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Государственное предприятие «Украинский государственный центр радиочастот»

REGULATORY AND TECHNICAL CONSIDERATIONS FOR GEOGRAPHIC AND POPULATION COVERAGE MEASUREMENT WITH DIGITAL PUBLIC TERRESTRIAL WIRELESS NETWORKS

НОРМАТИВНЫЕ И ТЕХНИЧЕСКИЕ АСПЕКТЫ ИЗМЕРЕНИЯ ПОКРЫТИЯ ТЕРРИТОРИИ И НАСЕЛЕНИЯ ЦИФРОВЫМИ НАЗЕМНЫМИ БЕСПРОВОДНЫМИ СЕТЯМИ ОБЩЕГО ПОЛЬЗОВАНИЯ

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The main requirements to digital public terrestrial wireless networks

Geographic and population coverage are two main characteristics of digital public terrestrial wireless technologies in “Point-to-Area” networks:

- **Sound and TV broadcasting**
- **Mobile service**
- **Broadband service.**

The main requirement to digital public terrestrial wireless networks is to cover the vast possible territory.

At the same time telecommunication operators attempt to cover by services maximum number of population in the certain areas.

In some countries one of the main licence conditions is to ensure the coverage of defined minimum percentage of population.

The main requirement for geographic and population coverage

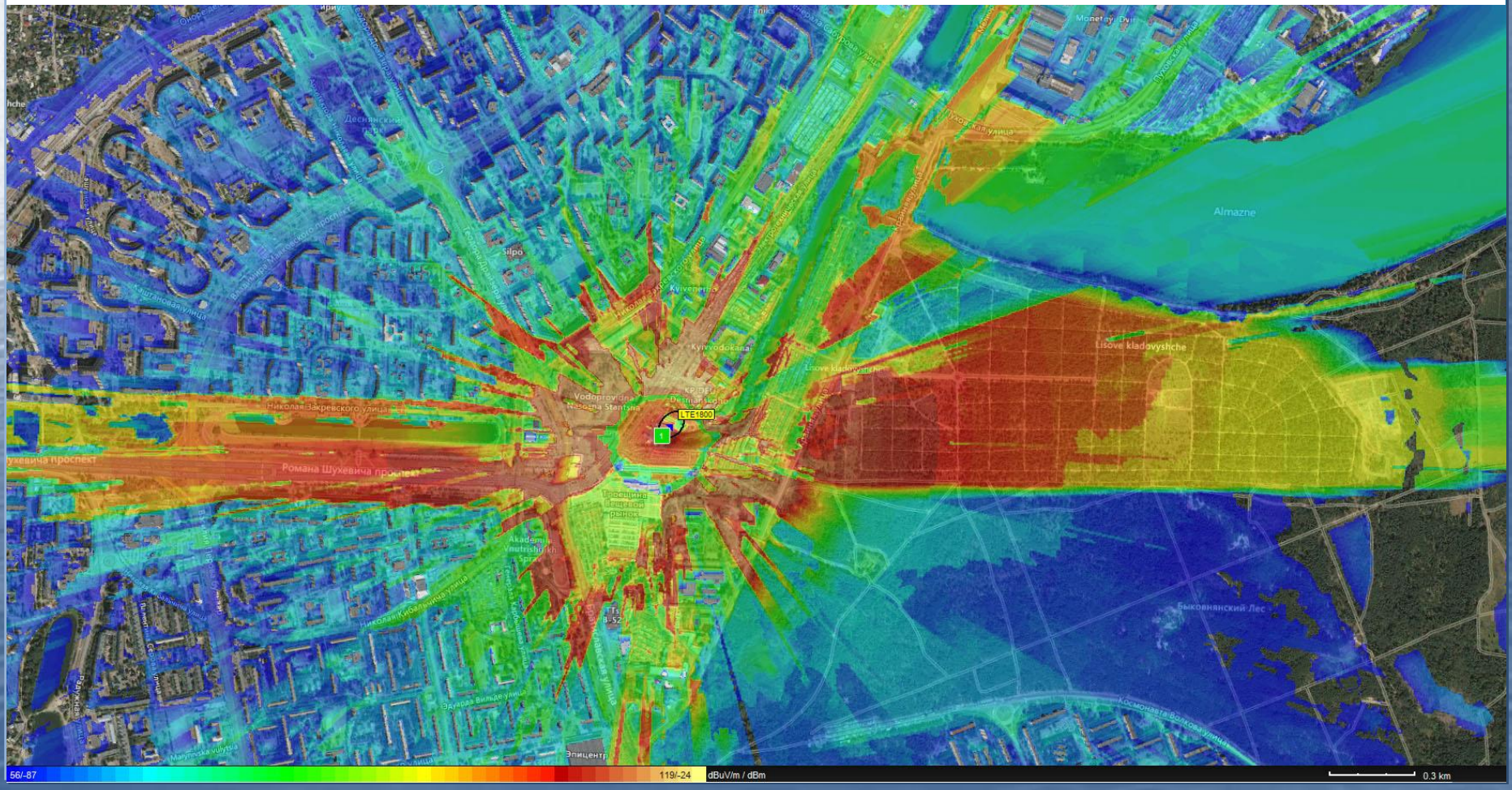
The geographic and population coverage can be determined by prediction and measurement methods.

A predicted coverage area is determined by calculation with using the ITU Recommendations:

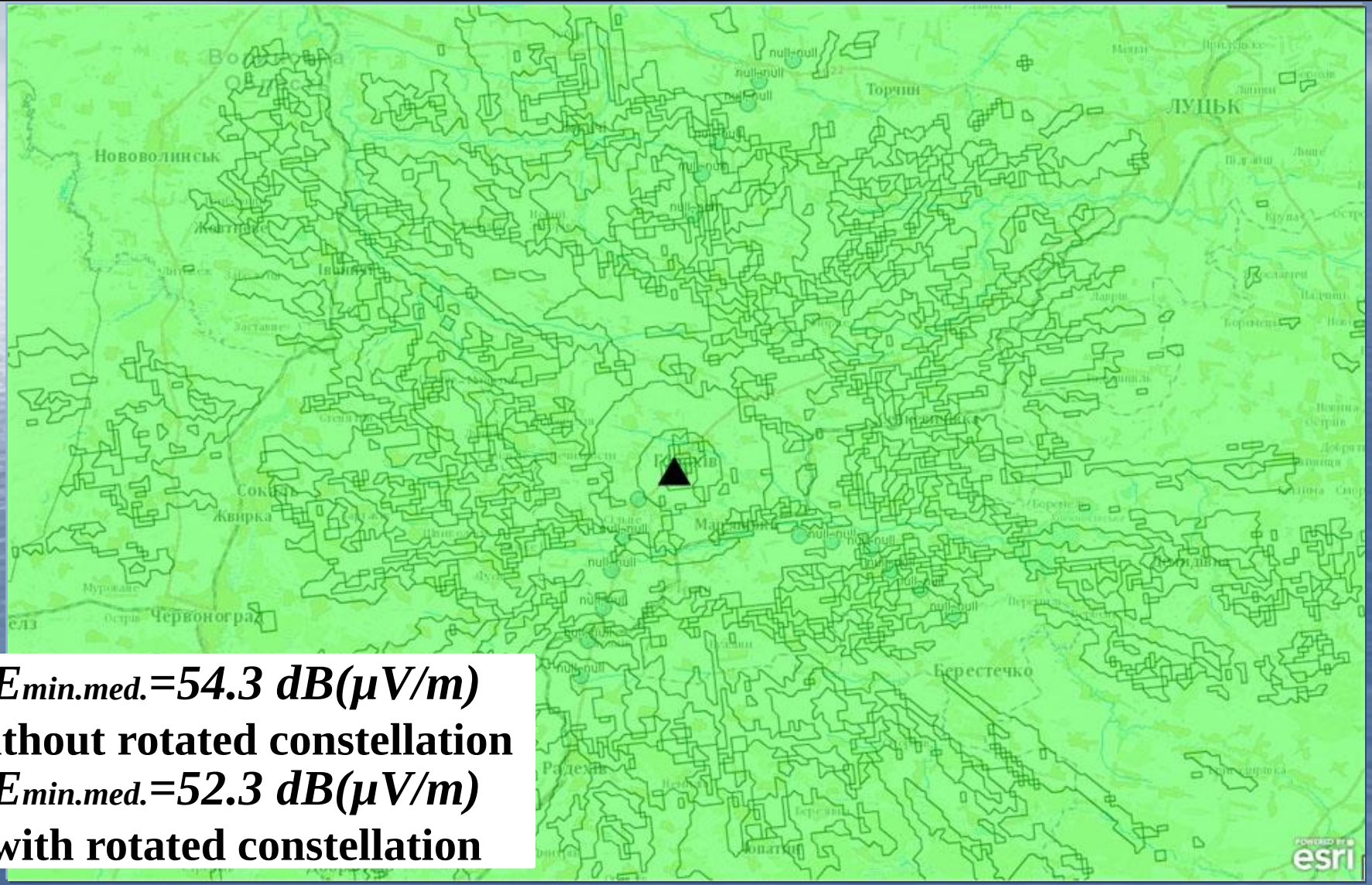
- **Recommendation ITU-R P.1546-5 Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz**
- **Recommendation ITU-R P.1812-4 A path-specific propagation prediction method for point-to-area terrestrial services in the VHF and UHF bands**
- **Recommendation ITU-R P.525-3 Calculation of free-space attenuation**

Calculated coverage area of GSM-900 base transceiver station

BTS calculated coverage area taking into account the radio wave propagation into buildings

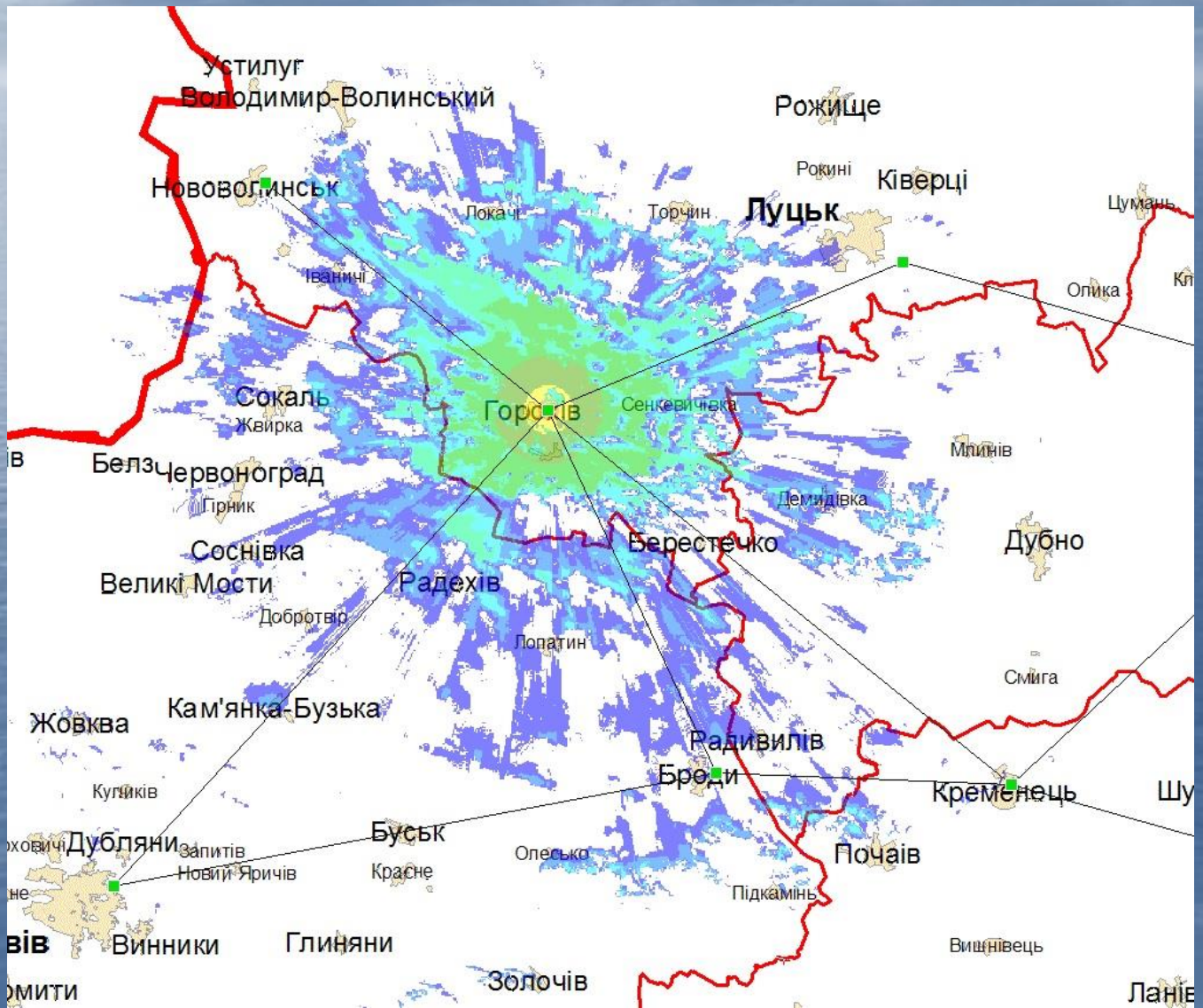


Calculated coverage area of DVB-T2 transmitter (Rec. ITU-R P.1812-4)



***E**min.med.=54.3 dB(μV/m)*
without rotated constellation
***E**min.med.=52.3 dB(μV/m)*
with rotated constellation

Calculated coverage area of DVB-T2 transmitter (located in Gorokhiv city)



The measurement of DVB-T/T2 transmitters coverage area (var. 1)

УДЦР

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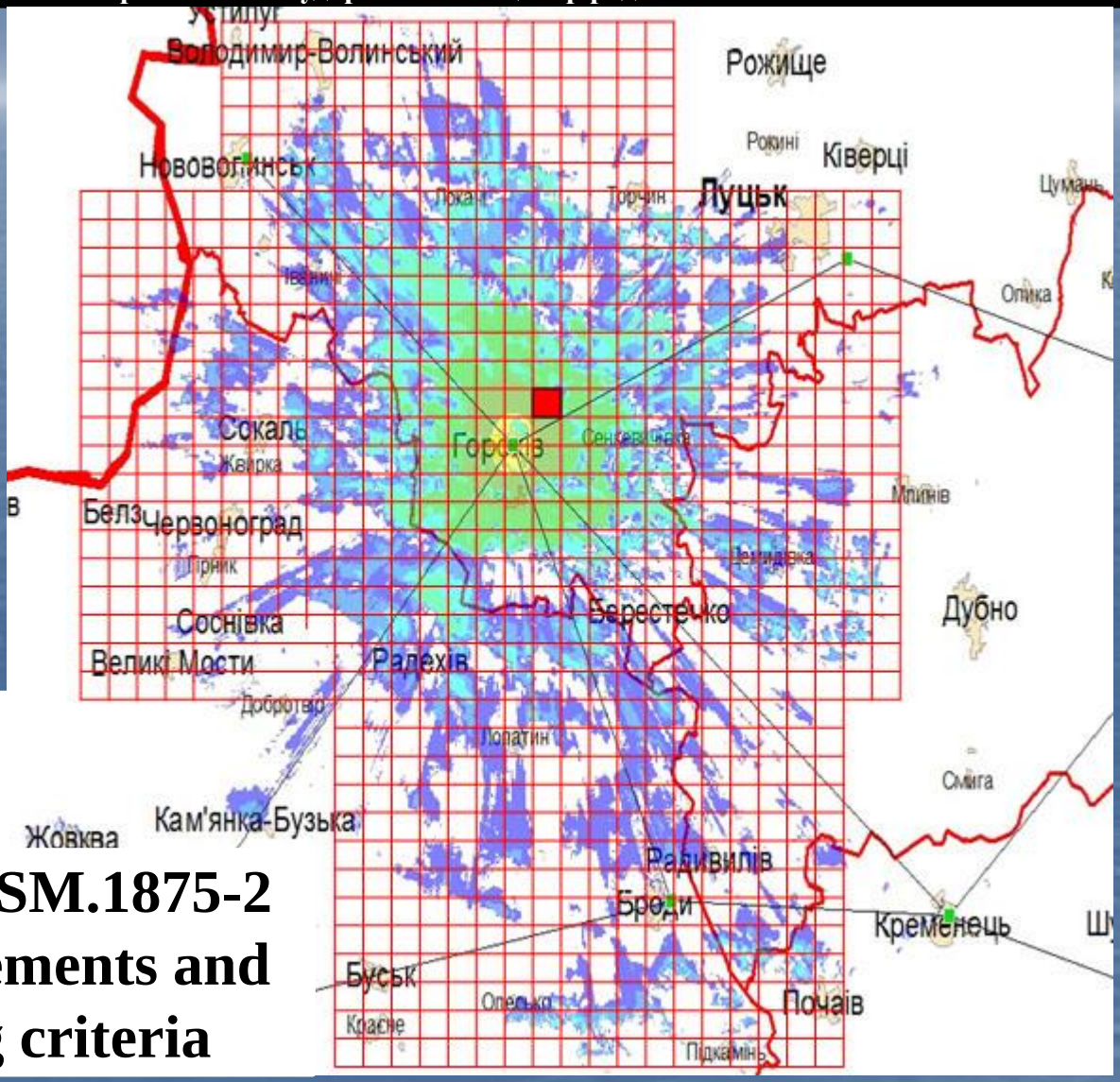
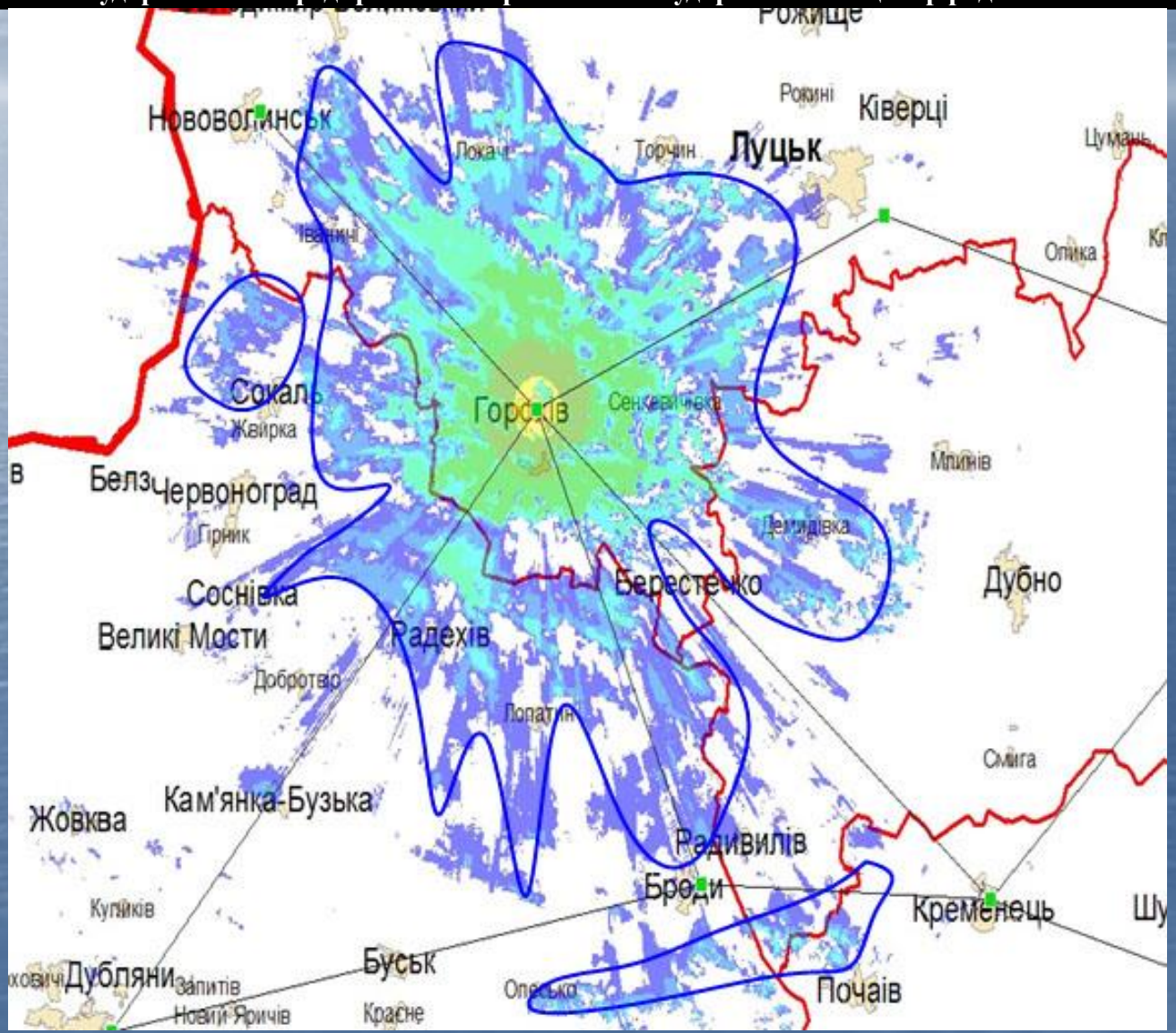


$E_{min.med.}$=52.3 dB(μV/m) with rotated constellation

Recommendation ITU-R SM.1875-2 DVB-T coverage measurements and verification of planning criteria

Boundary of the measured DVB-T2 transmitter coverage area



Boundary of the measured DVB-T2 transmitter coverage area

In 2015 UCRG had developed the Methods on evaluation of coverage area with digital terrestrial DVB-T2 standard network.

Метрологія

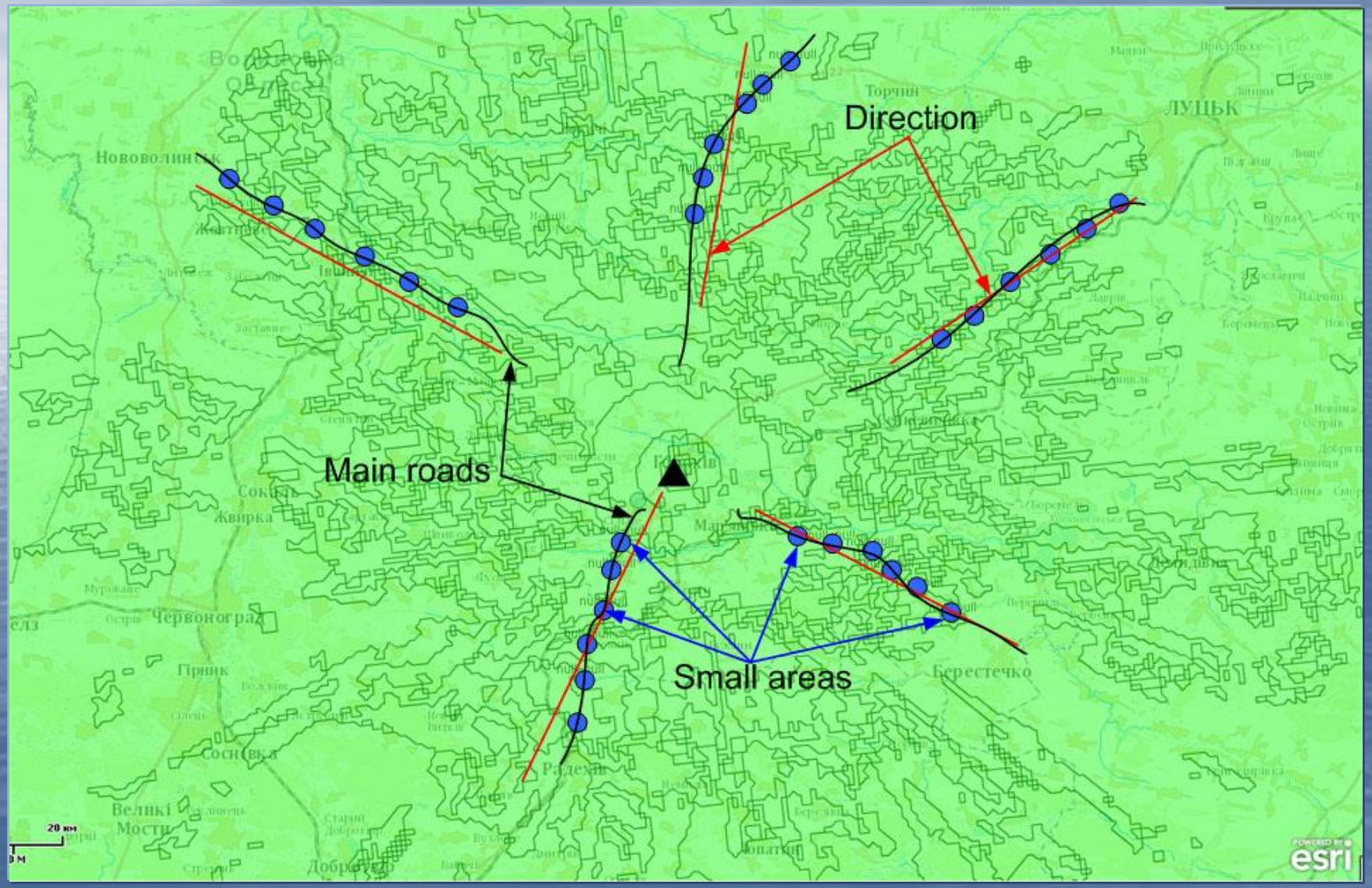
Визначення зони покриття мережі цифрового наземного телевізійного мовлення стандарту DVB-T2

(Определение зоны покрытия сети цифрового наземного телевизионного вещания стандарта DVB-T2)

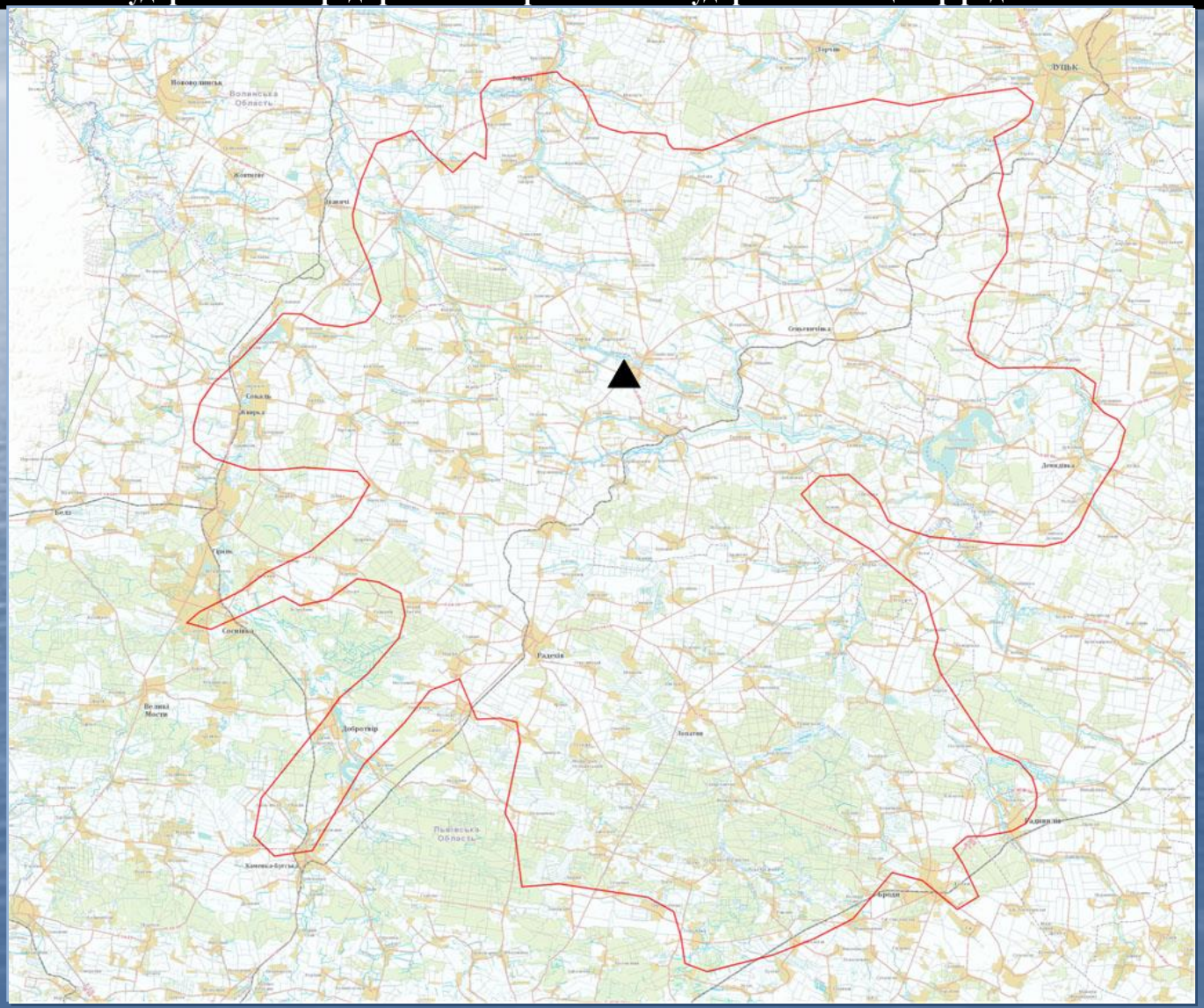
In 2015 it was adopted and certified with State Enterprise “UKRMETRTESTSTANDARD”.

In 2016 this Methods was approved with National Council of Television and Broadcasting in Ukraine.

The measurement of DVB-T2 transmitter coverage area (var. 2)



Measured coverage area of DVB-T2 transmitter in Gorokhiv city



The mobile spectrum monitoring unit ATLAS-33 (UCRF)

The measurement antenna system of mobile monitoring unit ATLAS-33

UCRF' fleet of mobile spectrum monitoring units ATLAS-33

Population coverage

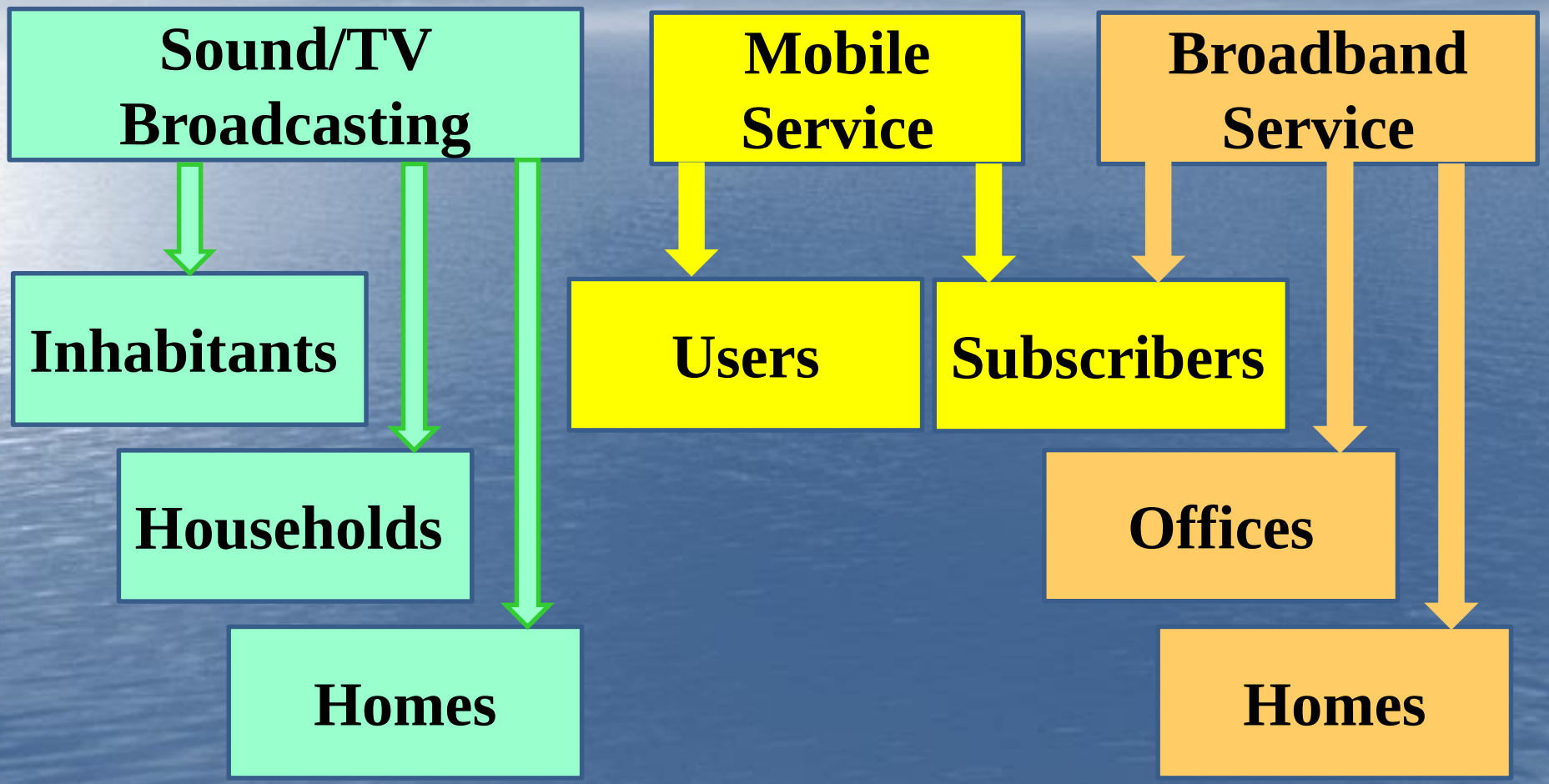
Population coverage determination is necessary to provide for National regulatory authorities (NRAs) with independent and reliable information on the state of certain population coverage broken down by telecommunication technology in their countries and to ensure telecommunication operators meet their coverage obligations.

Population coverage is determined quantitatively by following parameters:

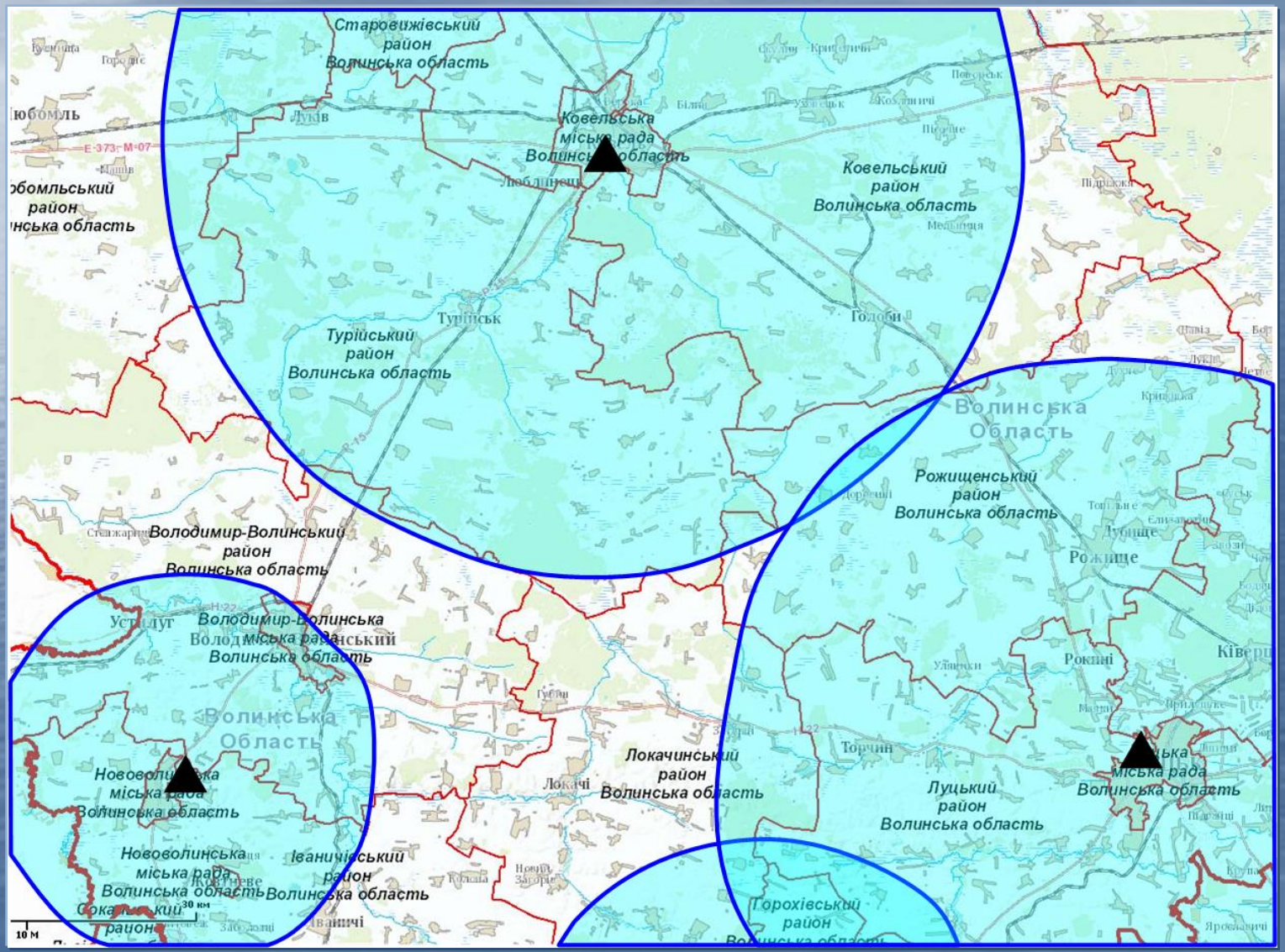
- **the total number of covered objects $N_{cov.}$ registered on a certain territory and have availability to use the certain telecommunication service;**
- **dimensionless parameter $C_{\%}$:**

$$C_{\%} = (N_{cov.} / N_{tot}) \times 100\%.$$

The objects for population coverage evaluation



Evaluation of population coverage within certain territory



Example of evaluation the population coverage with DVB-T2 network within certain territory

According to the Vital Statistics Reference Book, the entire tested territory covers 543 settlements with the total population of about 682,350 inhabitants.

- **328 settlements, where 562,600 inhabitants reside, are covered with DVB-T2 service;**
- **215 settlements with population of 119,750 inhabitants are uncovered.**

The population coverage parameter $C_{\%}$ in the appointed territory is equal to

$$C_{\%} = (562{,}600 / 682{,}350) \times 100\% \approx 84{,}25\% .$$

Monitoring of the radio coverage of land mobile networks

A predicted coverage area is determined by calculation with using the ITU Recommendation and Reports:

1) Recommendation ITU-R SM.1447 Monitoring of the radio coverage of land mobile networks to verify compliance with a given licence
2) ECC REPORT 231 Mobile coverage obligations
3) ECC Report 103 UMTS coverage measurements
4) ECC Report 118 Monitoring methodology to assess the performance of GSM networks

Information and communication technology (ICT) Indicators

ICT Indicators are determined by the Core List of ITU ICT Indicators. It includes 41 ICT indicators.
The Core List of ICT Indicators adopted with the World Summit on the Information Society (WSIS) in 2010.

The indicators are based on where the population lives, and not where they work or go to school, etc.
Indicator 9.c.1 “Proportion of population covered by a mobile network, by technology” is defined as population covered by a mobile network, broken down by technology, refers to the percentage of inhabitants living within range of a mobile-cellular signal, irrespective of whether or not they are mobile phone subscribers or users.

ICT Indicators for evaluation the population coverage by mobile service

The objects using for evaluating the population coverage:

- **Users,**
- **Subscribers.**

The key metrics using at the evaluation of population coverage:

- **Technology,**
- **Regional,**
- **Rural/Urban,**
- **Speed coverage.**

Indicator 271pop

measures the percentage of inhabitants that are within range of a mobile cellular signal, irrespective of whether or not they are subscribers

Indicator 271G

measures the percentage of inhabitants that are within range of at least 3G mobile cellular signal, irrespective of whether or not they are subscribers

Indicator 2712

“Digital mobile cellular subscriptions” measures the total number of mobile subscriptions to digital cellular systems

ICT Indicators for evaluation the population coverage with mobile service

The indicator A2 refers to the number of mobile cellular telephone subscriptions for each 100 inhabitants, includes IMT-2000 (3G).

The indicator A5 refers to the number of mobile broadband subscriptions for each 100 inhabitants with access to data communications (e.g. the Internet) at broadband speeds greater than or equal to 256 kbit/s (WCDMA, HSDPA, CDMA2000 1xEV-DO and CDMA 2000 1xEV-DV).

Population coverage with wireless broadband technologies

A wireless broadband services (WiBB) are delivered through the

- **WLAN (including WiMAX and Wi-Fi)**
- **WWAN (including Bluetooth and UWB)**
- **LMDS**
- **MMDS.**

The population coverage with WiBB technologies is determined with a fixed wireless service, which provide the wireless Internet for devices in relatively permanent locations, such as homes and offices.

The main approaches and methodology on population coverage evaluation

The approaches and methodology for evaluating the WiBB population coverage was developed in 2013 by HIS & VVA. The evaluation results are published in annual Final EC Reports Broadband Coverage in Europe. Mapping progress towards the coverage objectives of the Digital Agenda.

BEREC/RSPG Report describes:

- **the main principles and procedures for evaluation the population coverage with digital terrestrial public wireless services and networks, such as sound and television networks, mobile and broadband wireless networks, used by some administrations and operators;**
- **the experience of some ECC countries in evaluation the population coverage with digital terrestrial public wireless services.**

Coverage measurement with 5G networks

Taking into account the main services, ensuring functionality of 5G network:

- enhanced Mobile Broadband, eMBB

- Ultra-Reliable Low Latency Communication, URLLC

- Massive Machine-to-Machine (Device-to-device, D2D) Type Communications, mMTC,

the main objects for evaluation the 5G networks coverage are:

1) **Coverage areas – at the global level and**
2) **Households and Homes – at the local level.**


Thank you!