Peter

Fakulta elektrotechniky a informatiky Slovenskej technickej univerzity v Bratislave

Prirodovedecká fakulta Univerzity...

Univerzita Komenského V Bratisla...

Mlynská dolina, 811 02 Bratislava

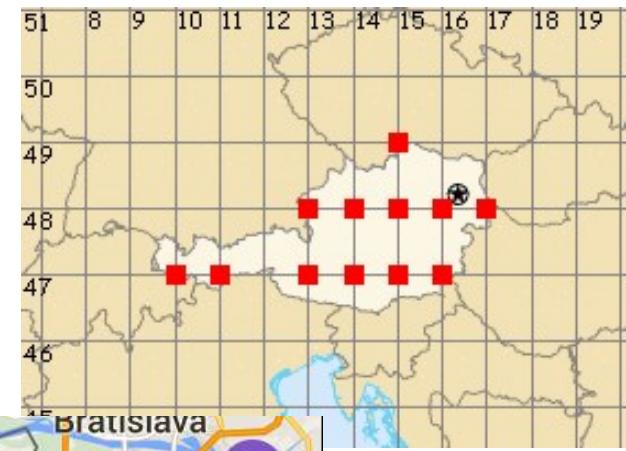
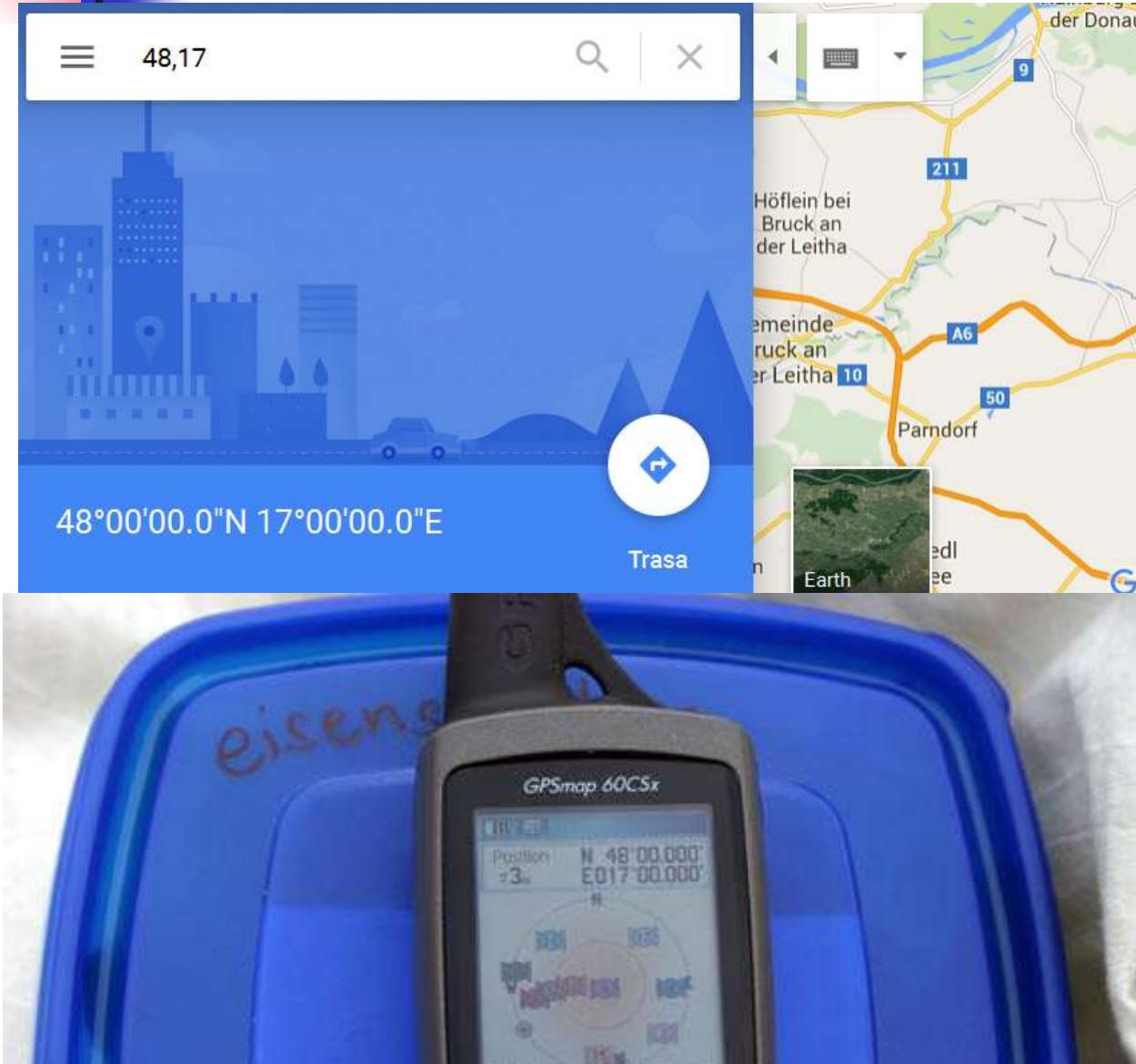
48.151548, 17.070210

Botanicke

Údaje máp © 2015 Google Zmluvné podmienky Ochrana osobných údajov maps.google.com Odoslanie späťnej väzby 200 m

# Confluence-Point

(mrežový bod - Gattendorf)



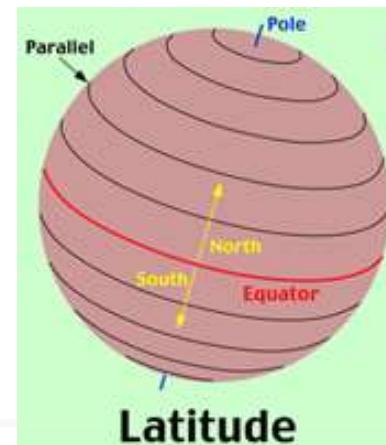
Koľko je slovenských  
mrežových bodov ??

<http://www.confluence.org/country.php?id=66>

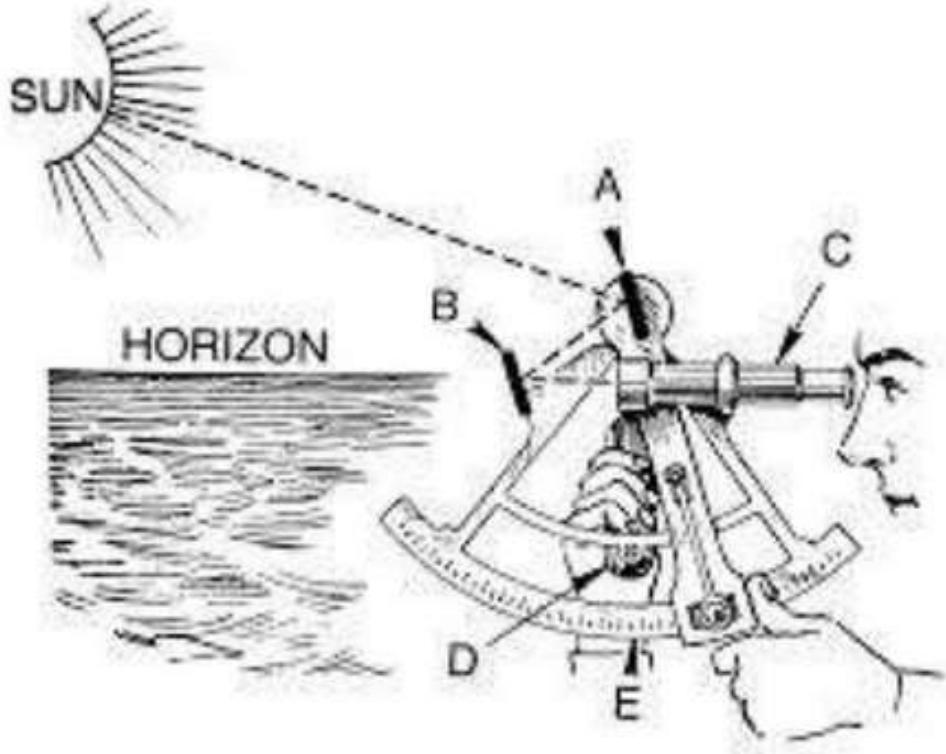
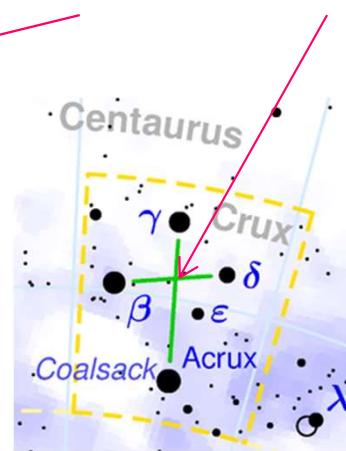
<https://www.confluence.org/country.php?id=36>

# Zemepisná šírka

(latitude, 0-90°N, 0-90°S, my sme 48... °N)



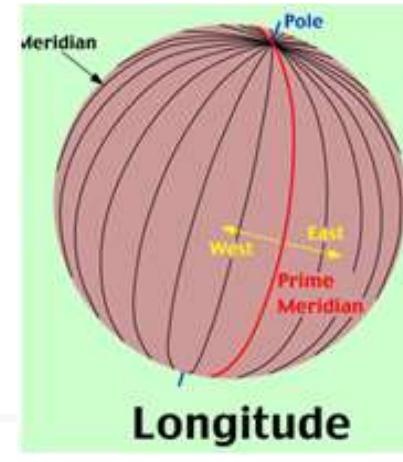
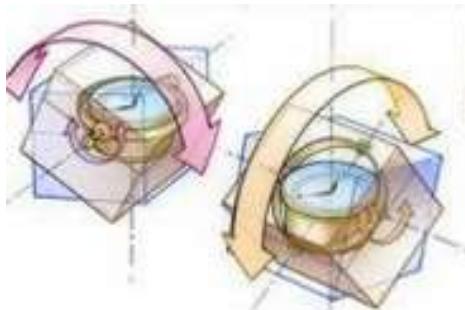
Merali uhol medzi horizontom a význačným bodom na oblohe, Slnko, Polárka (alias Severka), Južný kríž... a mali na výpočet tabuľky



# Zemepisná dĺžka

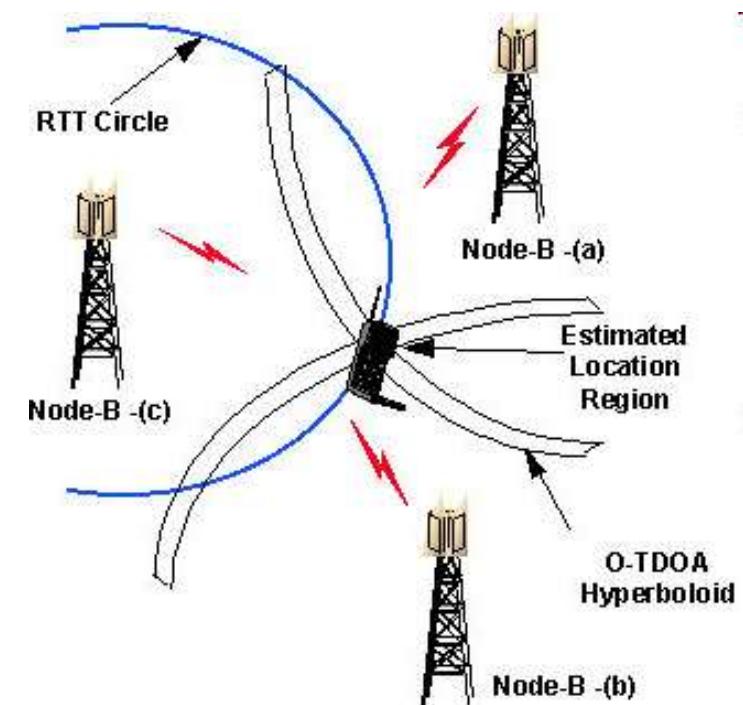
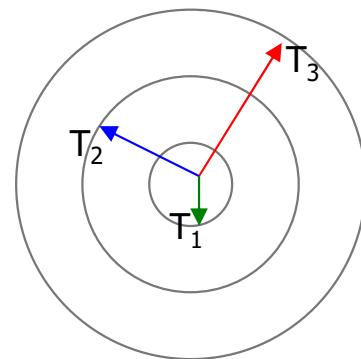
(longitude, 0-180°E, 0-180°W, my sme 17... °E)

- aby sme ju určili z hviezd, potrebujeme presný čas, resp. vedieť, kol'ko hodín je na Greenwich-i, lebo to súvisí s natočením Zeme
- problém sa redukuje na problém presného času
- kým na súší sa dajú použiť kyvadlové hodiny, na mori nie veľmi...



# Lokalizácia (dnes) bez GPS

- mobilné zariadenie komunikuje prostredníctvom jedného (asi najbližšieho) vykryvača, to určuje okruh s presnosťou závislou od hustoty vykryvačov,
- triangulácia – z viacerých podobných informácií a polohy vykryvačov v dosahu zložíme presnejšiu aproximáciu polohy,
- time of arrival – vykryvače v rôznej vzdialnosti dostanú informáciu z mobilného zariadenia v rôznych časoch  $T_1$ ,  $T_2$ ,  $T_3$ . Ked'že signál sa šíri  $\sim 300.000.000 \text{ m/s} = 300 \text{ km/ms}$



# Meranie času

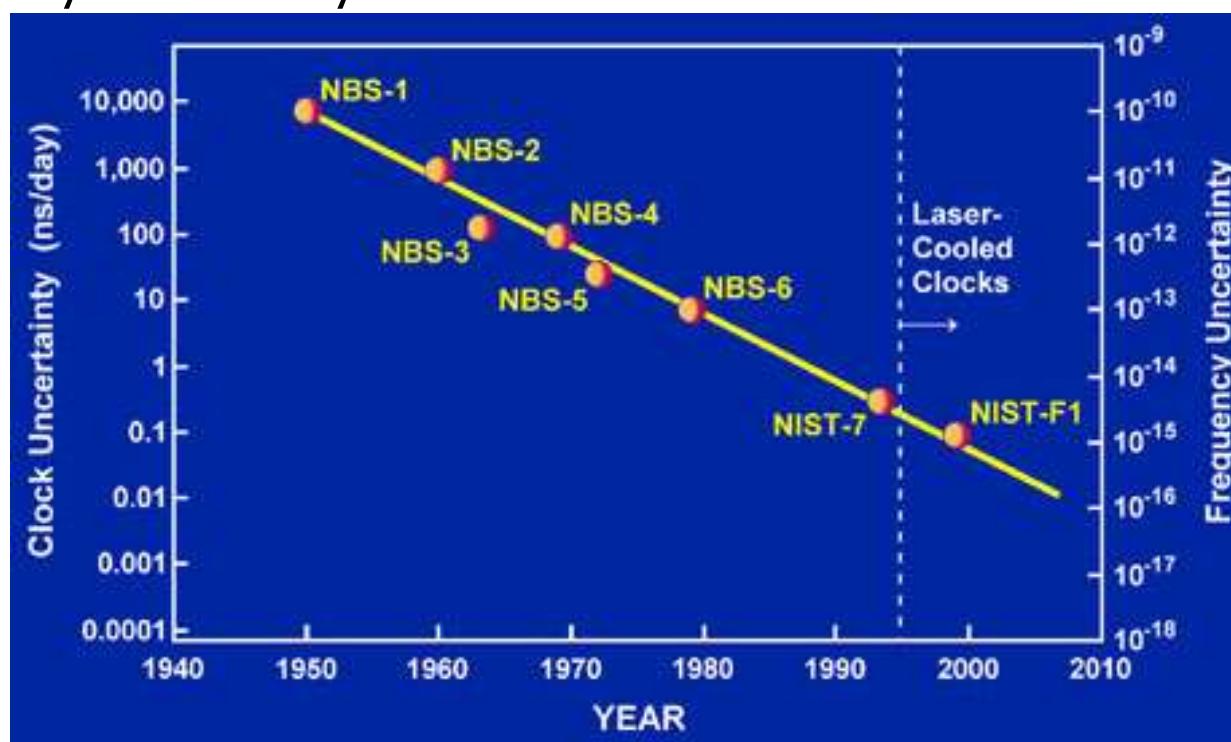
s akou presnosťou to vieme

$$\sim 300.000.000 \text{ m/s} = 300 \text{ km/ms} = 30 \text{ cm/ns}$$

chyba atómových hodín v ns za deň



$$\begin{aligned}100\text{m}/10\text{s} &= \\10\text{m}/1\text{s} &= \\10\text{cm}/0.01\text{s} &= \\1\text{cm}/1\text{ms}\end{aligned}$$



2013, the uncertainty reduced to cca  $3 \times 10^{-16}$ , (+/-) 1s za 100 million rokov !



# Lokalizácia z GSM signálu

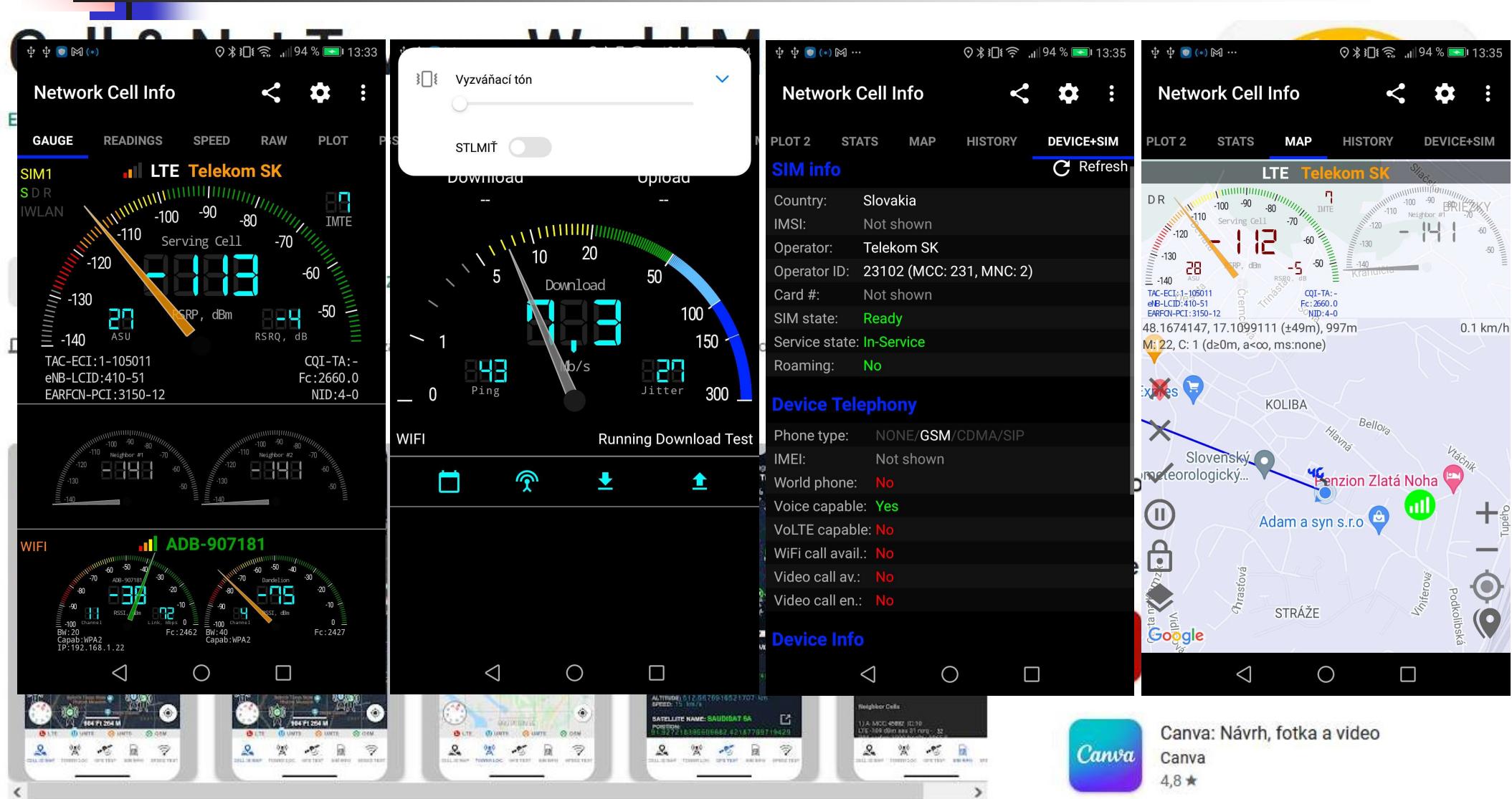
Nepresná informácia o polohe (mesto/mestská časť) sa dá získať z GSM siete

```
val tm = getSystemService(Context.TELEPHONY_SERVICE) as  
    TelephonyManager  
  
tm.networkOperator - operátor = (mcc+mnc) : String mcc+mnc  
    ■ mcc (mobile country code) = networkOperator.substring(0, 3)  
    ■ mnc (mobile network code) = networkOperator.substring(3)  
  
val gsmloc = tm.cellLocation as GsmCellLocation  
    ■ gsmloc.cid           - buňka (Cell ID)  
    ■ gsmloc.lac           - local area code
```

databázy GSM buniek (cid, lac, operátor)->(lat,long), nie sú úplne „free”, up-to-date

- [http://en.wikipedia.org/wiki/Cell\\_ID](http://en.wikipedia.org/wiki/Cell_ID)
- <https://developers.google.com/maps/documentation/business/geolocation/>
- <http://locationapi.org/> , <https://unwiredlabs.com/>
- <https://portal.combain.com/>

# Cell & Net towers World Live map Signal and Speed



<https://play.google.com/store/apps/details?id=com.ekik.celltowers&gl=AT>



Canva: Návrh, fotka a video

Canva

4,8 ★

# LocationAPI.org

```
D/MyGSMLocation(19361): gsm cid: 396517  
D/MyGSMLocation(19361): gsm lac: 1001  
D/MyGSMLocation(19361): operator:23102  
D/MyGSMLocation(19361): network: 23102  
D/MyGSMLocation(19361): mcc: 231  
D/MyGSMLocation(19361): mnc: 2
```

- zaregistrujete sa napr. na free trial, max. 50 requests/day, resp. 1500 requests
- dostanete klúč (token), 95b2941777892d (ked' toto čitate, možno neplatí ☹)
- s8hmu5kq716gawzkczfz

<http://locationapi.org/site/page?view=apiv2>

Request: 1 cell | 3 cells | 7 cells

mcc:  
**231 SK**

mnc:  
**01 Ora**  
**02 Tele**  
**04 TMo**  
**06 O<sub>2</sub>**

```
1 {  
2   "token": "1445573628",  
3   "mcc": 231,  
4   "mnc": 2,  
5   "cells": [  
6     {"cid": 396517,  
7      "lac": 1001,  
8      "signal": -60,  
9      "tA": 13  
10    }]  
11 }
```

Response:

```
1 {  
2   "status": "ok",  
3   "balance": 45,  
4   "lat": 48.16802,  
5   "lon": 17.11049,  
6   "accuracy": 1063,  
7   "message": "Accuracy is in BETA!"  
8 }
```

## API v2 Documentation

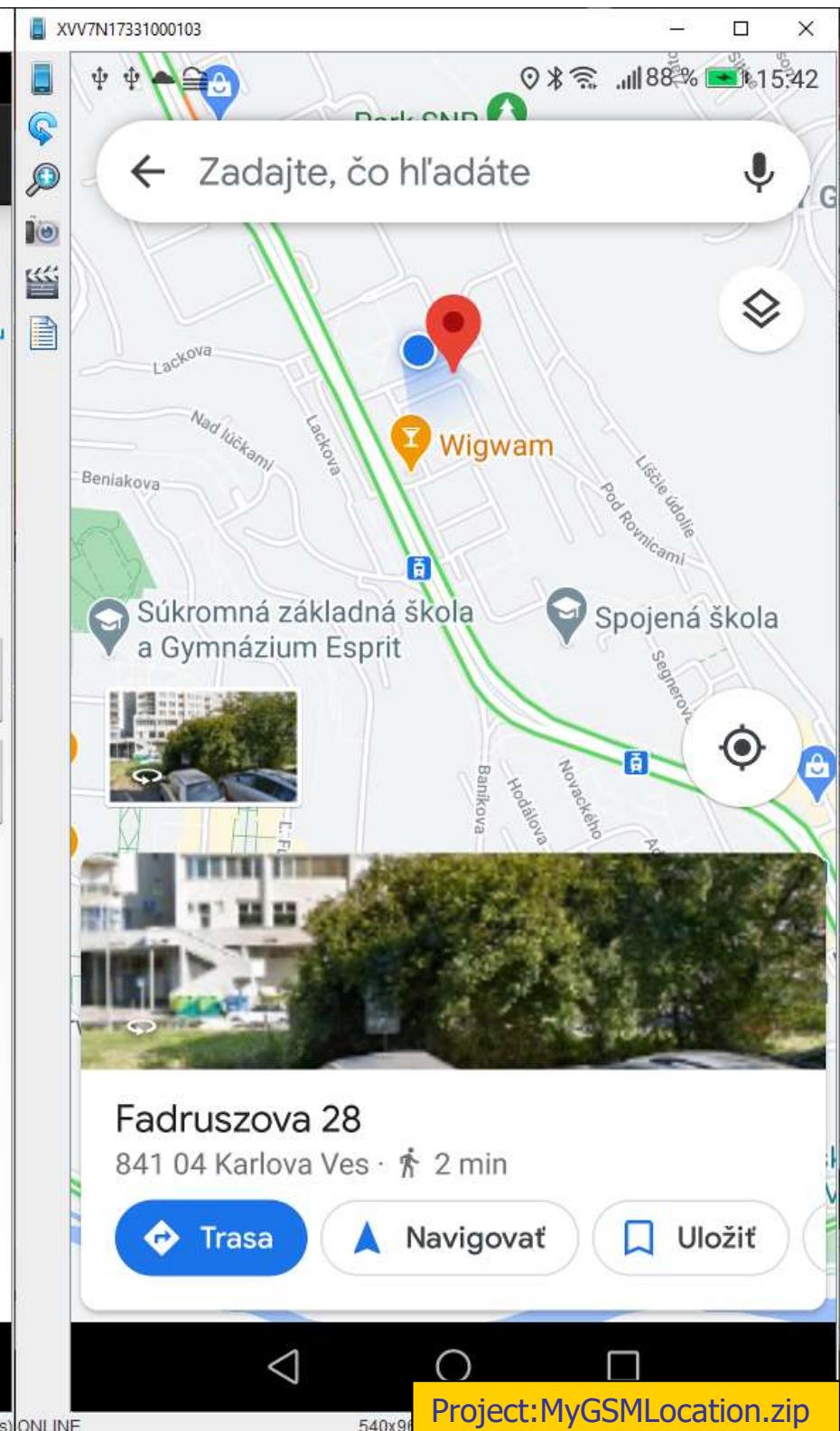
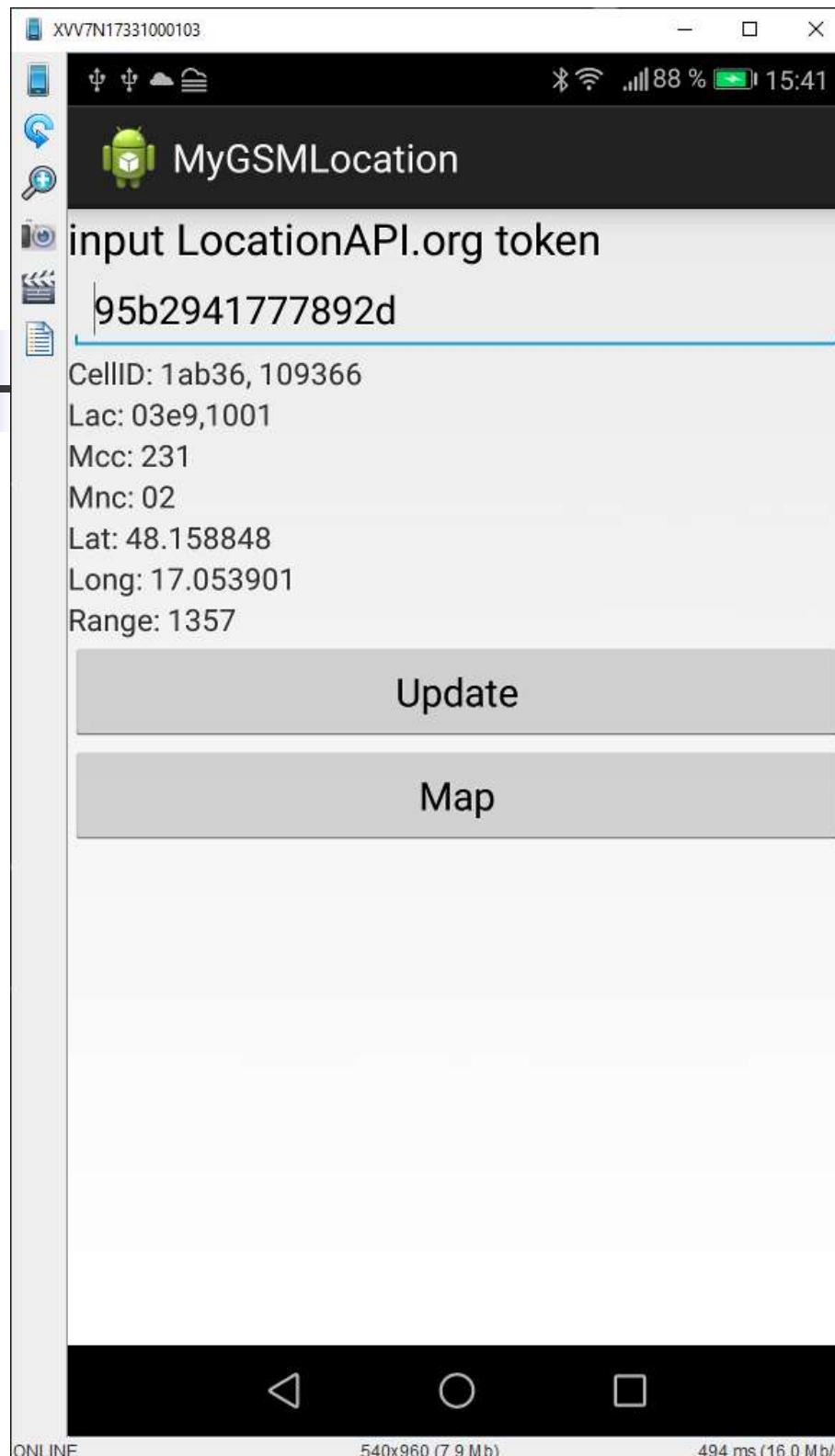
1. [Usage](#)
2. [Test it out](#)
3. [Request body](#)
4. [Response body](#)
5. [Example Script - PHP](#)
6. [Example Script - Python](#)

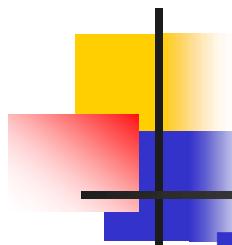
### Usage

Requests are sent using POST to the following url:

<http://locationapi.org/v2/process.php>

Label	Access Token
Private Token	95b2941777892d 





# LocationAPI z aplikácie

<https://developers.google.com/maps/documentation/urls/android-intents>

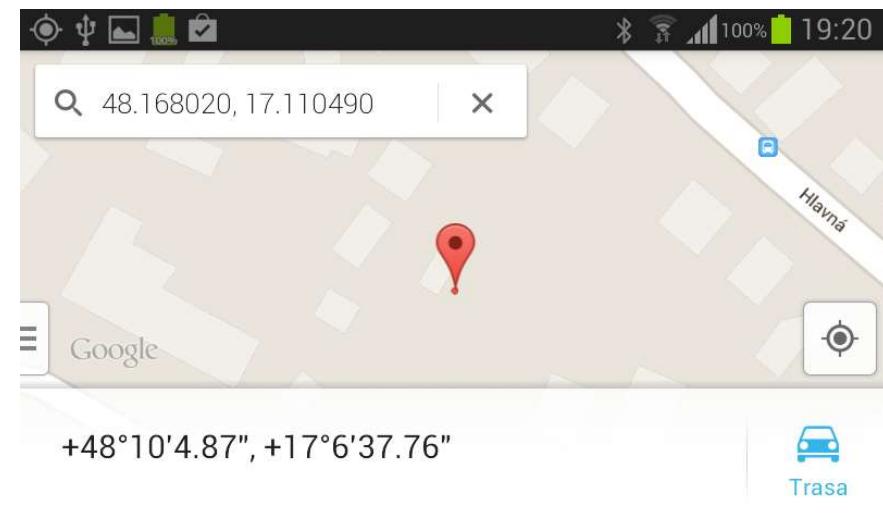
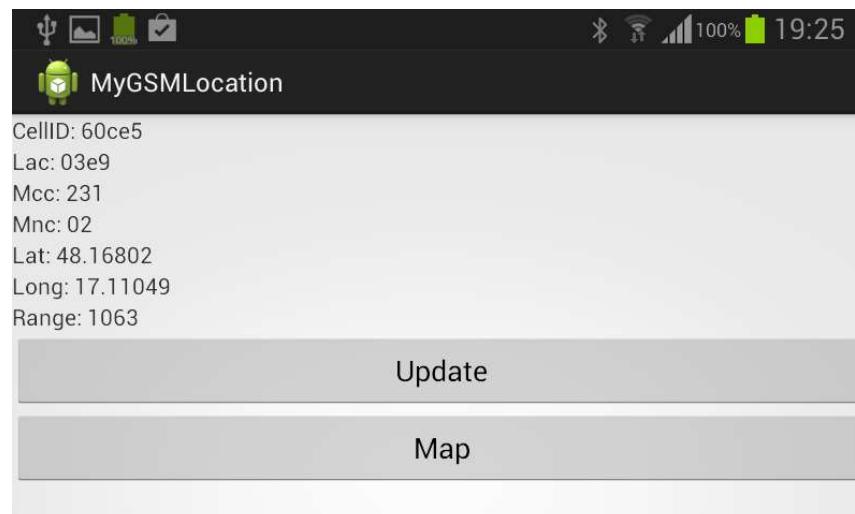
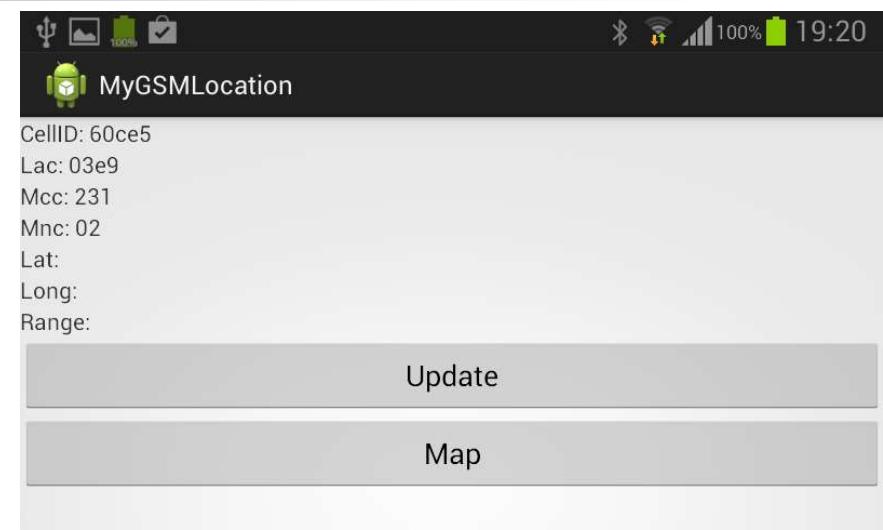
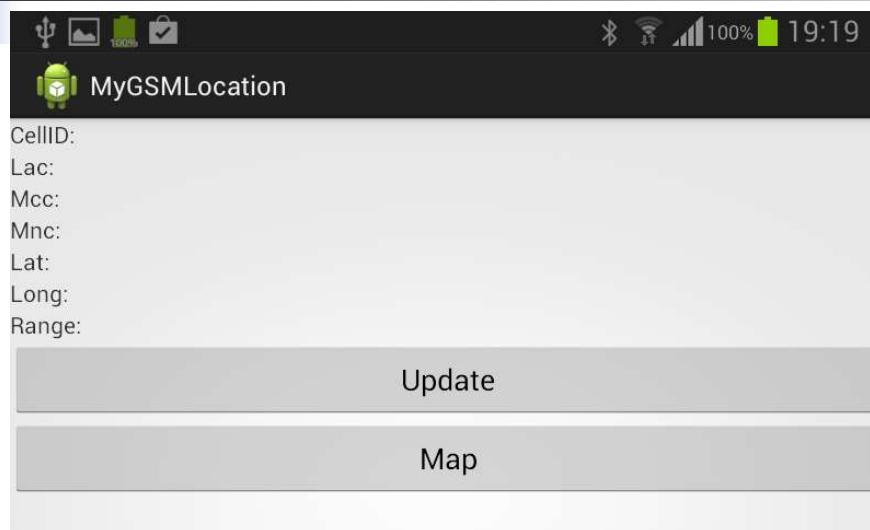
potrebujeme urobiť http-POST request na

<https://eu1.unwiredlabs.com/v2/process.php>

... na budúce (v prednáške http/REST API)

- ked'že to niečo trvá, **nesmieme to robit' v hlavnom vlákne** – AsyncTask resp. corutiny ... na budúce ...
- do tela dotazu (requestu) potrebujeme **zakódovať** (cellID, lac, mcc, mnc + môj token) hoc jednoduchý, ale predsa-len **JSON** object->json  
... na budúce (v prednáške http)
- z tela odpovede (responsu) potrebujeme **dekódovať** hoc jednoduchý, ale **JSON** objekt, t.j. prečítať latitude-longitude, json -> object  
... na budúce (v prednáške http)
- no a **zobrazit' na mape**, vytvoríme, zavoláme intent **startActivity**(  
Intent (android.content.Intent.ACTION\_VIEW,  
Uri.parse ("geo:0,0?q=\$latit,\$longit")) )  
... alebo na budúce (v prednáške Google MAPS)
- resp. všetko je v priloženom kóde, resp. z php/pythonovských príkladov

# GSM LocationAPI.org



Project:MyGSMLocation.zip

# Cell Tower & WiFi Coverage

## Pokrytie

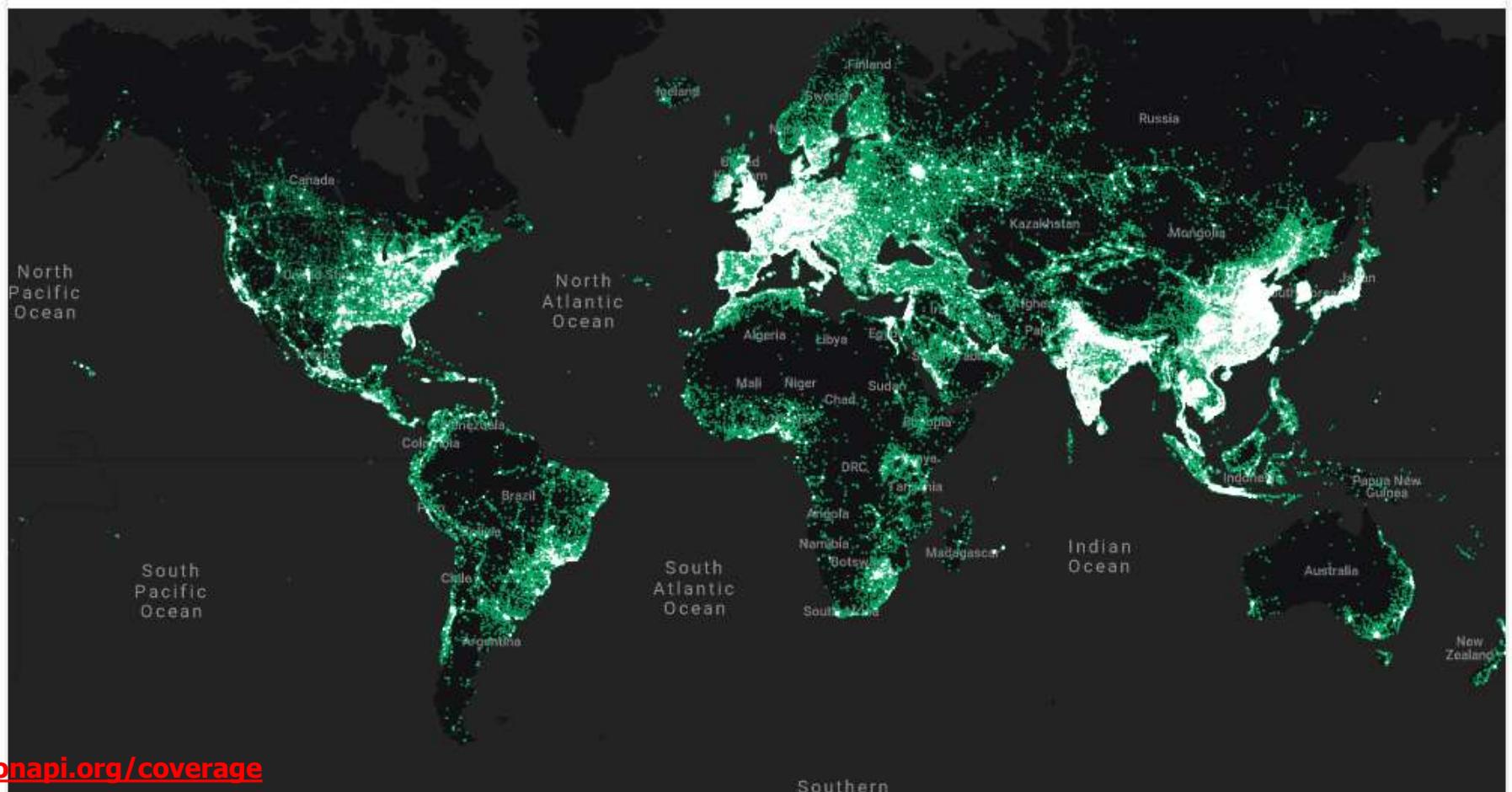
**204.27 million**

Cells

**4.15 billion**

WiFi Access Points

This interactive map shows the physical locations of Cell towers & WiFi APs from our database. Data has been rounded off to resolution of ~100 meters.



# Wifi

- 00:0f:f7:2e:16:a0,"FMFI\_UK",48.152248500846326,17.07091609016061,5,100,FMFI\_UK,1,FMFI\_UK
- 00:0f:f7:2e:16:a2,"eduroam",48.1524363392964,17.070470340549946,5,100,eduroam,1,eduroam

Request: 2 WiFis

```
1 {  
2   "token": "95b2941777892d",  
3   "wifi": [  
4     {  
5       "bssid": "00:0f:f7:2e:16:a0"  
6     },  
7     {  
8       "bssid": "00:0f:f7:2e:16:a2"  
9     }],  
10   "address": 1  
11 }
```

Response:

```
1 {  
2   "status": "ok",  
3   "balance": 48,  
4   "lat": 48.15225561,  
5   "lon": 17.06998922,  
6   "accuracy": 10,  
7   "address": "Staré grunty, Švédske do  
8 }  
9  
10 < > III
```

Location:



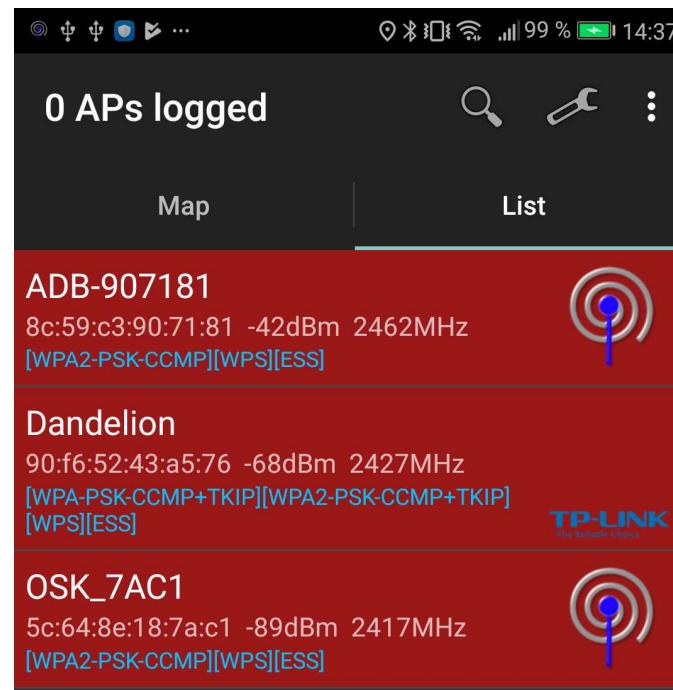
- 8c:59:c3:90:71:81
- 0c:84:dc:96:7b:06
- <https://www.google.com/maps/place/48%C2%B001'02.9%22N+17%C2%B006'36.0%22E/@48.1674834,17.1078093,17z/data=!3m1!4b1!4m5!3m4!1s0x0:0x0!8m2!3d48.1674834!4d17.109998>

# Wifi tracker

{

```
"token": "95b2941777892d",
"mcc": 231,
"mnc": 2,
"cells": [
    {"lac": 1001,
     "cid": 109366
    }],
"address": 1
```

}



# Iné služba, iná DB, iné API

(podobné výsledky)

Request

```
1 ~ {  
2   "radioType": "gsm",  
3   "cellTowers": [{  
4     "mobileCountryCode": 231,  
5     "mobileNetworkCode": 2,  
6     "locationAreaCode": 1001,  
7     "cellId": 396517 }]  
8 }
```

Response

```
1 ~ [ {  
2   "location": {  
3     "lat": 48.16677,  
4     "lng": 17.11046  
5   },  
6   "accuracy": 254  
7 }]
```

Location



[https://cps.combain.com?key=YOUR\\_API\\_KEY](https://cps.combain.com?key=YOUR_API_KEY)

Method: POST

Content-Type: application/json

... registrujte sa a vyskúšajte

<https://portal.combain.com/>

# WiFi

- 00:0f:f7:2e:16:a0,"FMFI\_UK",48.152248500846326,17.07091609016061,5,100,FMFI\_UK,1,FMFI\_UK
- 00:0f:f7:2e:16:a2,"eduroam",48.1524363392964,17.070470340549946,5,100,eduroam,1,eduroam

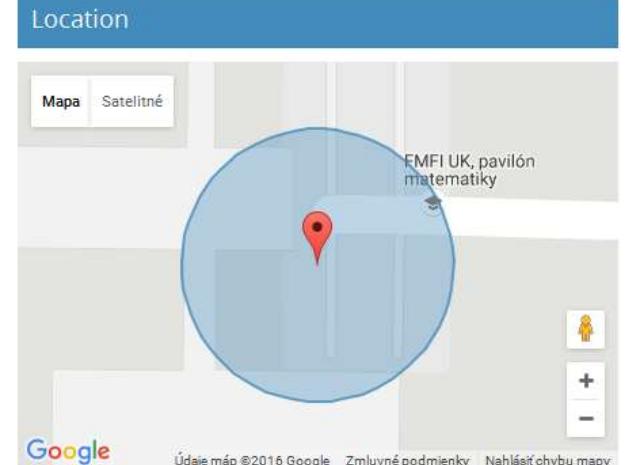
Request

```
1 ↴ {  
2   "wifiAccessPoints": [  
3     "macAddress": "00:0f:f7:2e:16:a0",  
4     "signalStrength": -61  
5   },  
6   {  
7     "macAddress": "00:0f:f7:2e:16:a2",  
8     "signalStrength": -62  
9   ]  
10 }  
  
WIFI
```

Response

```
1 ↴ {  
2   "location": {  
3     "lat": 48.15225,  
4     "lng": 17.07092  
5   },  
6   "accuracy": 20  
7 }  
  
WIFI
```

Location



FMFI UK, pavilón matematiky

Mapa Satelitné

Google Údaje map ©2016 Google Zmluvné podmienky Nahlásiť chybu mapy

## 231 – Slovakia

Total number of GSM:	56493
Total number of WCDMA:	84208
Total number of LTE:	24465
Total number of CDMA:	0
Total number of WIFI:	2189255



# Pokrytie

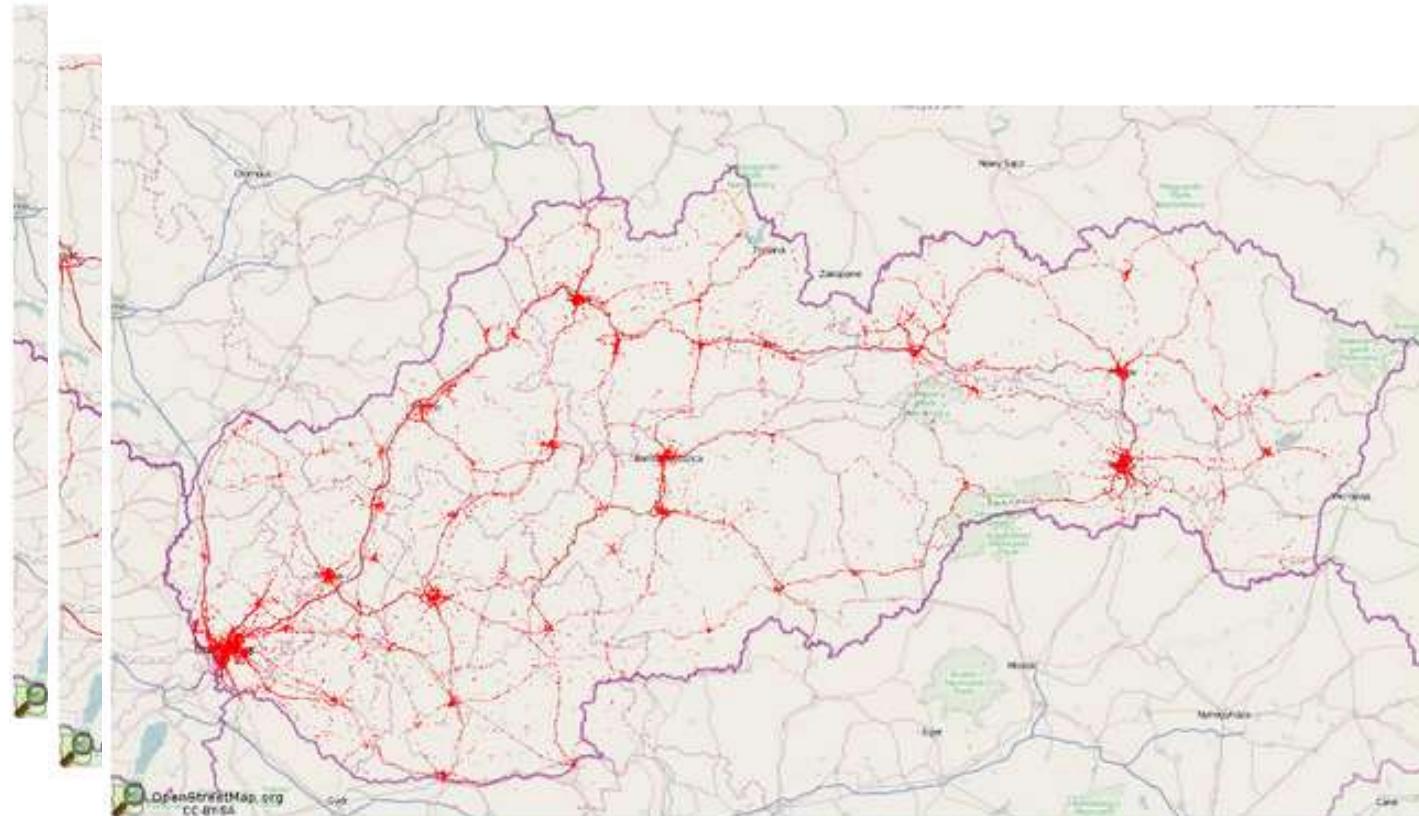
Ra

Radio Type:

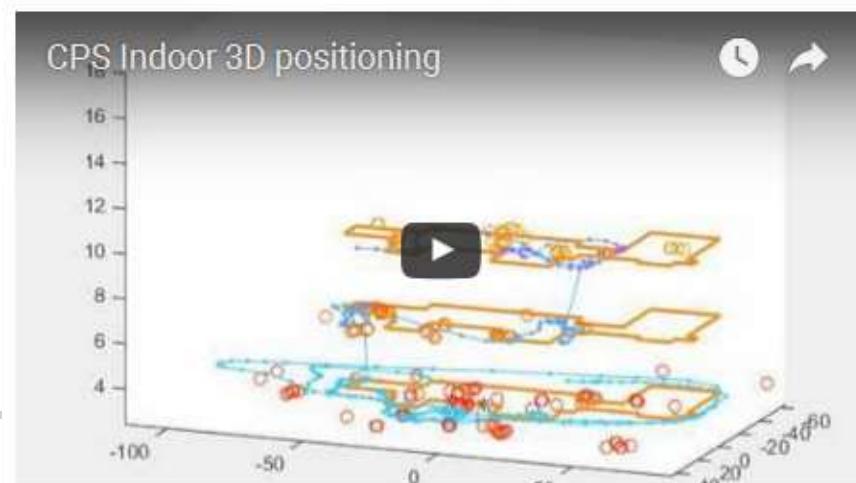
Radio Type:

All GSM

All LTE



# Indoor



See how our SLAM creates a 3D map of all WiFi's in a building



## Mattehuset

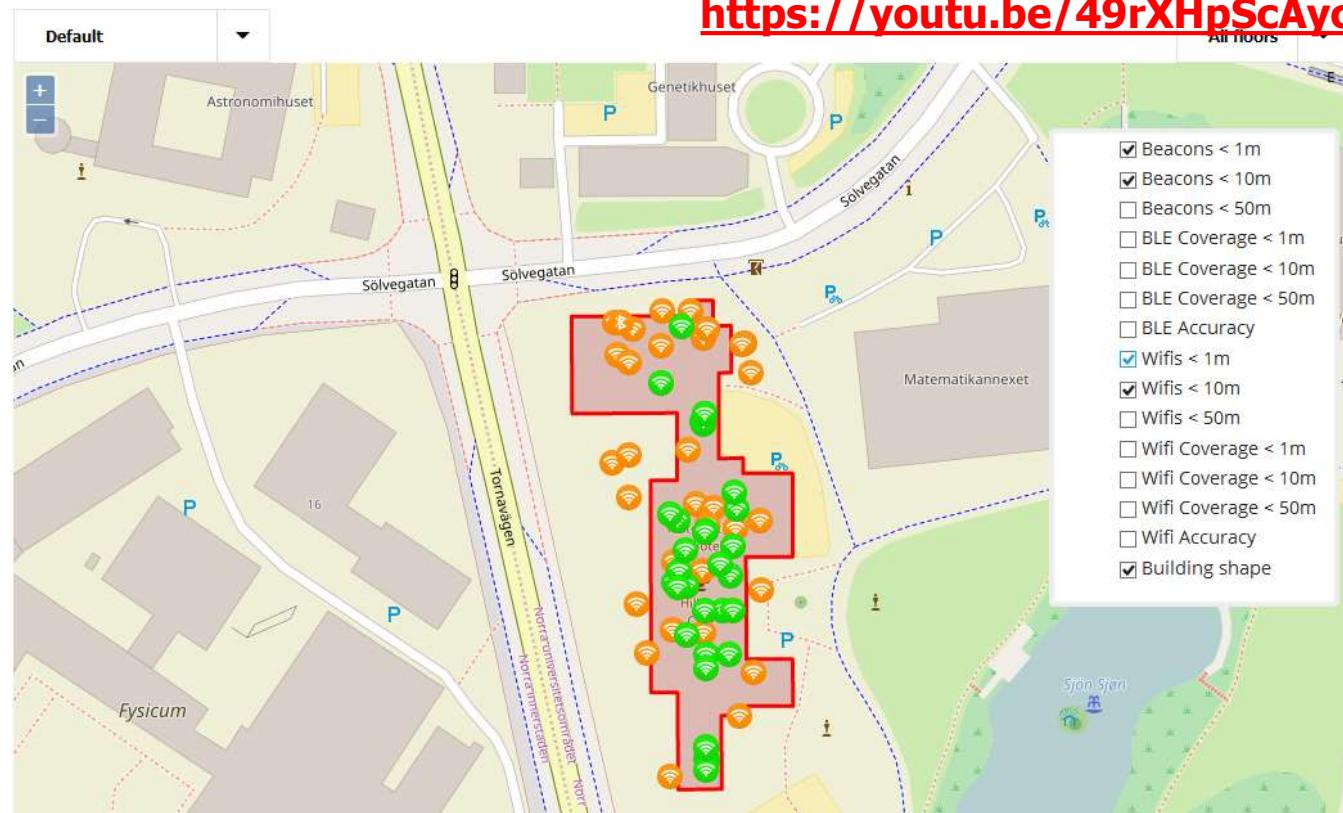
Address: Sölvegatan 18

Zip code: 22363

City: Lund

Country: Sweden

Type: School

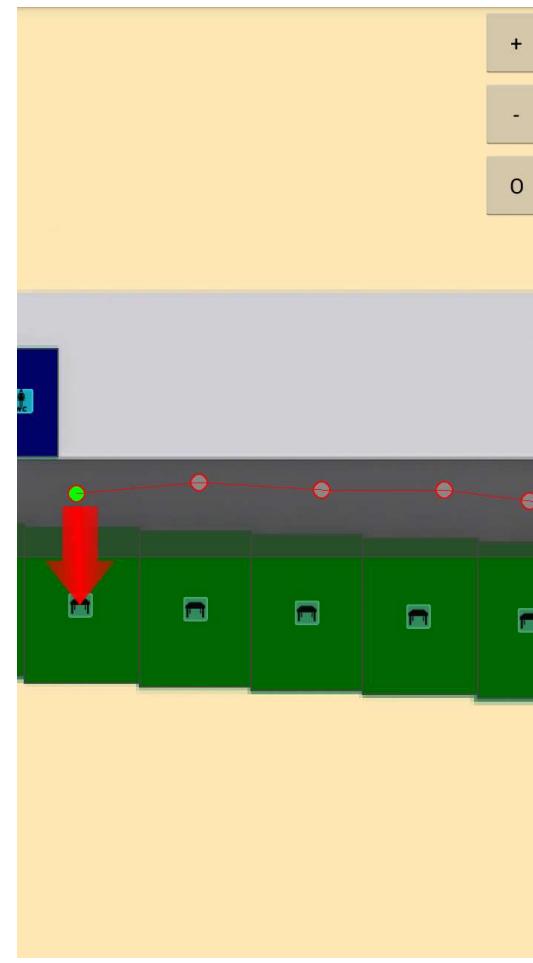
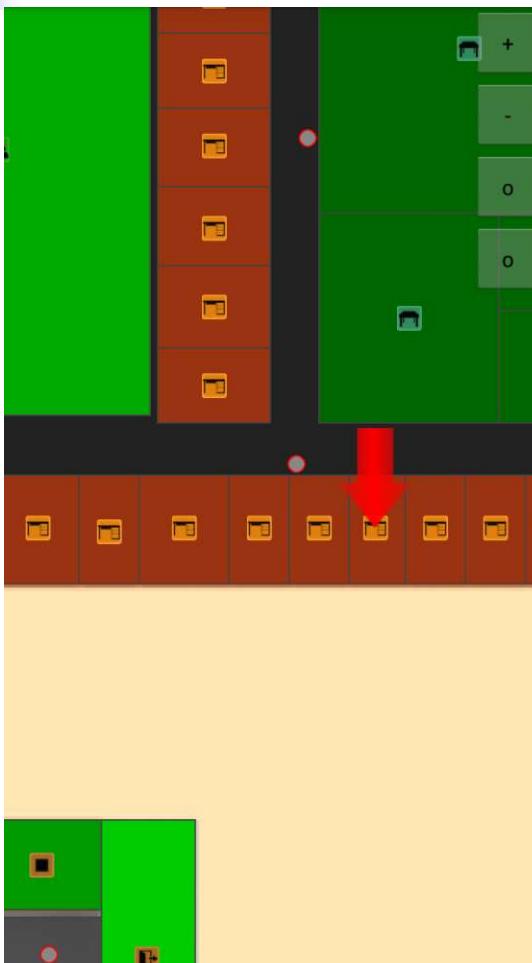


<https://youtu.be/CaO5ffE78so>

<https://comtain.com/building/?id=171>

# Lokalizácia a navigácia v interieri

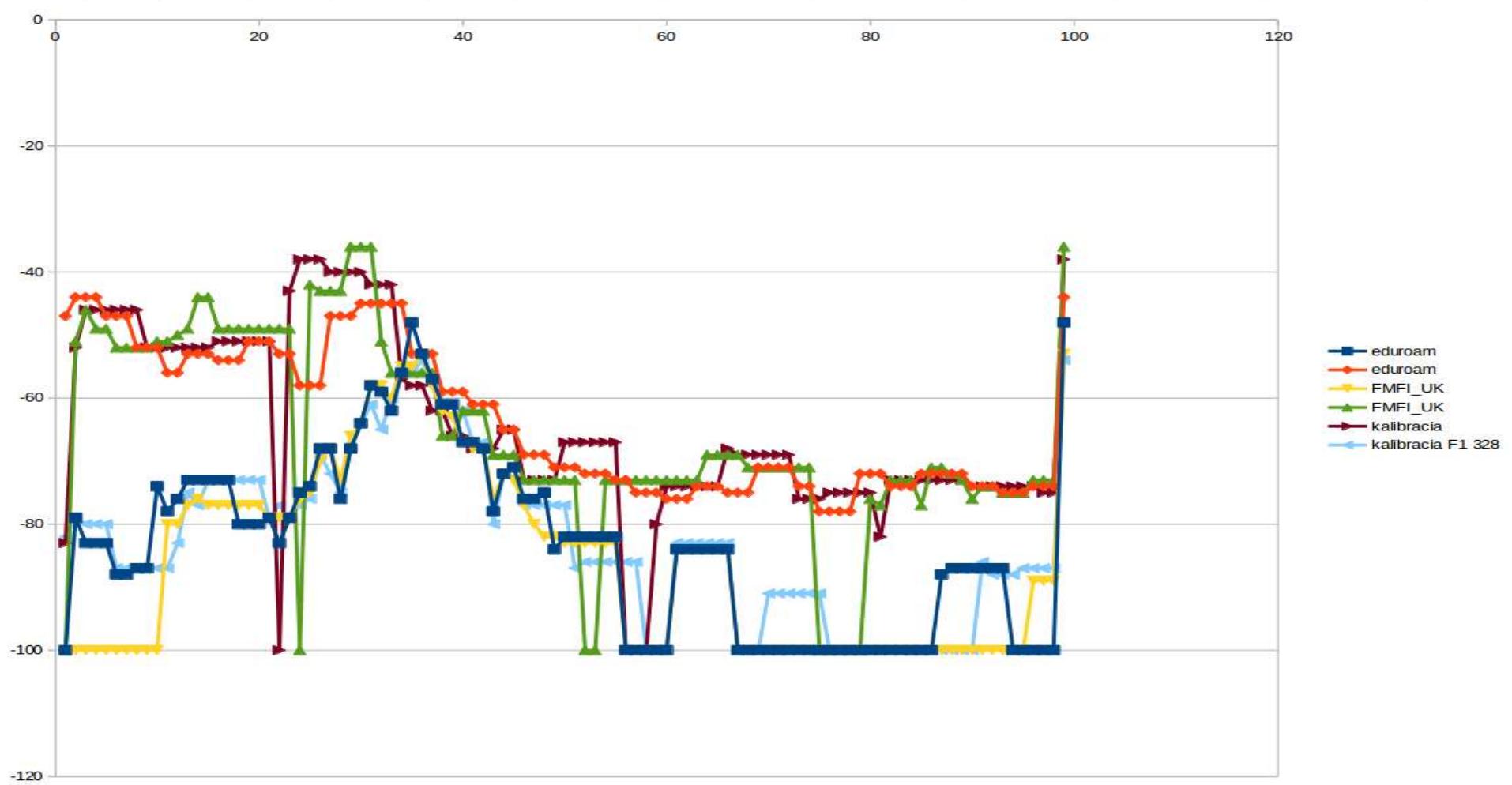
Bc. Martin Šuník



# Lokalizácia a navigácia v interieri

## Bc. Martin Šuník

Pohyb po chodbe, Y je sila signálu, X je čas

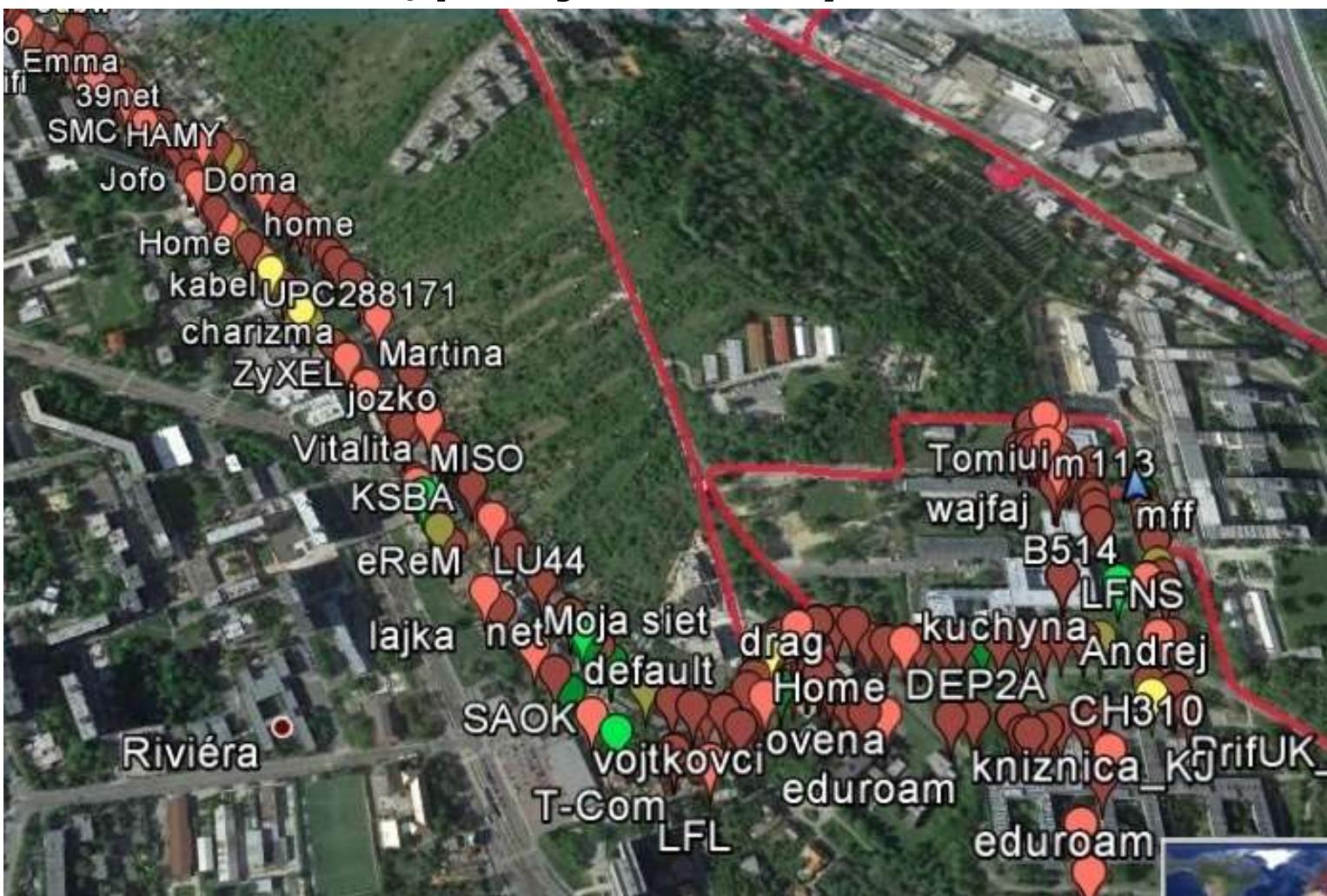




# Wifi tracker

<https://play.google.com/store/apps/details?id=org.prowl.wifiscanner>

## Alternatíva, použijeme hotový software



Exportujeme do

- .CSV  
wifiscan-export.csv
- .kml  
wifiscan-export.kml

transformujeme  
databázu:

- mac addr
- gps
- ssid

wifiscan-export\_redukovaný\*

Nakrmíme combian

wifi-scan-export.kml, csv, .txt

# WiFi positioning system (WPS)

(prípade zlyhávajúceho GPS, resp. v kombinácii s GSM, GPS)

```
wifiManager =  
    applicationContext.getSystemService(Context.WIFI_SERVICE) as  
    WifiManager  
  
if (!wifiManager.isWifiEnabled) {  
    wifiManager.setWifiEnabled(true)  
}  
  
if (android.os.Build.VERSION.SDK_INT >= Build.VERSION_CODES.M  
    && // dôležité od verzie Marshmallow  
    checkSelfPermission(Manifest.permission.ACCESS_COARSE_LOCATION)  
    !== PackageManager.PERMISSION_GRANTED) {  
  
    requestPermissions(arrayOf(  
        Manifest.permission.ACCESS_WIFI_STATE,  
        Manifest.permission.CHANGE_NETWORK_STATE,  
        Manifest.permission.ACCESS_FINE_LOCATION,  
        Manifest.permission.ACCESS_COARSE_LOCATION),  
        RUNTIME_PERMISSION_REQUEST_CODE) // callback pre  
    }  
    onRequestPermissionsResult
```

# WiFi positioning system (WPS)

(requestPermissions callback)

```
// callback
override fun onRequestPermissionsResult(
    requestCode: Int,
    permissions: Array<String>,
    grantResults: IntArray ) {
when (requestCode) {
    RUNTIME_PERMISSION_REQUEST_CODE -> {
        for (i in grantResults.indices) {
            if (grantResults[i]==PackageManager.PERMISSION_GRANTED) {
                Log.d(TAG, "GRANTED")
            } else {
                Log.d(TAG, "DENIED")
            }
        }
    }
    return
}
}
```

# WiFi positioning system (WPS)

(broadcast receiver)

```
broadcastReciever = object : BroadcastReceiver() {  
  
    override fun onReceive(context: Context?, intent: Intent?) {  
        val scanList = wifiManager.scanResults  
        val wifis = arrayOfNulls<String>(scanList.size)  
        for (i in scanList.indices) {  
            val sr = scanList[i]  
            wifis[i] = sr.SSID +           // network name  
                      "," + sr.BSSID + // mac addr  
                      "," + sr.capabilities + // authent, key,  
                      "," + sr.level    // db  
        }  
        listView1.adapter = ArrayAdapter<String>( applicationContext,  
                                              android.R.layout.simple_list_item_1, wifis)  
    }  
}
```

v onCreate zaregistrujte `broadcastReciever` pre intent `SCAN_RESULTS_AVAILABLE_ACTION`  
`registerReceiver(broadcastReciever, IntentFilter(  
 WifiManager.SCAN_RESULTS_AVAILABLE_ACTION))`

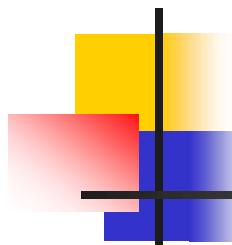
v spustíte skenovanie

```
wifiManager.startScan()
```



```
Dandelion,90:f6:52:43:a5:76,[W  
PS][WEP][ESS],-93  
Pupava,  
f0:84:2f:81:79:31,[WPA2-PSK-  
CCMP][ESS],-54  
Pampeliska,64:70:02:9d:e6:ac,  
[WPA-PSK-CCMP][ESS],-78
```

Project:MyWiFiScanner.zip



# Capabilities

[WPA2-PSK-CCMP][ESS]

[WPA2-PSK-CCMP+TKIP][ESS]

[WPA-PSK-CCMP+TKIP]

[WPA2-PSK-CCMP+TKIP][ESS]

[WPA-PSK-TKIP CCMP][WPA2-PSK-TKIP-CCMP][WPS][ESS]

[Authentication Algorithm - Key Management Algorithm - Pairwise Cipher]

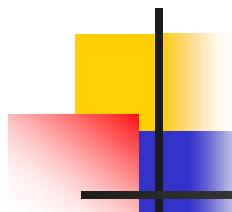
- Authentication Algorithm

- EAP
  - WPA
  - WEP

- Pairwise Cipher

- CCMP
  - TKIP

```
//A capability of [ESS] represents an open access point
if (scanResult.capabilities != null &&
    scanResult.capabilities.contains("[ESS]"))
    openNetworks++
```



# Žiadost' o povolenie

Ak **SDK 23** (Marshmallow) alebo vyššie:

```
if (android.os.Build.VERSION.SDK_INT >= Build.VERSION_CODES.M)
```

- musíte deklarovať napr. `ACCESS_COARSE/FINE_LOCATION` alebo v A-Manifest.xml
- musíte žiadať o povolenie dynamicky, ktoré užívateľ schváli alebo zamietne

```
requestPermissions(arrayOf(  
    Manifest.permission.ACCESS_FINE_LOCATION,  
    ...  
    Manifest.permission.ACCESS_COARSE_LOCATION  
) ,  
    RUNTIME_PERMISSION_REQUEST_CODE)
```

Ak **SDK 22** alebo nižšie:

- deklarujete `ACCESS_COARSE/FINE_LOCATION` len v AndroidManifest.xml

# Permissions do Manifest.xml

(toto je/bolo pravda do API <23)

```
<uses-permission  
    android:name="android.permission.ACCESS_FINE_LOCATION"/>  
  
<uses-permission  
    android:name="android.permission.ACCESS_COARSE_LOCATION"/>
```

a veľmi skoro budeme potrebovať ...

```
<uses-permission android:name="android.permission.INTERNET"/>
```



Accur: 16.0

Lat: 48.148645786610885

Long: 17.07564264831152

Altitude: 205.77959820298153

Provider: gps

Speed: 13.070392

Bearing: 193.14948

Time: 1699377836000 ... 7.11.2023

6:23:56 PM

# Permissions do Manifest.xml

(ak API >=23)

Okrem tohto:

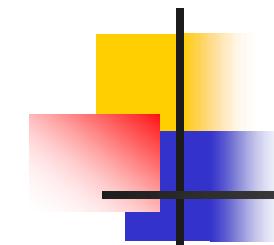
```
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>
<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION"/>
a veľmi skoro budeme potrebovať ...
<uses-permission android:name="android.permission.INTERNET"/>
```

treba v kóde dynamicky žiadať o povolenie (zjednodušený kód):

```
if (android.os.Build.VERSION.SDK_INT >= 23) {
    if (getApplicationContext().checkSelfPermission(permission) != PackageManager.PERMISSION_GRANTED)
        permissionsList.add(permission)
}
```

... a následne požiadať o povolenia:

```
requestPermissions(permissionsList.toArray(),
    REQUEST_CODE_ASK_MULTIPLE_PERMISSIONS)
```



# Úrovne povolení

## **Normal Permissions –** nízka úroveň narušenia súkromia

- ACCESS\_NETWORK\_STATE
- CHANGE\_NETWORK\_STATE
- ACCESS\_WIFI\_STATE
- CHANGE\_WIFI\_STATE
- CHANGE\_WIFI\_MULTICAST\_STATE
- BLUETOOTH
- BLUETOOTH\_ADMIN
- INTERNET
- SET\_ALARM
- SET\_WALLPAPER
- VIBRATE
- WAKE\_LOCK

## **Signature Permissions –** appka musí byť podpísaná autoritou

- BIND\_ACCESSIBILITY\_SERVICE
- BIND\_NFC\_SERVICE
- BIND\_TV\_INPUT
- BIND\_WALLPAPER
- READ/WRITE\_VOICEMAIL
- WRITE\_SETTINGS

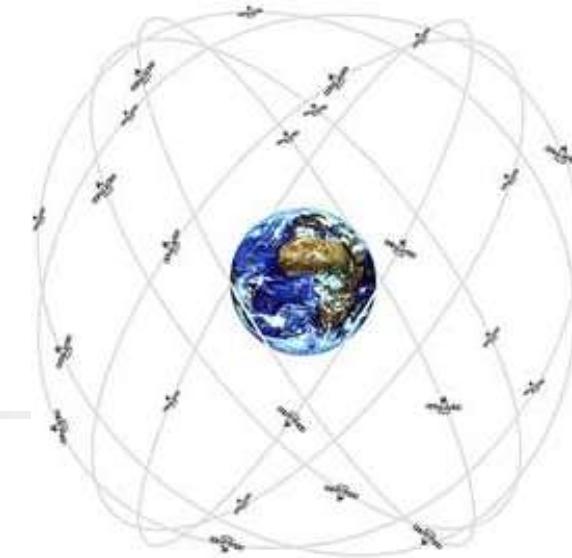
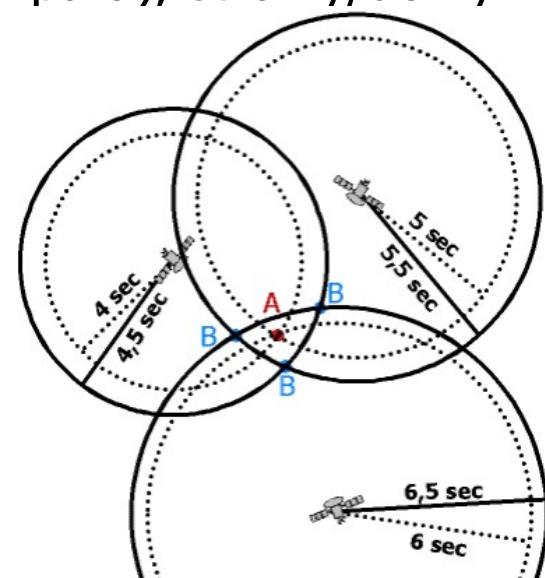
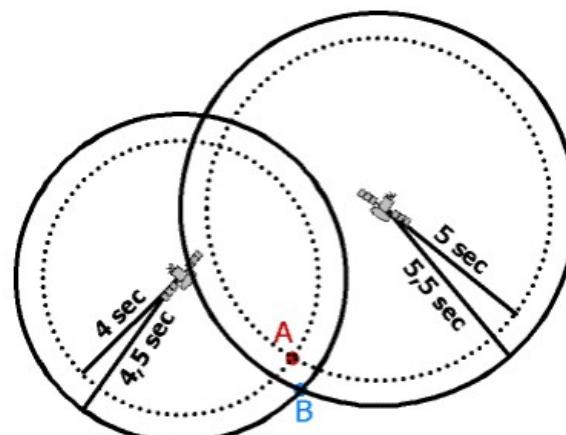
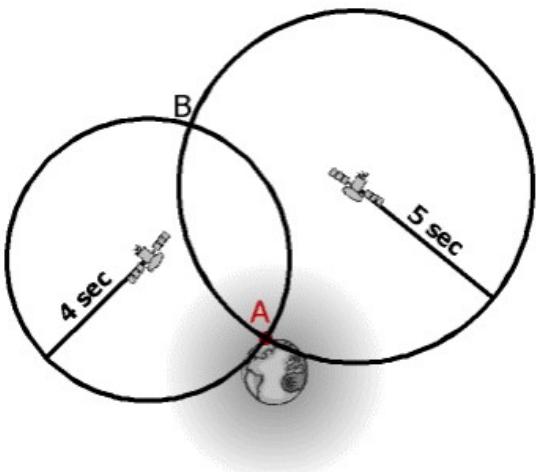
## **Dangerous Permissions –** appka musí explicitne žiadať povolenie

- READ/WRITE\_CALENDAR
- CAMERA
- READ/WRITE\_CALL\_LOG
- READ/WRITE\_CONTACTS
- GET\_ACCOUNTS
- ACCESS\_FINE\_LOCATION
- ACCESS\_COARSE\_LOCATION
- SEND/RECEIVE\_SMS

# World Geodetic System

- viac ako 24 satelitov v niekoľkých rovinách,
- vysielajú v signáli svoje súradnice a presný čas,
- prijímač zistí časový posun, za ktorý správa príde k prijímaču,
- ako ? prijímač nemá presný čas... (<http://gpsinformation.net/main/gpslock.htm>)
- to approximuje vzdialenosť od satelitu,
- satelia disponujú presným časom [merania s presnosťou  $1\text{ns}=30\text{cm}$ ],
- 3 satelia určujú 3 guľové sféry, ktorých prieniku zodpovedajú 2 body,
- preto sa používajú minimálne 4 satelia na určenie polohy,
- problémy: atmosferická refrakcia, počasie (vodná para), stromy/domy

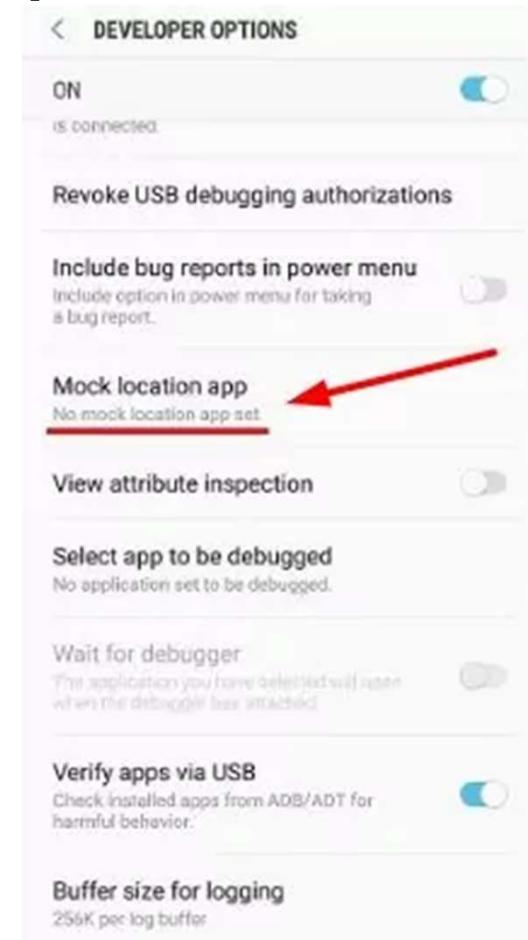
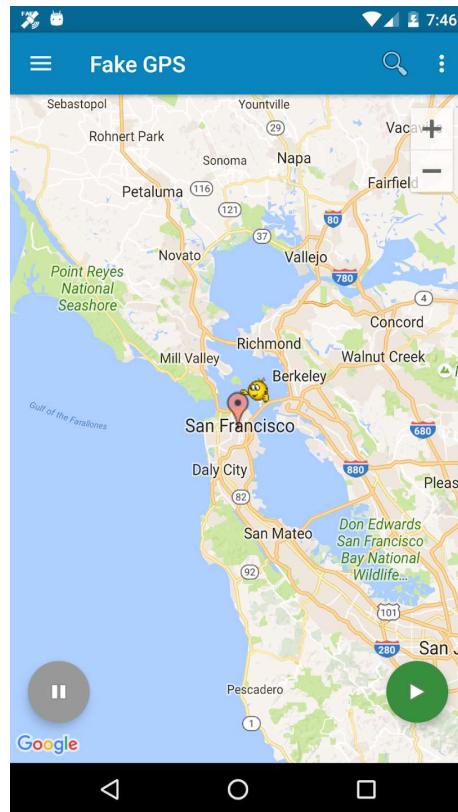
<http://en.wikipedia.org/wiki/Geoid>  
<http://www.kowoma.de/en/gps/orbits.htm>



# Location Mocking GPS Spoofing



## ■ Download Mock Location App



<https://play.google.com/store/apps/details?id=com.lexa.fakegps>

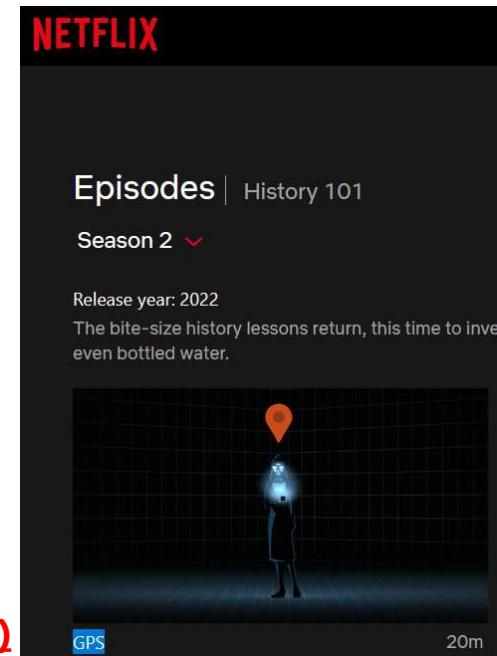
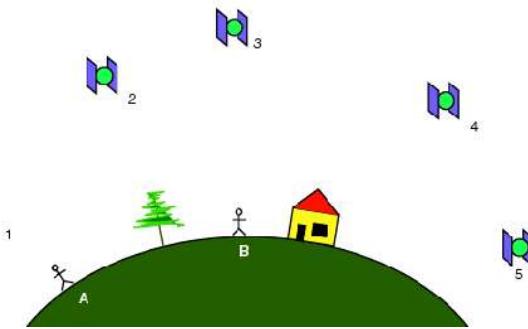
# Ostáva mnoho otázok

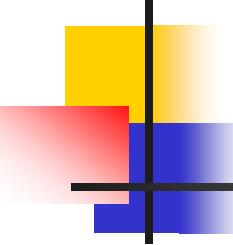
- ako vysoko lietajú sately ?
- stoja sately, alebo sa pohybujú vzhľadom na Zem ?
- kto vie/určuje polohu satelitov ?
- čo, ak satelit má posunuté hodinky ?
- vieme sice vypočítať vzdialenosť dvoch bodov na zemi (Great Circle Distance, [http://en.wikipedia.org/wiki/Great-circle\\_distance](http://en.wikipedia.org/wiki/Great-circle_distance)), ale ako vypočítať vzdialenosť bodu na zemi od satelitu ?
- ako je možné, že presnosť, ktorú dosiahneme je v rádoch metre-desiatky  
vojaci/geodeti používajú gps s presnosťou na cm.  
Čo majú iné ? Prijímač ? Vlastné sately ?

Pre zvyšok prednášky považujme za štandard:WGS-84

- latitude (zem.šírka) -90 .. +90
- longitude (zem.dĺžka) -180 ... +180
- altitude (nadmorská výška) oproti ideálnemu elipsoidu

[https://en.wikipedia.org/wiki/History\\_101\\_\(TV\\_series\)#Season\\_2\\_\(2022\)](https://en.wikipedia.org/wiki/History_101_(TV_series)#Season_2_(2022))





# GPS - NMEA

```
$GPGGA,184357.08,1928.967,S,02410.530,E,1,04,1.9,100.00,M,-33.9,M,,0000*67
$GPGLL,1928.947,S,02410.536,E,184358.08,A,A*70
$GPVTG,16.78,T,,M,74.00,N,137.05,K,A*36
$GPRMC,184400.08,A,1928.907,S,02410.547,E,74.00,16.78,210410,0.0,E,A*29
$GPGGA,184401.08,1928.888,S,02410.553,E,1,04,2.2,100.00,M,-33.9,M,,0000*6E
$GPGLL,1928.868,S,02410.559,E,184402.08,A,A*7D
$GPVTG,16.78,T,,M,74.00,N,137.05,K,A*36
$GPRMC,184404.08,A,1928.829,S,02410.571,E,74.00,16.78,210410,0.0,E,A*25
$GPGGA,184405.08,1928.809,S,02410.577,E,1,04,1.1,100.00,M,-33.9,M,,0000*65
$GPGLL,1928.789,S,02410.583,E,184406.08,A,A*7E
$GPVTG,16.78,T,,M,74.00,N,137.05,K,A*36
$GPRMC,184408.08,A,1928.750,S,02410.595,E,74.00,16.78,210410,0.0,E,A*22
$GPGGA,184409.08,1928.730,S,02410.601,E,1,04,2.8,100.00,M,-33.9,M,,0000*64
$GPGLL,1928.710,S,02410.607,E,184410.08,A,A*76
```

Ked' „preskočíme“ fyziku, čo a aké informácie GPS príjimač produkuje ?

GPS signál obsahuje vety (>19) rôznych formátov, napr. niektoré z nich:

- \$GPGGA - Global Positioning System Fix Data
- \$GPGLL - Geographic position, latitude / longitude
- \$GPGSV - GPS Satellites in view
- \$GPZDA - Date & Time

\$GPGLL,5133.81,N,00042.25,W\*75

- 1 5133.81 Current latitude
- 2 N North/South
- 3 00042.25 Current longitude
- 4 W East/West
- 5 \*75 checksum

Knižnica pre prácu s GPS poskytuje API zakrývajúce tieto raw-formáty

<http://aprs.gids.nl/nmea/>

# Prémia "Slnečné hodiny"

V „čiernej skrinke“ bol externý Bluetooth GPS prijímač, ktorý generuje:

```
$GPGGA,202013.000,4810.0583,N,01706.6030,E,1,05,3.9,306.5,M,,,0000*04  
$GPGSA,A,3,07,30,28,08,13,,,,,,5.8,3.9,4.3*36  
$GPRMC,202013.000,A,4810.0583,N,01706.6030,E,0.18,170.37,021116,,*09  
$GPGGA,202014.000,4810.0578,N,01706.6030,E,1,05,3.9,306.4,M,,,0000*06  
$GPGSA,A,3,07,30,28,08,13,,,,,,5.8,3.9,4.3*36
```

Takže, keď vznikal tento .log,  
Bolo 2.11.2016 presne 20:20:13 UTC



Location API zakrýva NMEA  
ale keď potrebujete,  
viete sa k nemu dostať...

# LocationManager

## LocationProvider

```
lateinit var lm: LocationManager

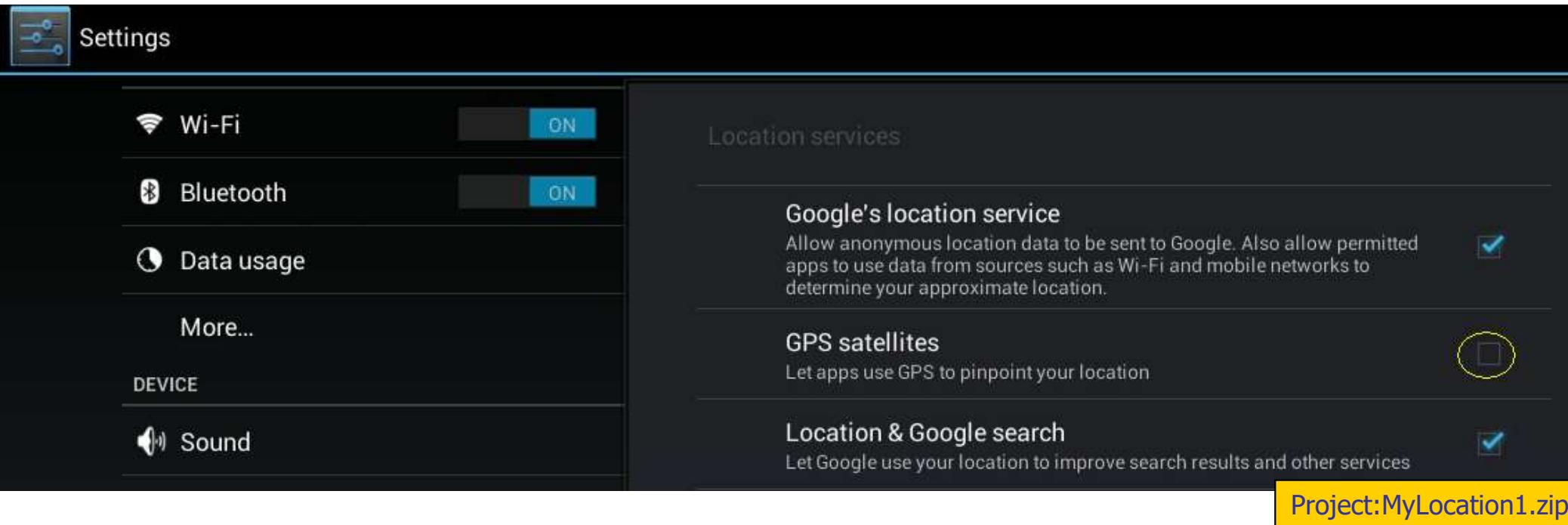
...
lm = getSystemService(Context.LOCATION_SERVICE) as LocationManager

val cr = Criteria()
    cr.isAltitudeRequired = false
    cr.accuracy = Criteria.ACCURACY_COARSE // hrubá presnosť
    // cr.setAccuracy(Criteria.ACCURACY_FINE); // fajnová presnosť
    cr.powerRequirement = Criteria.POWER_LOW
    cr.isSpeedRequired = false

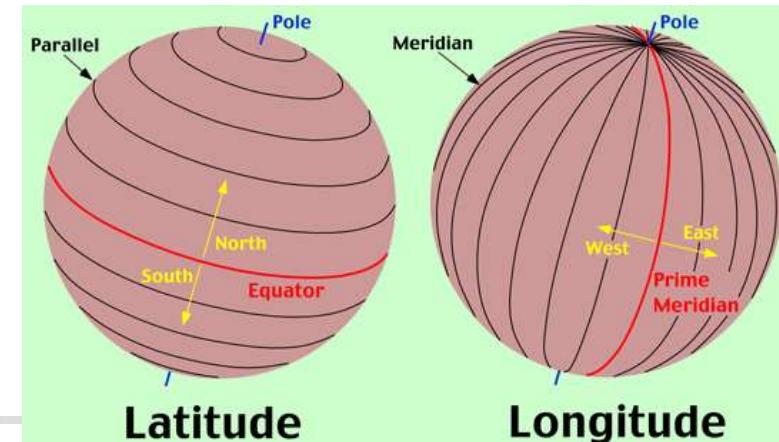
Log.d("MyLoc", "all providers:${lm.allProviders}")
String provider = LocationManager.GPS_PROVIDER;
    // LocationManager.NETWORK_PROVIDER
    // lm.getBestProvider(cr, false); // enabled or disabled
    // lm.getBestProvider(cr, true); // enabled providers
```

# Ak máme GPS vypnuté

```
if (!lm.isProviderEnabled(LocationManager.GPS_PROVIDER) ) {  
    val settingsIntent = Intent(  
        android.provider.Settings.ACTION_LOCATION_SOURCE_SETTINGS)  
    startActivity(settingsIntent)  
} else  
    Log.d("MyLoc", "GPS is enabled")
```



# Location



```
val loc = lm.getLastKnownLocation(provider);  
if (loc != null) {  
    loc.latitude           longitude           altitude  
    loc.accuracy          provider  
    loc.speed              - rýchlosť v m/s  
    loc.bearing            - azimut, ale musíme sa hýbať !! nepresnosť  
                           niekedy môže zapríčiniť, že sa hýbeme, ak ked' stojíme !  
    loc.time               - milisec od 1970}
```



Accur: 800.0

Lat: 48.1660259

Long: 17.1115362

Altitude: 0.0

Provider: network

Speed: 0.0

Bearing: 0.0

Time: 1699802864406 ... 12.11.2023  
4:27:44 PM



Accur: 16.0

Lat: 48.148645786610885

Long: 17.07564264831152

Altitude: 205.77959820298153

Provider: gps

Speed: 13.070392

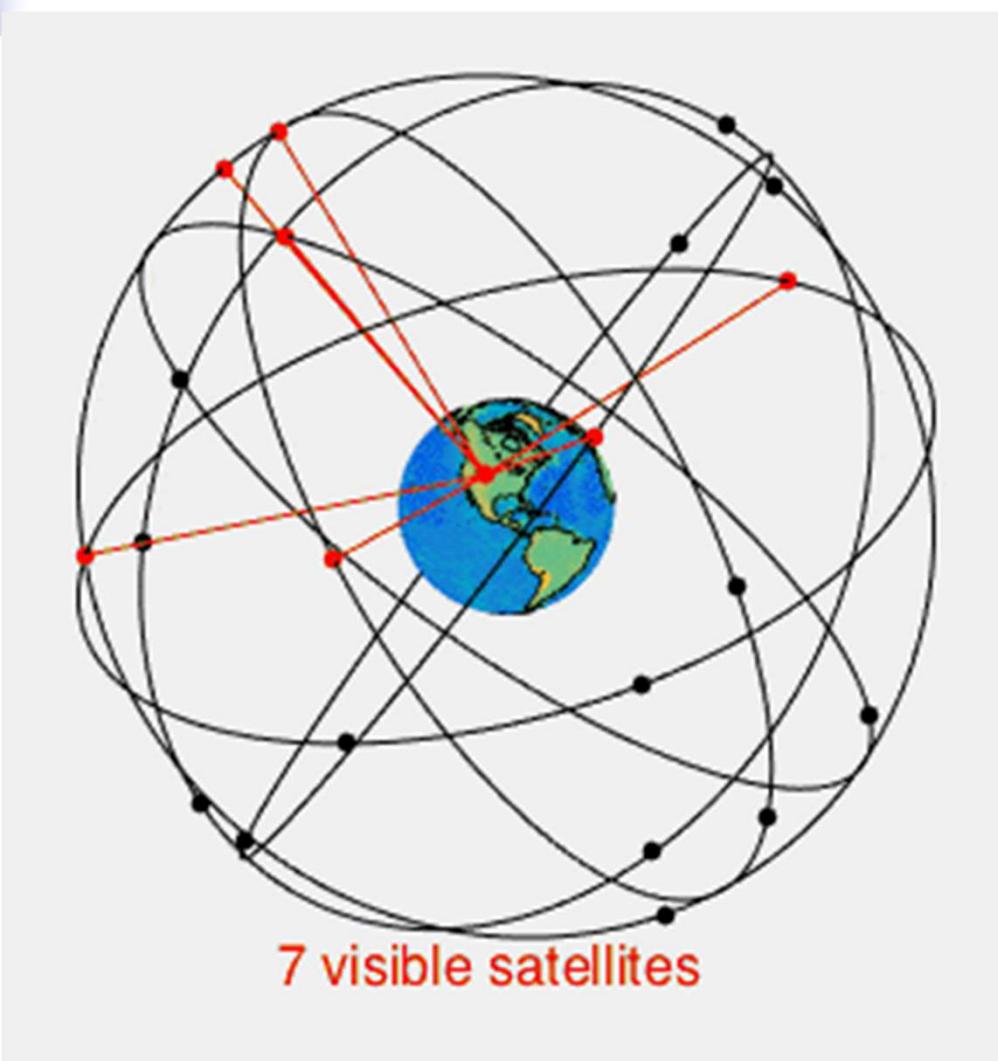
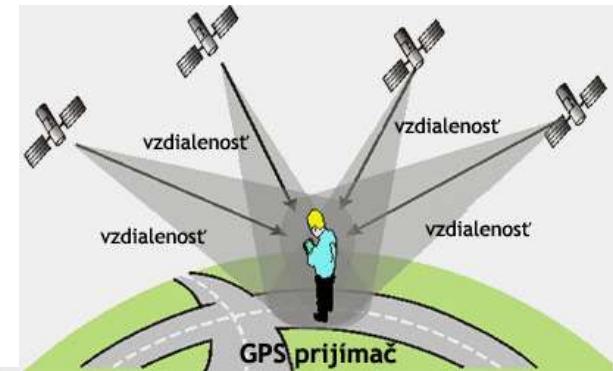
Bearing: 193.14948

Time: 1699377836000 ... 7.11.2023  
6:23:56 PM

Project: MyLocation1.zip

# LocationListener - updates

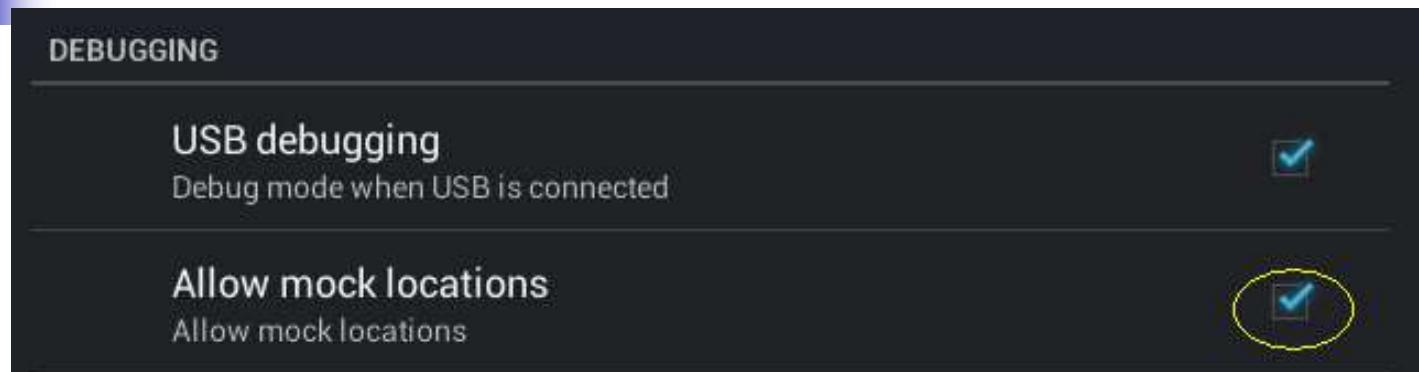
```
override fun onResume() { ←  
    // každú sekundu, resp. ak sme prešli aspoň 10 metrov  
    lm.requestLocationUpdates(provider, 1000, 10, this)  
    // minDistance = 0, minTime = 0  
    lm.requestLocationUpdates(provider, 0, 0, this)  
}  
  
override fun onPause() { ← // ak aktivita prestane byť aktívna  
    lm.removeUpdates(this) // patri sa to vypnúť  
}  
  
override fun onLocationChanged(Location arg0) { ←  
    Log.d("MyMap", "onLocationChanged:" ...  
    updateLocation(arg0) // zobraz na display zmenu polohy  
}
```



Na obežnej dráhe Zeme sa nachádza vždy najmenej 24 operačných GPoS satelitov. Satelia prevádzkované americkým ministerstvom obrany obiehajú s períodou 12 hodín (dve obežné dráhy za deň), vo výške asi 21 000 km a ich rýchlosť je asi 3.9 km/s (14 000 km/h)

# Ako debugovať, ak prší...

ak máme mobil, tak napr. si nainštalujeme nejaký FakeGPS



MapActivity  
Accur:1.0  
Lat:-22.967033  
Long:-43.180698  
Altitude:65.0  
Provider:gps  
Speed:0.0  
Bearing:0.0  
Time:1353694738829 ...Nov 23, 2012 7:18:58 PM



Simulovať polohu možno aj v emulátore (avd) – Android Device Monitor, DDMS

# ProximityListener

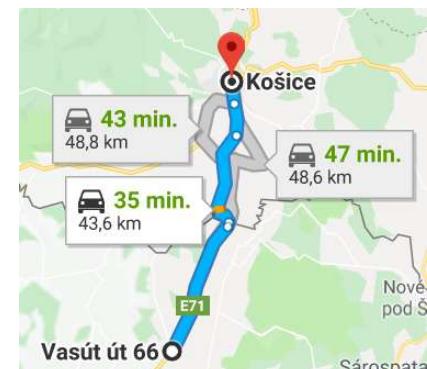
```
val pid = PendingIntent.getBroadcast(this,-1L,  
                                Intent("blizko KE"), 0)  
  
// ak sa priblížime k bodu (KE) na 50.000 metrov, odpáli sa pid  
lm.addProximityAlert(48.720297, 21.258333, 50000f, (long)(-1), pid)
```

```
// a kto to chytí ?  
  
val bRec = object : BroadcastReceiver() {  
    override fun onReceive(context, intent) {  
        if (intent.getBooleanExtra(  
            LocationManager.KEY_PROXIMITY_ENTERING, false))  
            Log.d("MyLoc", "už si v Košicoch (< 50 km)")  
    }  
}  
  
registerReceiver(bRec, IntentFilter("blizko KE"))
```

11-23 20:21:37.034: D/MyLoc(1100): Location:47.83066:20.736218333333333

11-23 20:21:37.234: D/MyLoc(1100): už si v Košicoch (< 50 km)

11-23 20:21:37.284: D/MyLoc(1100): onLocationChanged:47.83317:20.738178333333334



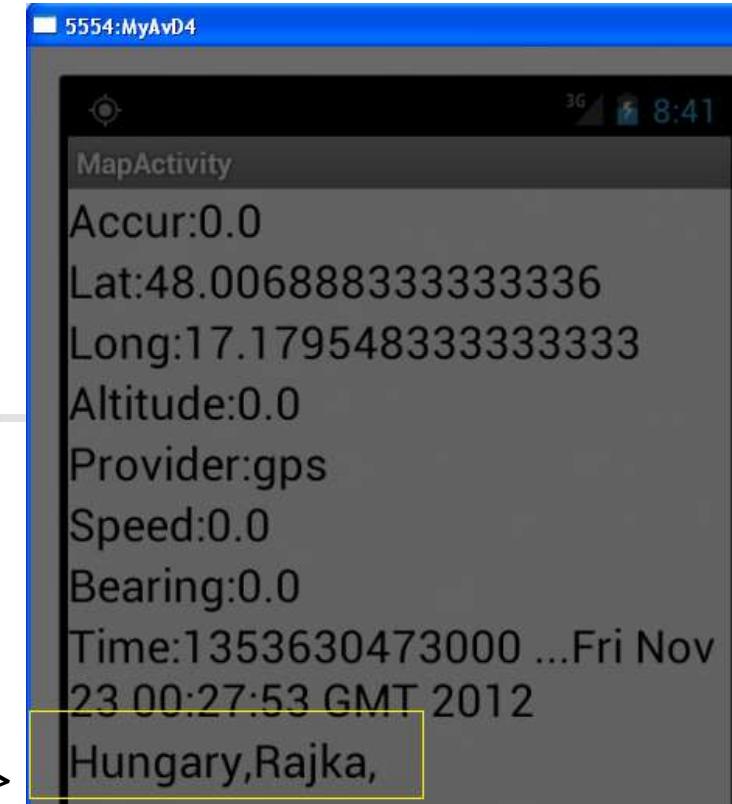
Project: MyLocation2.zip

# Geocoder

(getFromLocation)

**Geocoder.getFromLocation** transformuje  
(Latitude;Longitude) na List<Address>,  
ale potrebuje internet:

```
<uses-permission android:name="  
    android.permission.INTERNET"/>  
  
if (Geocoder.isPresent()) {  
    val gc = Geocoder(baseContext(), Locale.getDefault());  
    try {  
        // if gc != null  
        for(adr in gc.getFromLocation( // max. 1 adresu  
            loc.getLatitude(), loc.getLongitude(), 1)) {  
            String str = ""  
            str += adr.getCountryName() + "," // if adr != null  
            for (i in 0 until adr.getMaxAddressLineIndex())  
                str += adr.getAddressLine(i) + ","  
            tvaddr.setText(str)  
        }  
    }  
}
```

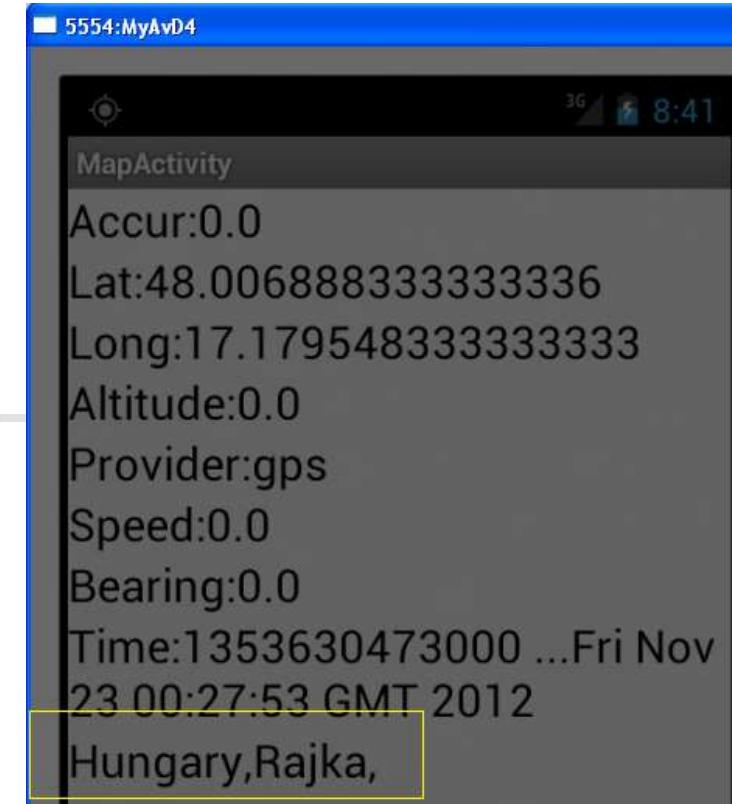


# Geocoder

(getFromLocation)

- **Geocoder.getFromLocation** transformuje (Latitude;Longitude) na List<Address>
- Geocoder.getFromLocationName nájde miesto podľa popisu, vráti List<Address> ale potrebuje internet:

```
<uses-permission android:name= "android.permission.INTERNET"/>  
if (Geocoder.isPresent()) {  
    Geocoder gc = new Geocoder(baseContext() , Locale.getDefault())  
    try {  
        // if gc != null  
        for(ad in gc.getFromLocation(  
            loc.getLatitude() ,  
            loc.getLongitude() , 1)) { // max. 1 adresu  
            ....  
        for(ad in gc.getFromLocationName(  
            "Univerzita Komenskeho, Mlynska dolina, Bratislava" , 5);  
            // max. 5 adres
```



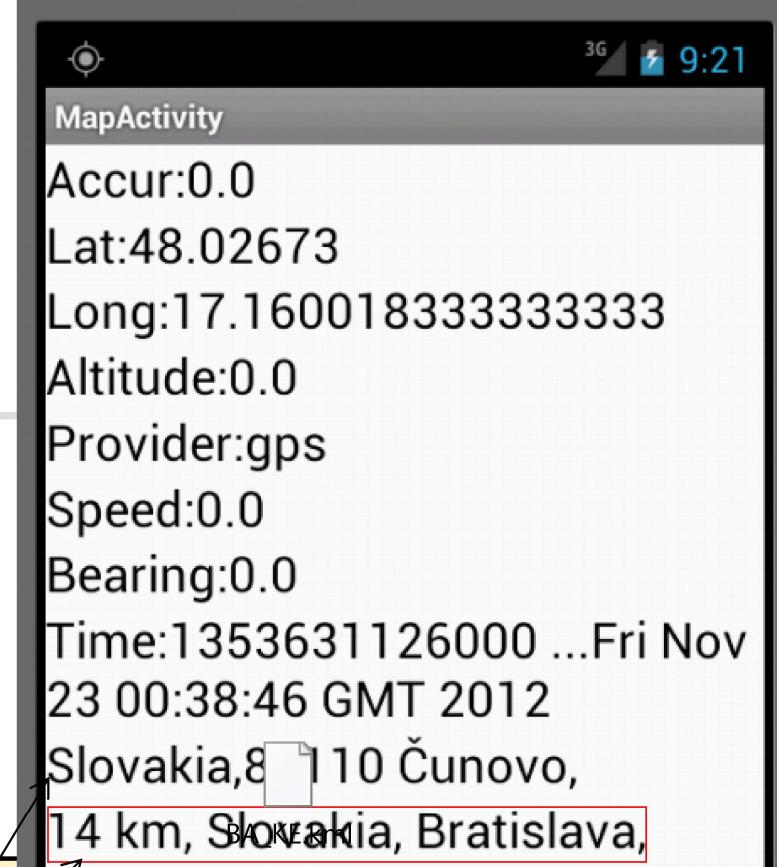
# Geocoder

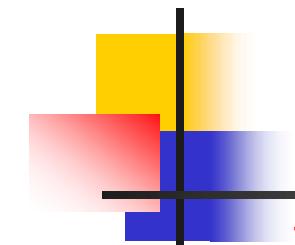
(getFromLocationName)

- `Geocoder.getFromName` transformuje

```
String na List<Address>
```

```
val addrs = gc.getFromLocationName(  
    "Bratislava", 5); // max. 5 adries  
for (adr : addrs) { //addrs!=null  
    locationBA = Location("Blava")  
    locationBA.latitude = adr.latitude  
    locationBA.longitude = adr.longitude  
    var s = Math.round(loc.distanceTo(locationBA)/1000)+" km, "  
        ... loc.bearingTo(locationBA)/1000) ... azimut  
    s += adr.countryName + ", " // if adr != null  
    for (i = 0 until adr.getMaxAddressLineIndex())  
        s += adr.getAddressLine(i) + ","  
    tvBA.text = s  
}
```





Toto je roky jedna z najobľúbenejších prémii tohto predmetu, nakoniec mnohé asi pochopíte až keď ju zdoláte. Je zverejnená úmyselne v stredu ráno, aby tí, čo sú v stredu na cvičení mali jemnú geo-výhodu.

V blízkosti fakulty sa nachádza MFF keška, jej súradnice sú 48.???? 17.????. Navrhnite vlastnú aplikáciu, pomocou ktorej kešku nájdete. Počas hľadania kešky urobte niekoľko *skrínšotov* vašej apky (aj nejakú fotku s vami :-). Takýto foto-románik priložíte do zipu, aby opravovatelia úlohy/prémie aspoň trochu videli, ako hľadanie prebiehalo.

Keška obsahuje 6 (slovom šest') pokladov. Po objavení kešky si jeden z nich zoberte a dekódujte, a dekódovaný obsah pošlite ako riešenie prémie, spolu s foto-románikom. Ak ste kešku našli, nezničte ju, myslite na ďalších... Ak ju nájdete poničenú "muglami", informujte ma, prosím.

V žiadnom prípade nesmiete kešku hľadať a nájsť inou apkou, ako vašou, t.j. vami vyrobenou v rámci riešenia tejto prémie. Ide o parameter fair-play, v prípade podozrenia z falošného hráča, budete pozvaný na hľadanie ostrej kešky, až potom dostanete body.

Hint: keška je označená logom, ktoré poznáte z tohto predmetu, uľahčí vám to identifikáciu...

Vel'a šťastia a zdravia.



# MFF Keška, 48.151901 17.068422

~~— zatial' nikto...~~



**Lukáš G.**

Tak to je teda výzva a zážitok! Aplikáciu som vytváral s targetSdkVersion 19, čím som "obišiel" dynamické permissions. Zahrnul som aj nejakú d'alšiu funkciu...

**KatkaO.**



**MatúšB.**



