# Best practice for implementation of SFN DAB+ networks

Poland

Mirek Ostrowski, Radio Wroclaw

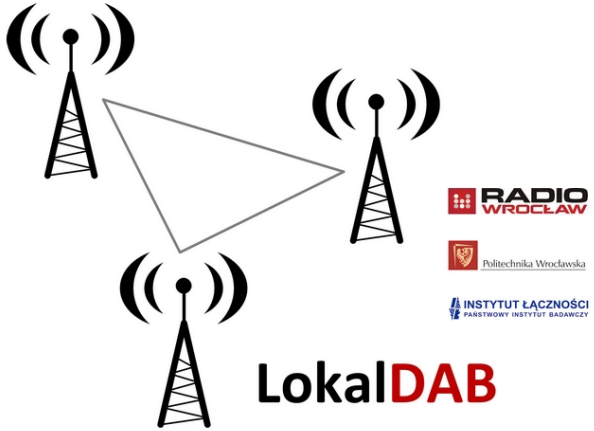
# Agenda

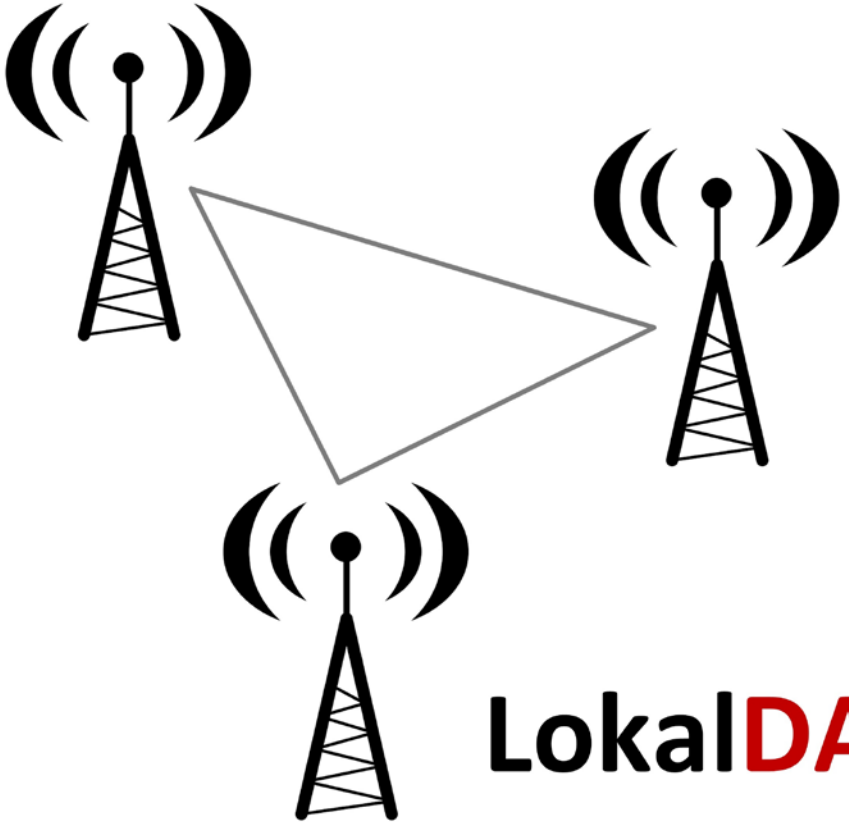


1. Introduction
2. The problem and challenges
3. The solution – what we did
4. What we learned

# Local DAB Project Official Title

„A single-frequency network using the DAB+ broadcast platform for the needs of local broadcasters in Poland"





# LokalDAB

Politechnika Wrocławska

INSTYTUT ŁĄCZNOŚCI
PAŃSTWOWY INSTYTUT BADAWCZY

RADIO WROCŁAW

KRRiT UKE EBU WORLD DAB

The National Centre for Research and Development

The Project project funded by The National Centre for Research and Development PBS3/A3/19/2015

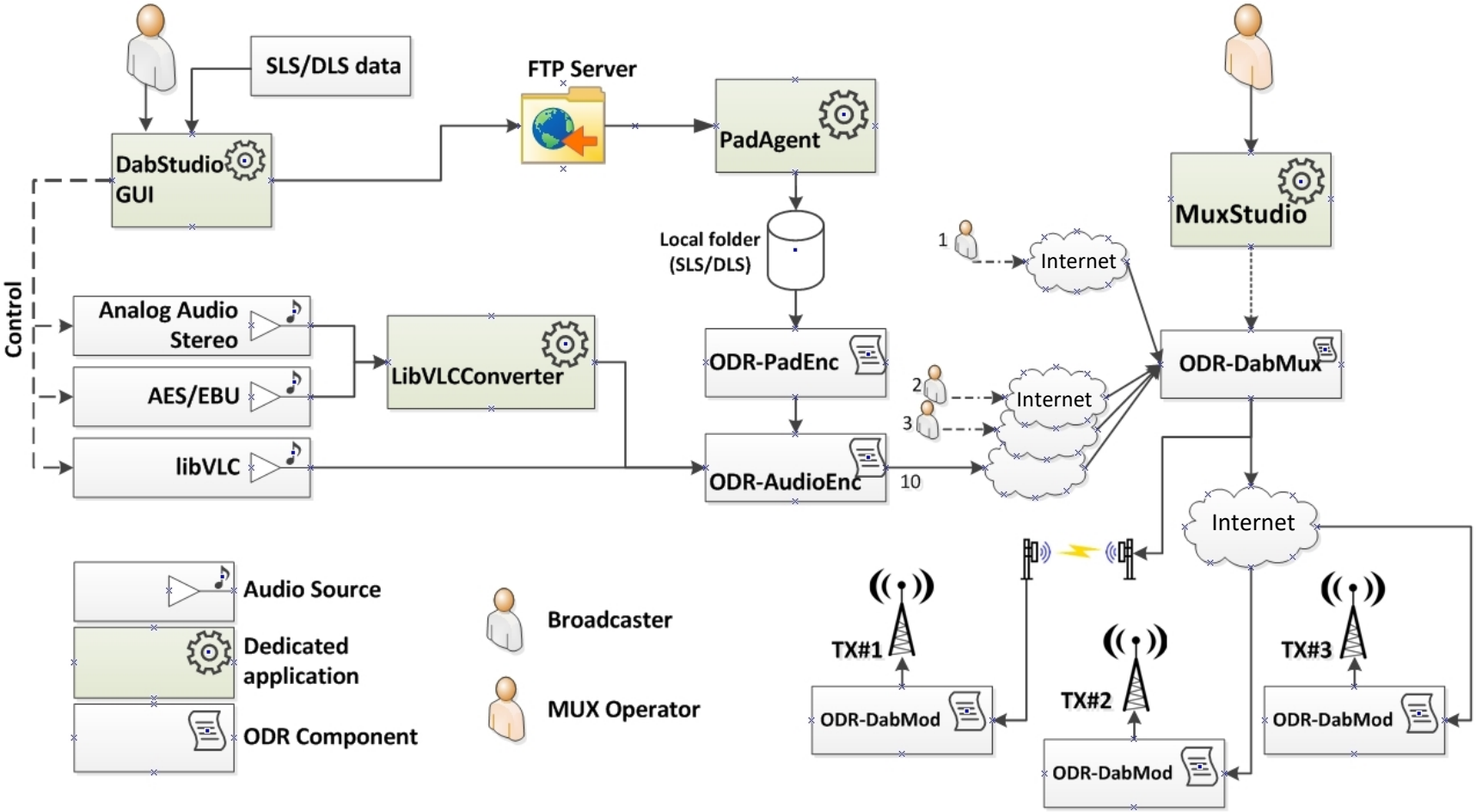
# Local DAB Project Financing institution



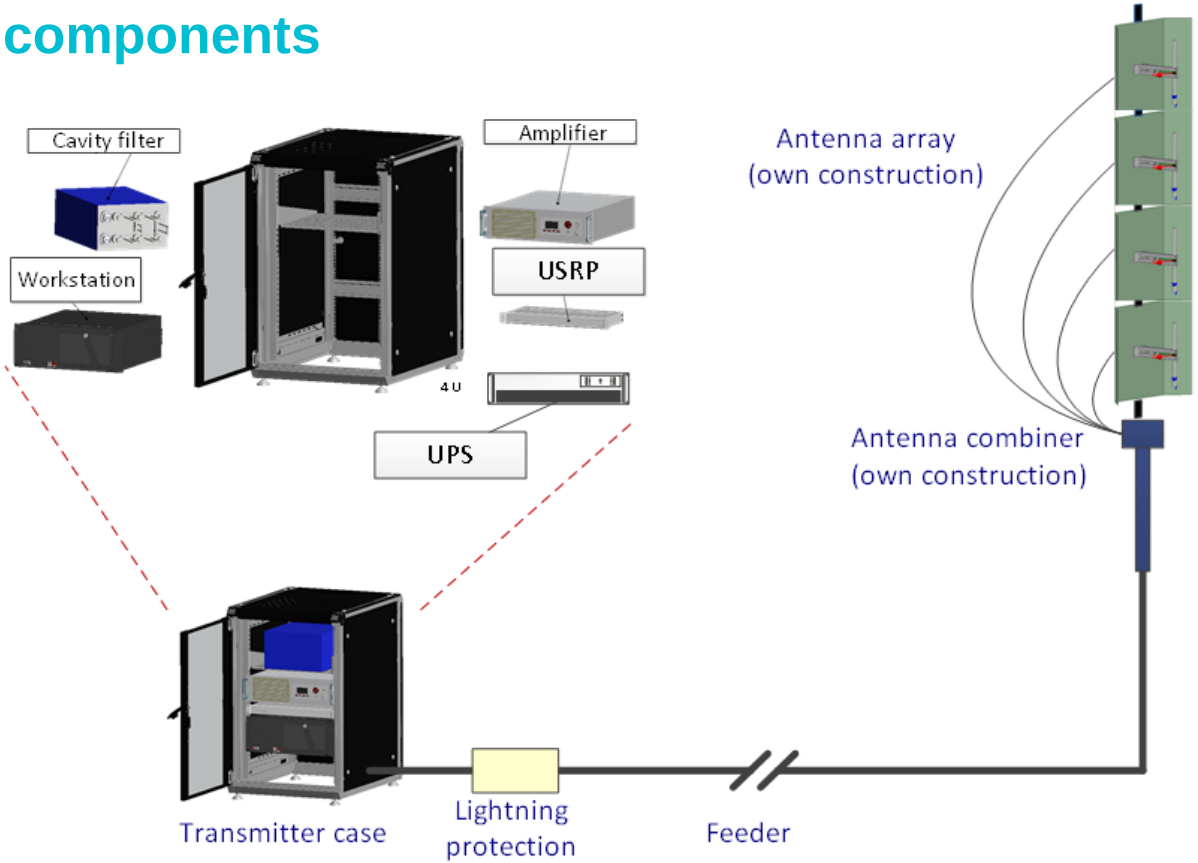

Financing time frame 2015 – 2017

Project lifetime after financing period 2017 - 2022

# Architecture of Local DAB

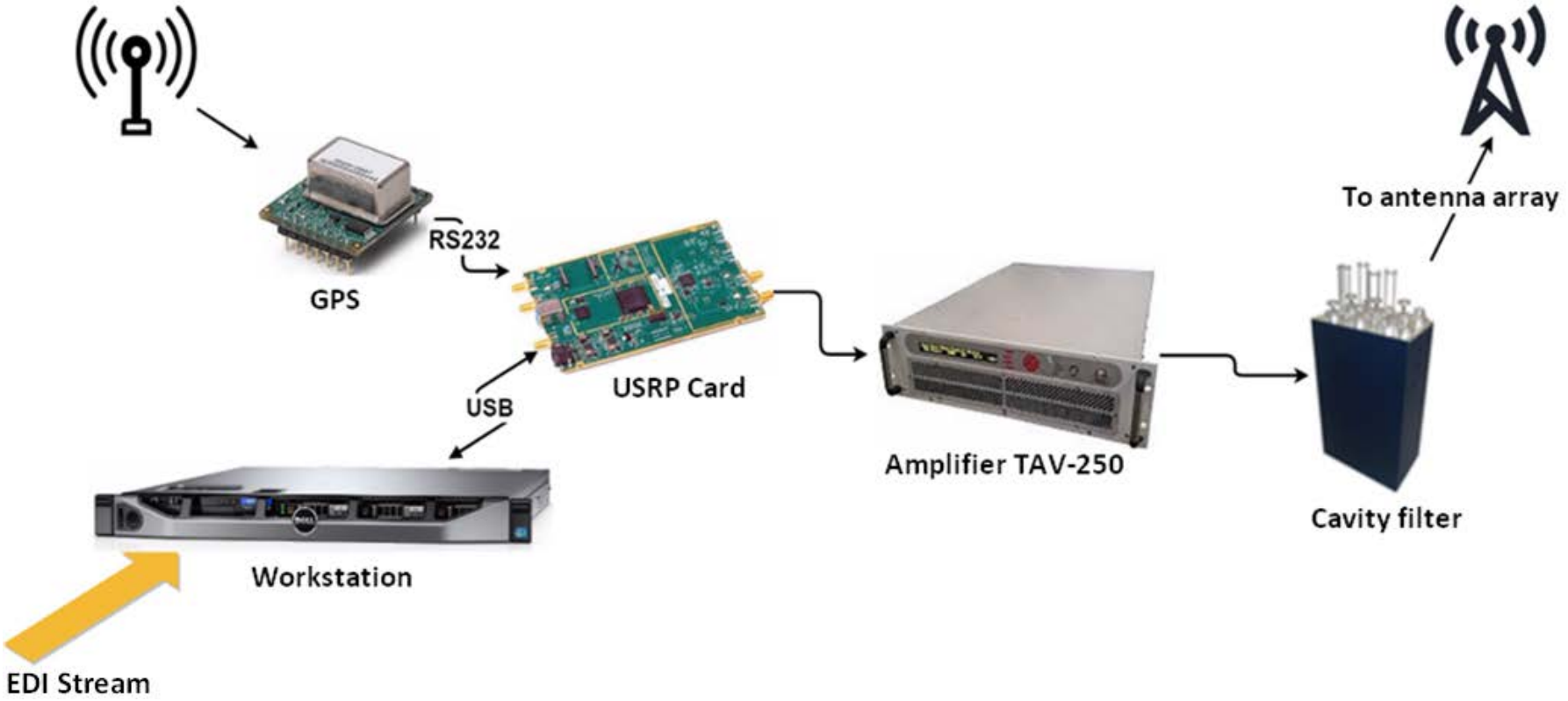


# Local DAB head-end components

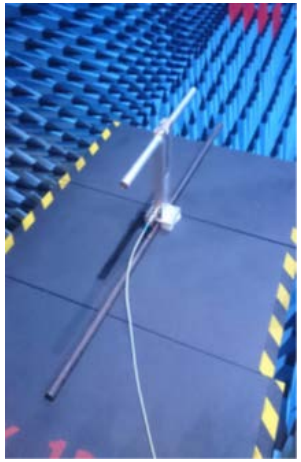


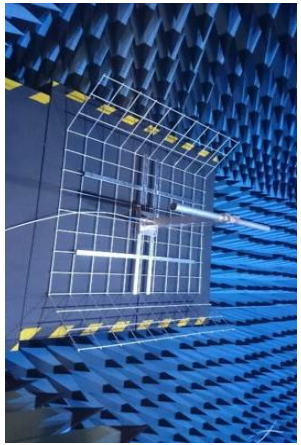
# Local DAB head-end components

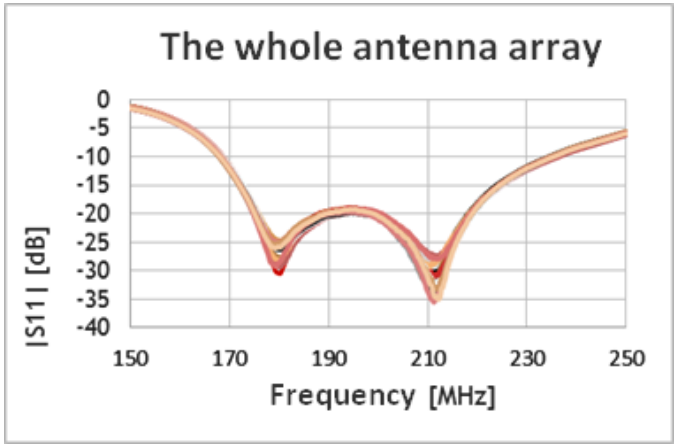


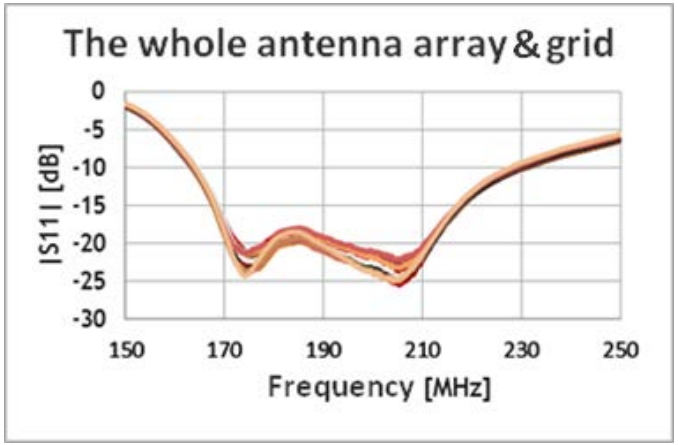


# Local DAB antenna array

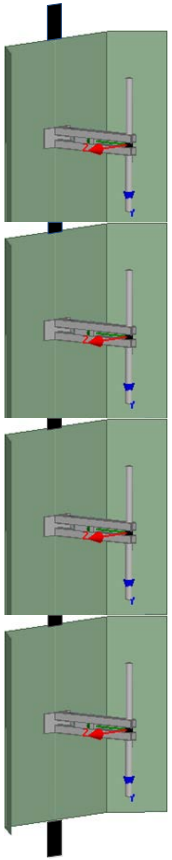


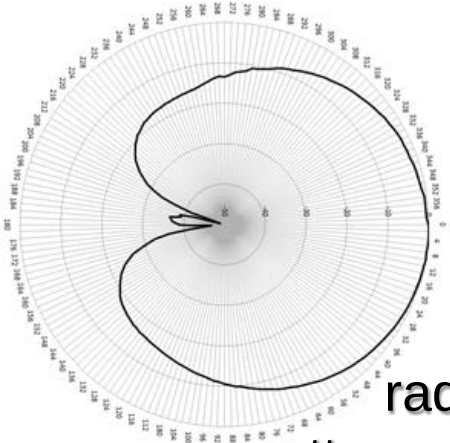




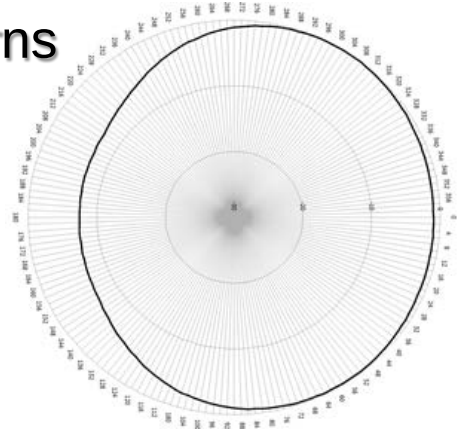
# Local DAB antenna arrays



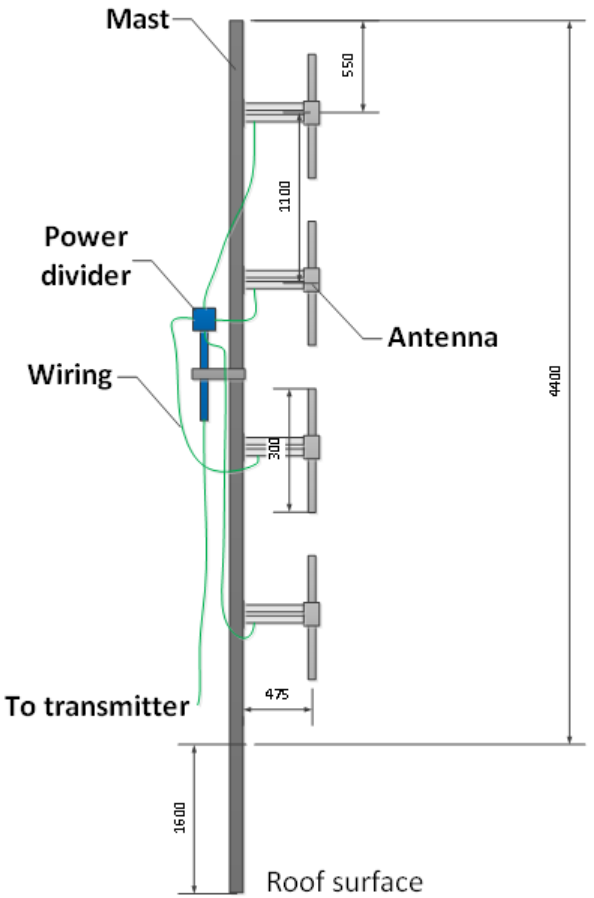


With a grid

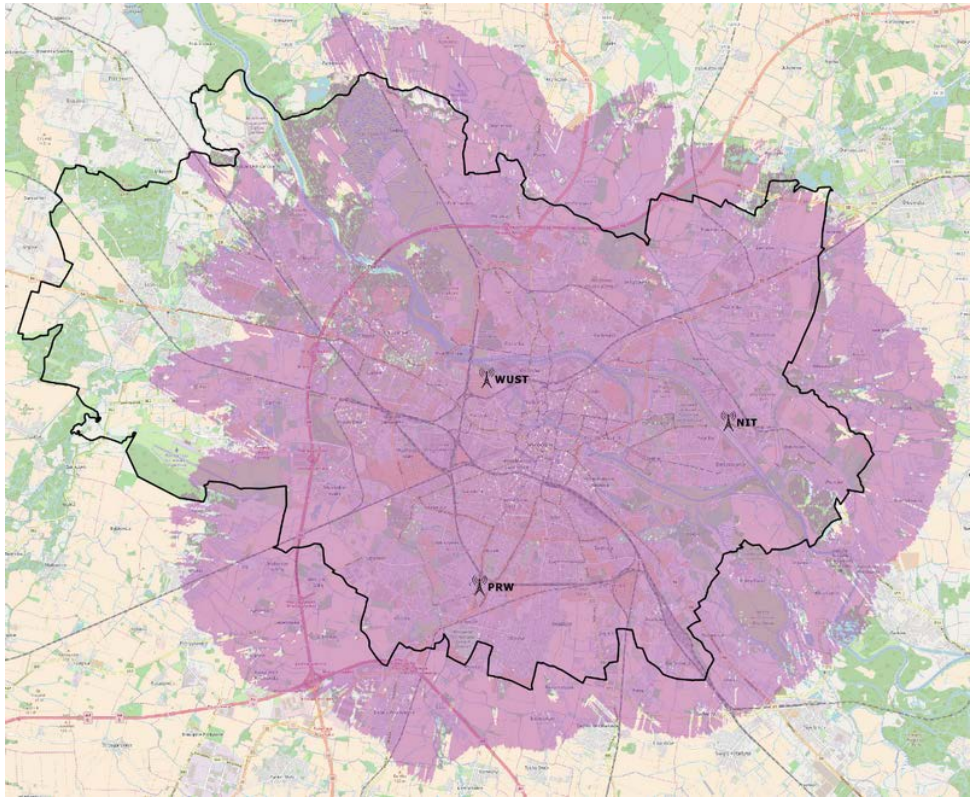
Horizontal radiation patterns



Without a grid



# Local DAB expected coverage of SFN




# Local DAB MUX with 10 services













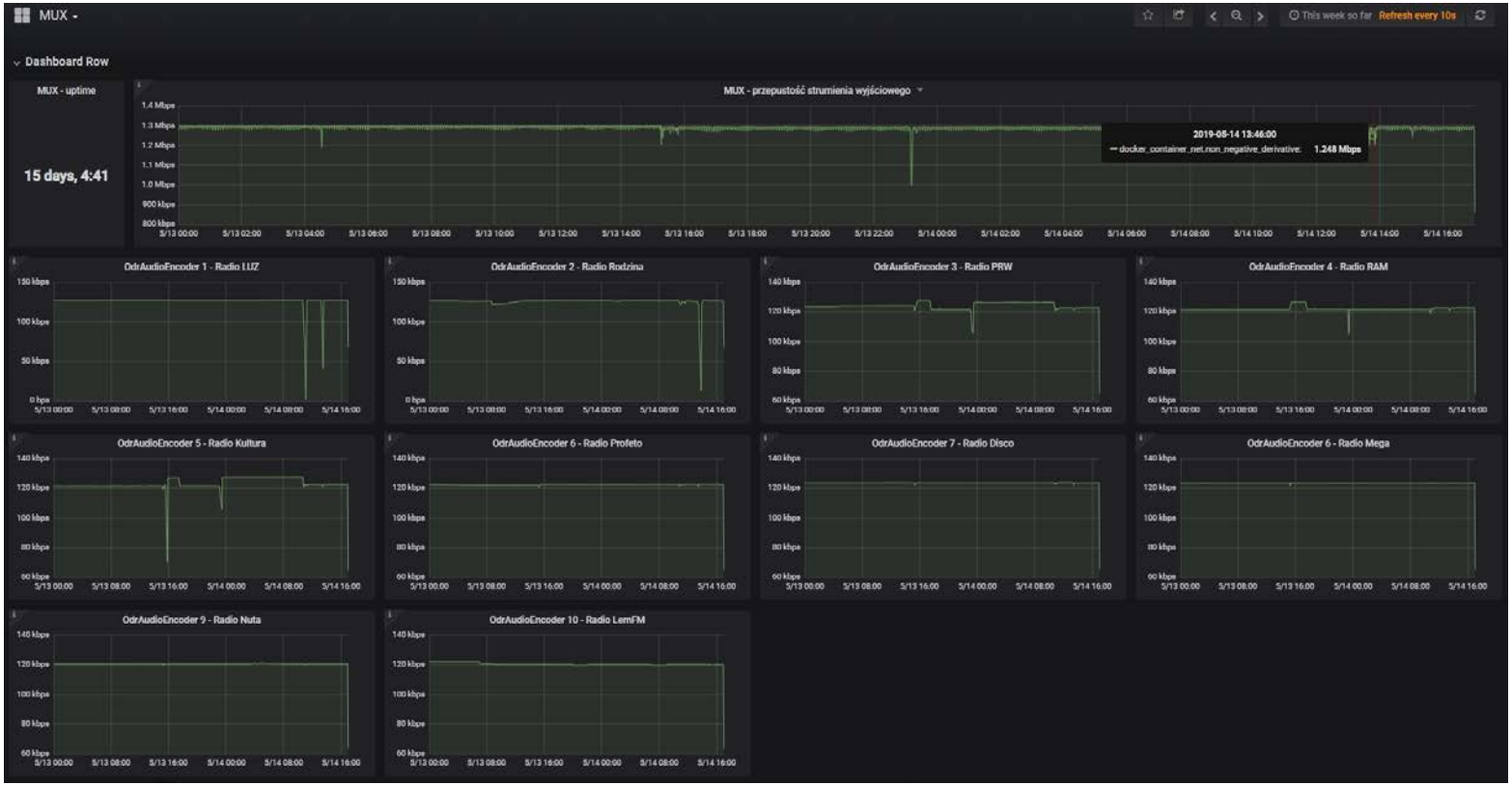

worldDAB

# Grafana

Dashboard of the system

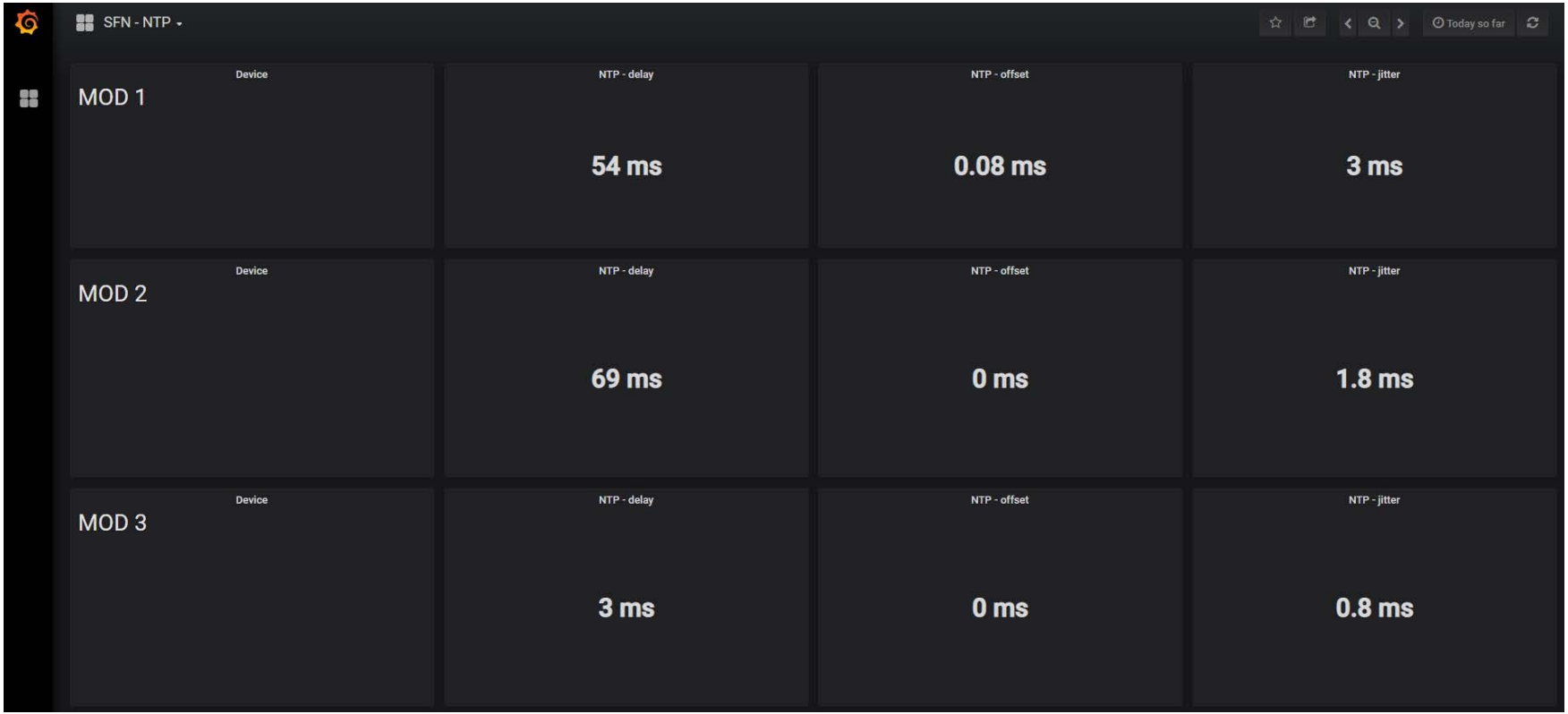
# Grafana - MUX with 10 services





# Grafana - NTP parameters





# Grafana – Head-end status (TX#3)



# Grafana – problems with Internet connection



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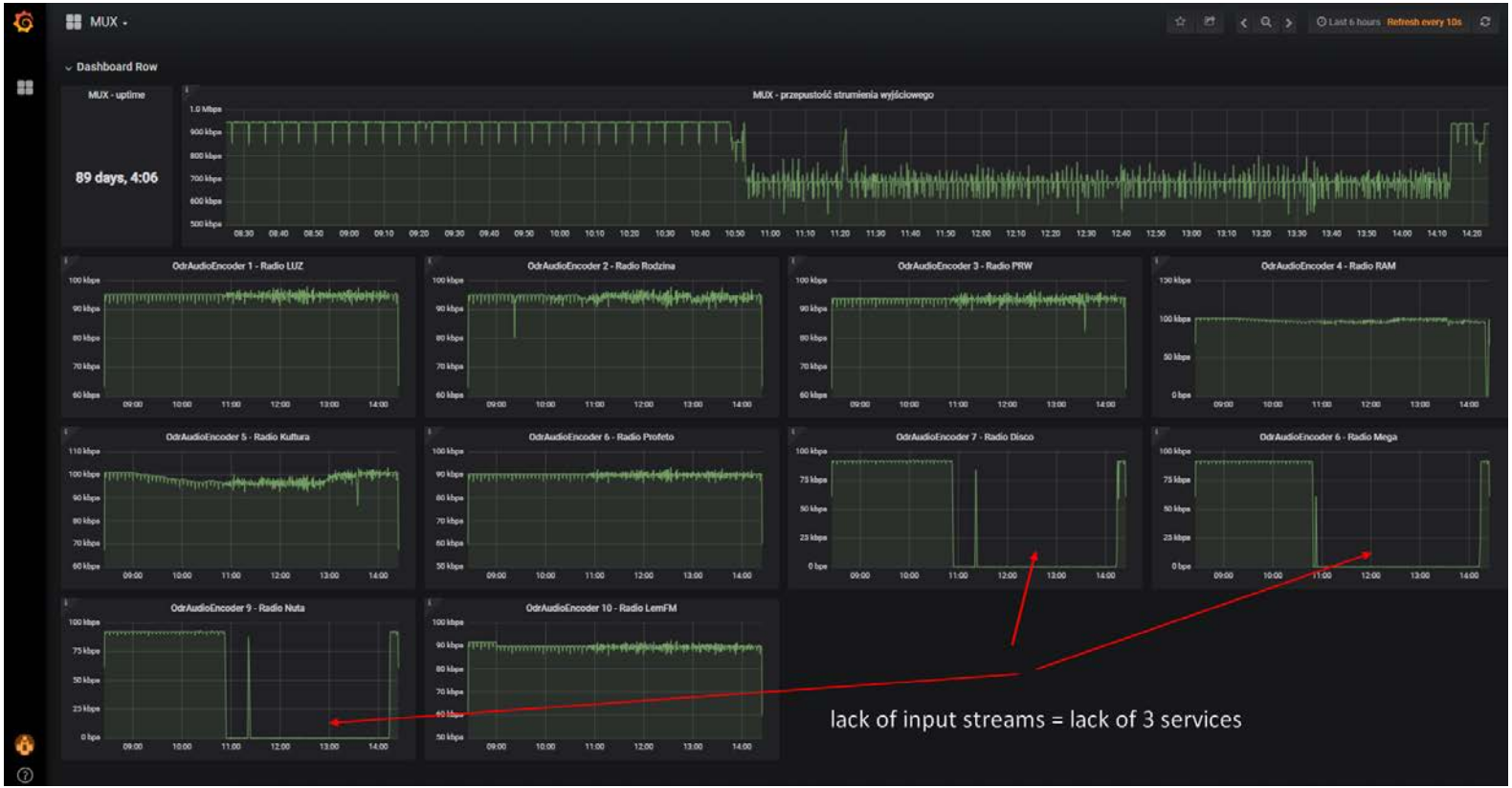


# In search of the source of the problem

Field measurements

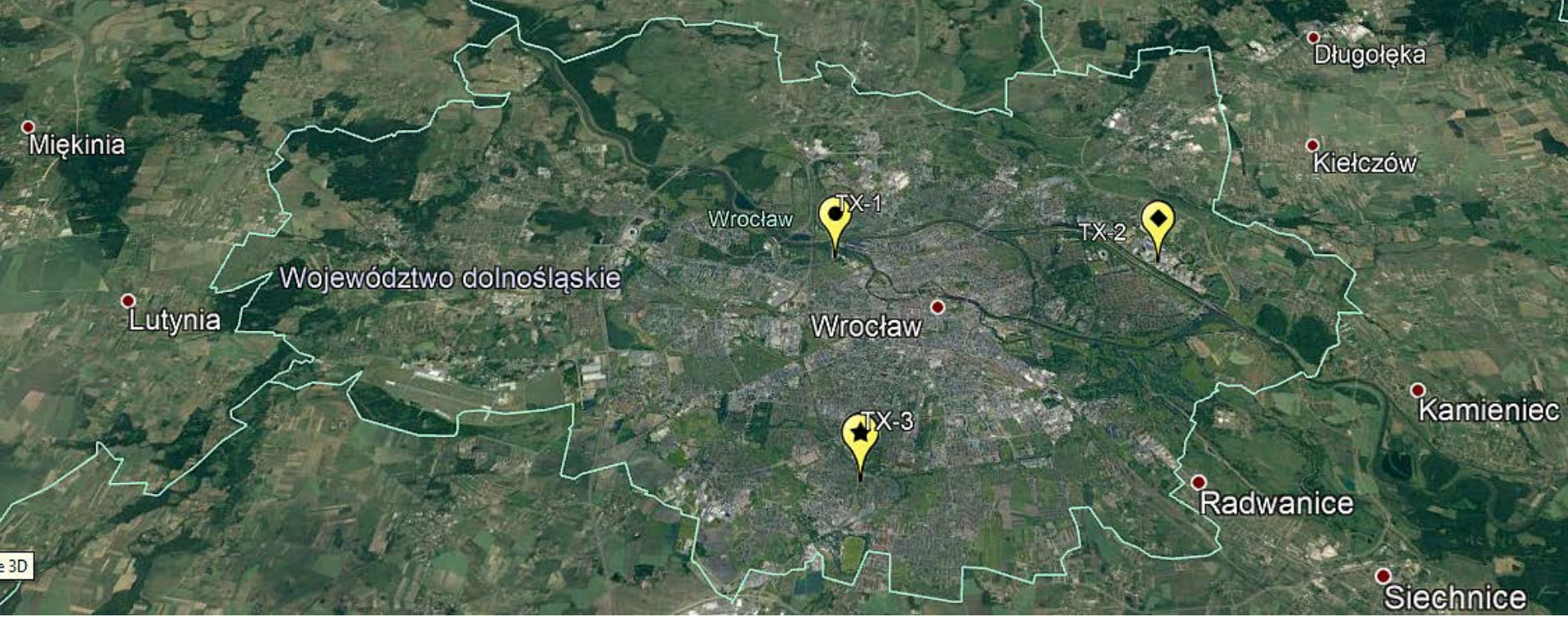
# Field measurements

- RF level,
- SNR and MER,
- Bit Error Rate before Viterbi for MSC and FIC,
- FIB CRC error rate,
- in-band Spectrum,
- channel impulse response,
- relative time position of null symbol to GPS,
- constellation diagrams,
- MER diagrams,
- frequency and sampling rate offset,
- GPS coordinates and time


**DABRF**

**receiver and modulator**

**Ingenieurbüro Mulka, Dresden, Germany**




The locations of the transmitters marked with the icon are as follows:

TX #1:Wroclaw University of Science and Technology: 51.1271491,17.0091166

TX #2: The National Institute of Telecommunications: 51.1153582,17.1135315

TX #3: Radio Wroclaw: 51.0708741,17.0061065

Frequency
Block 11A
EIRP ≈ 1 kW

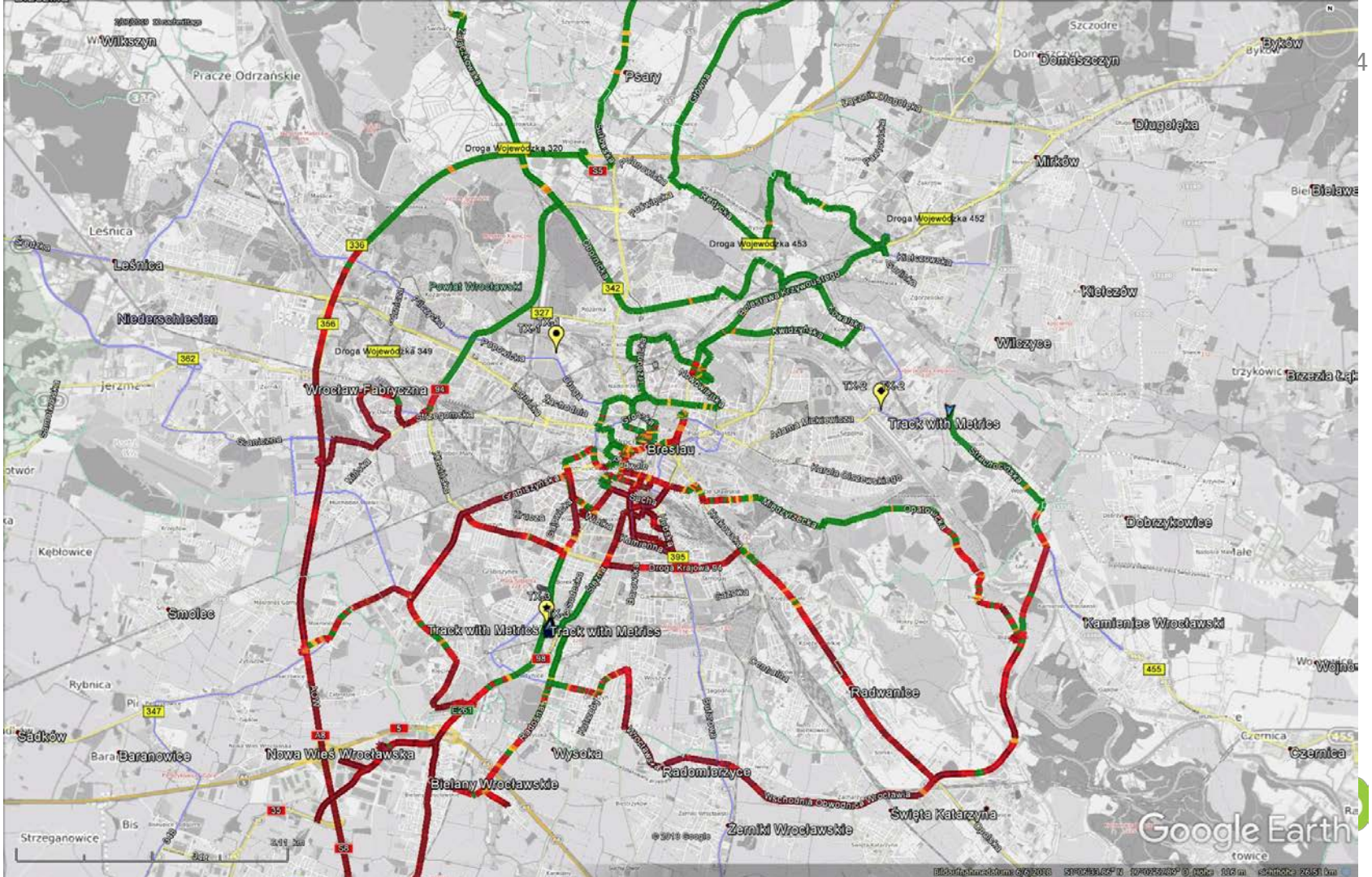
worlddab

# The results of field measurements

A good indicator for the quality valuation is the FIB-CRC error rate, which was plotted over the map

green represents no CRC errors

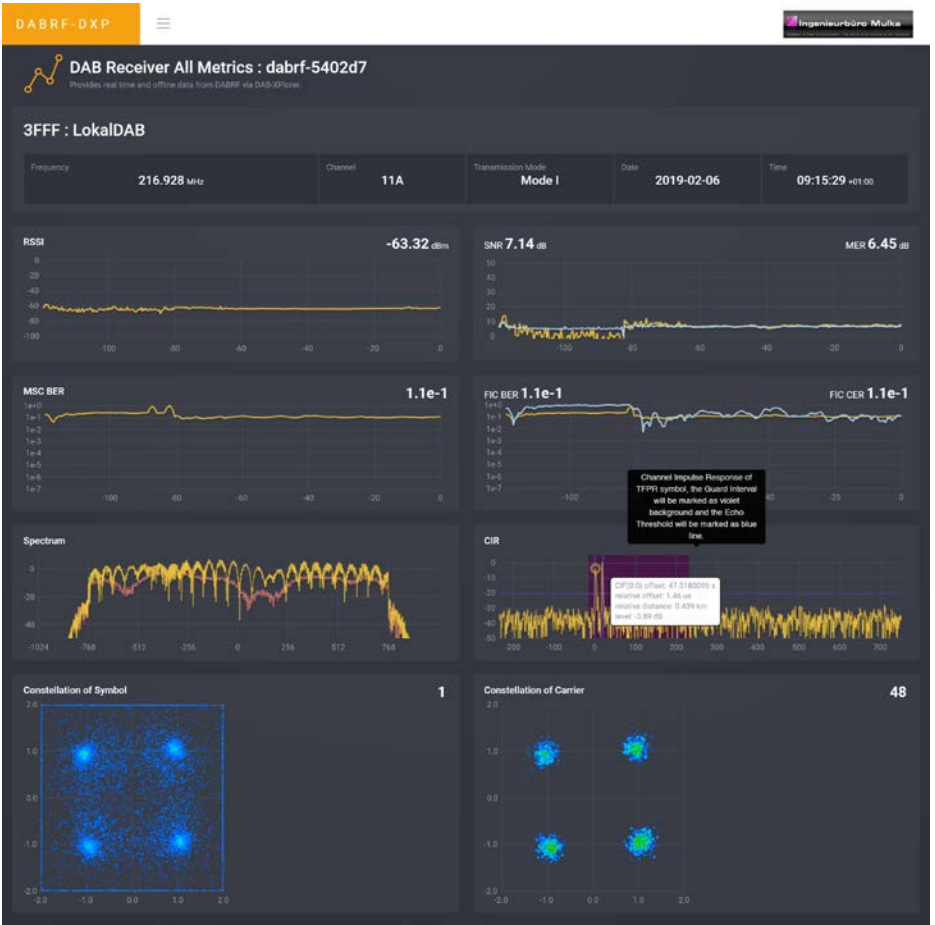
red signifies high CRC error ratio

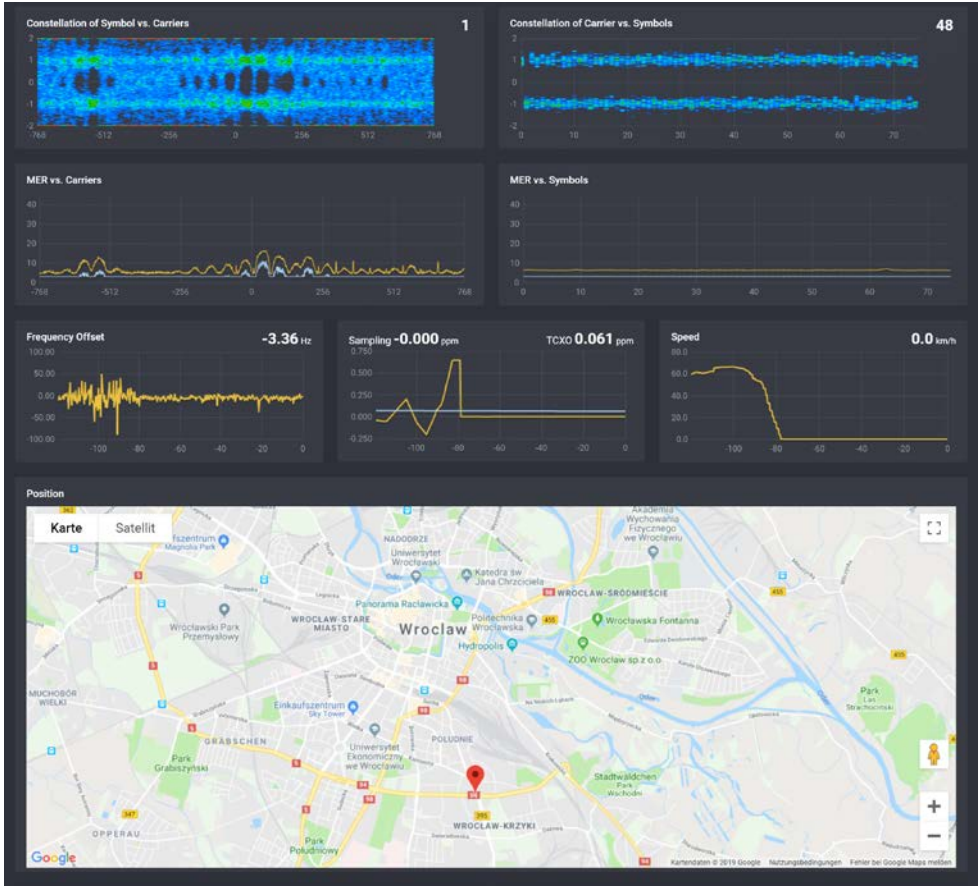

Wilkszyn
Pracze Odrzańskie
Psary
Szczodre
Domaszczyn
Byków
Długołęka
Mirków
Bielawa
Droga Wojewódzka 320
Droga Wojewódzka 452
Droga Wojewódzka 453
Leśnica
Powiat Wrocławski
Niederschlesien
Kiełczów
Wilczyce
Droga Wojewódzka 349
Wrocław-Fabryczna
Track with Metrics
Breslau
Dobrzykowice
Kębłowice
Smolec
Kamieniec Wrocławski
Rybnica
Radwanice
Sadków
Baranowice
Nowa Wieś Wrocławska
Wysoka
Radomierzyce
Bielany Wrocławskie
Święta Katarzyna
Żerniki Wrocławskie
Strzeganowice
Google Earth

# An interesting point is the low SNR at good RF levels at some critical places.



## DABRF receives TX#1 and TX#2



# An interesting point is the low SNR at good RF levels at some critical places.



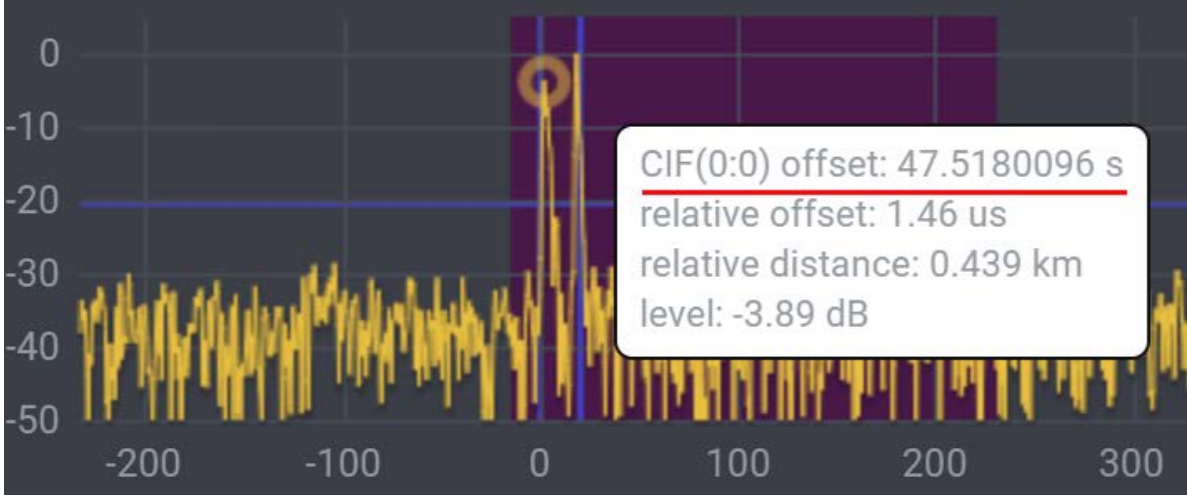
## DABRF receives TX#3


In both cases the RF level is around -62 dBm,
which is high enough for a good reception,
but the SNR is 8 dB which is very low.

The reason for that is, that the transmitter TX#3 had
an unexpected delay of around 2 seconds,
which was measured by the DABRF in the diagram of the
Channel Impulse Response

**Near TX#2**

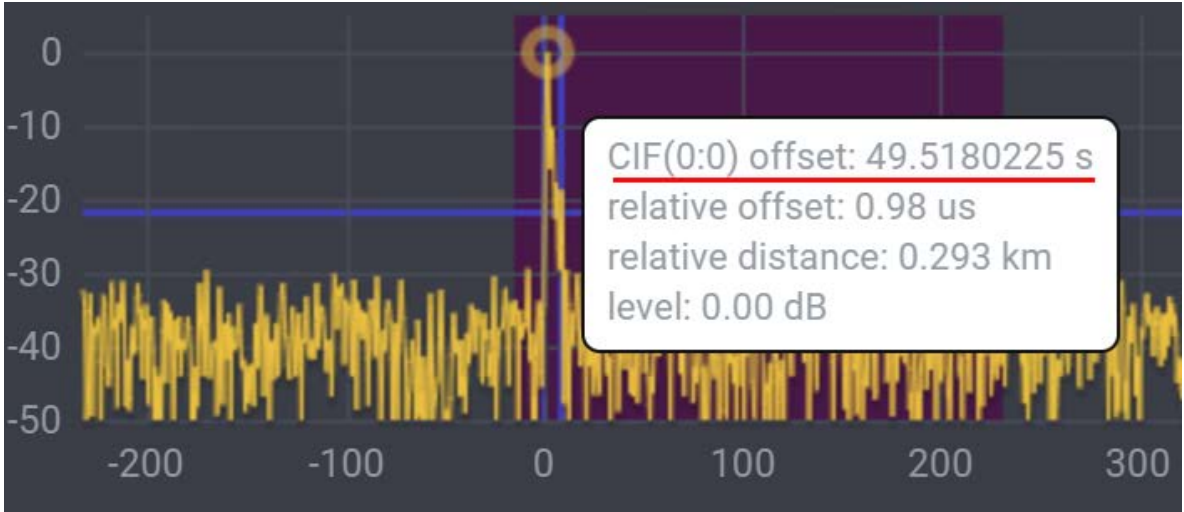
CIF(0:0) offset = 47,518 s




**Near TX#3**

CIF(0:0) offset = 49,518 s

i.e. 2 s delayed



# The solution

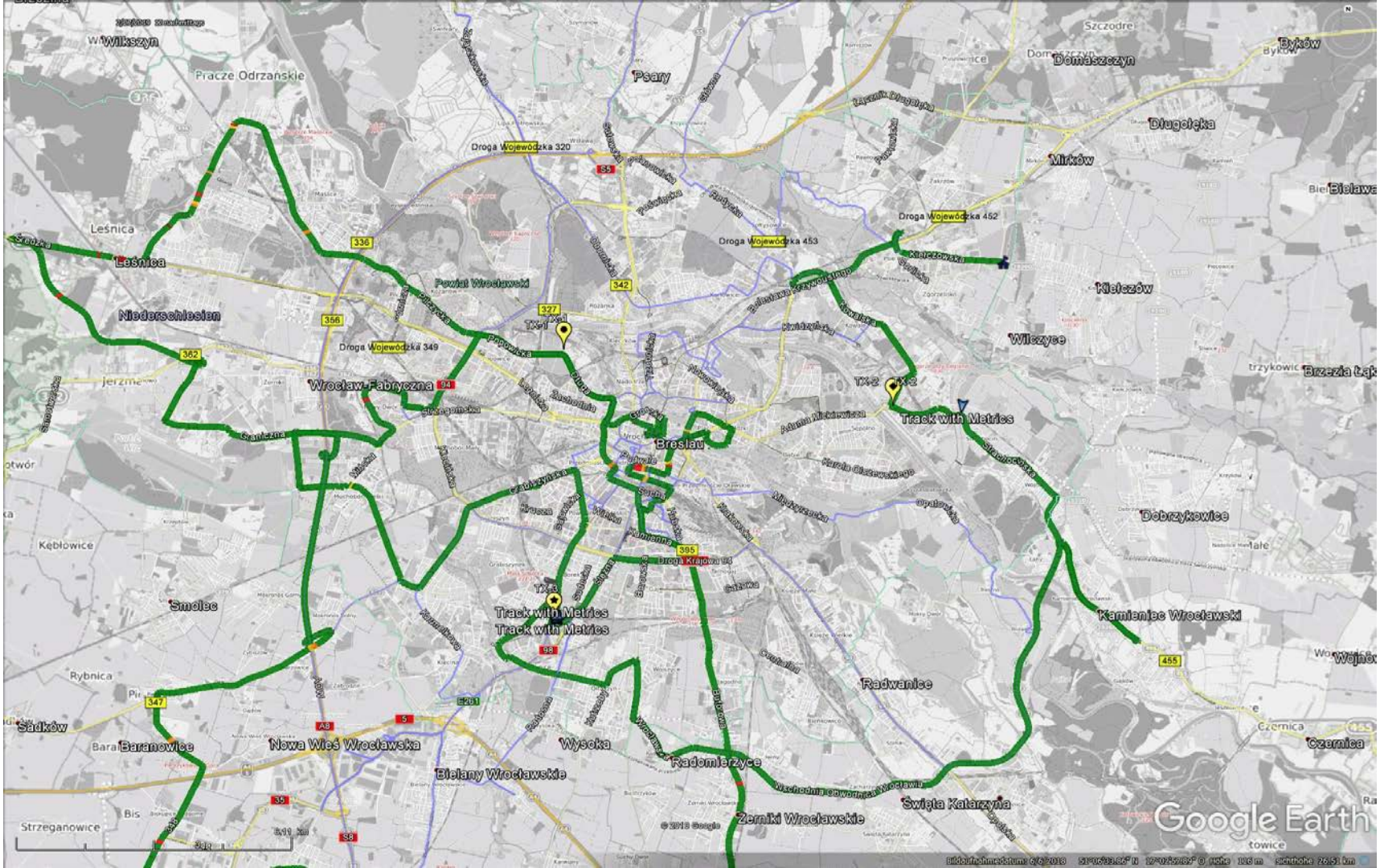
What we did

Decisive for the time measurement is, that a reference between the time and the frame is made with CIF counter (0:0).

This is a unique feature of the DABRF receiver.

The problem was caused by the wrong address on the DNS server in TX#3 transmitter, which caused a problem with the transmission of the corresponding NTP data, resulting in lack of synchronization.

# Results of field measurements after correcting the time synchronization of TX#3 transmitter


Wilkszyn
Pracze Odrzańskie
Psary
Domaszczyn
Byków
Długołęka
Mirków
Bielawa
Droga Wojewódzka 320
Droga Wojewódzka 452
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Kamieniec Wrocławski
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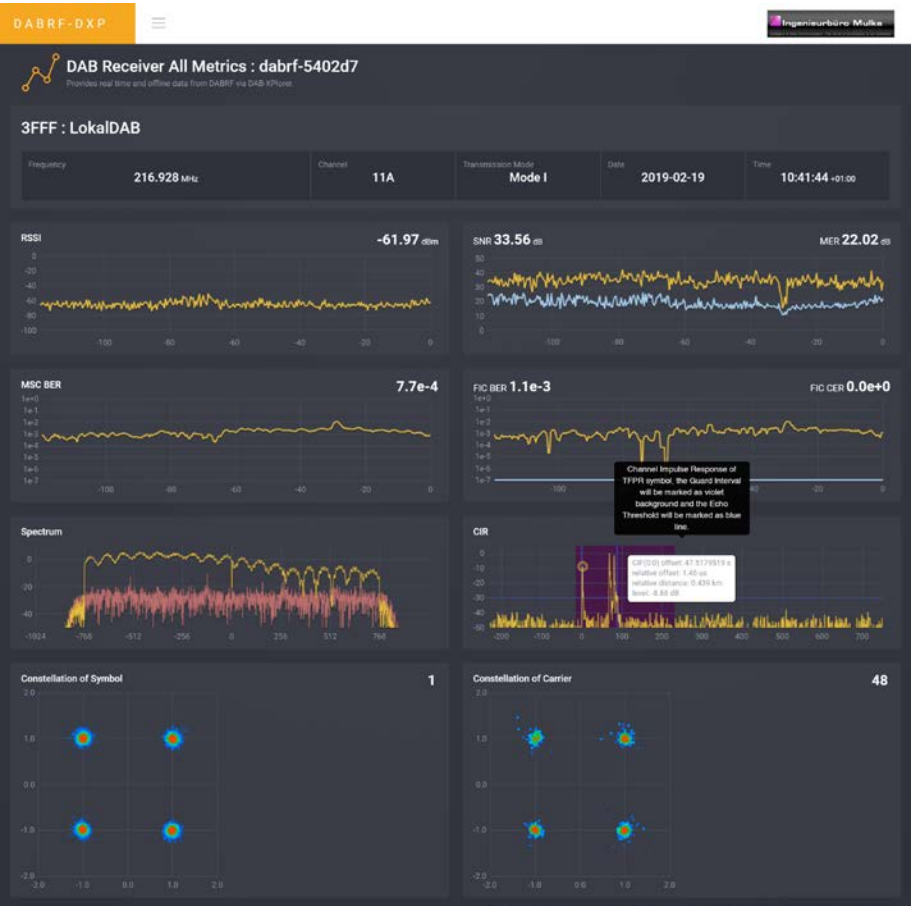
Strzeganowice
Google Earth

# After correcting the time synchronization of TX#3 transmitter

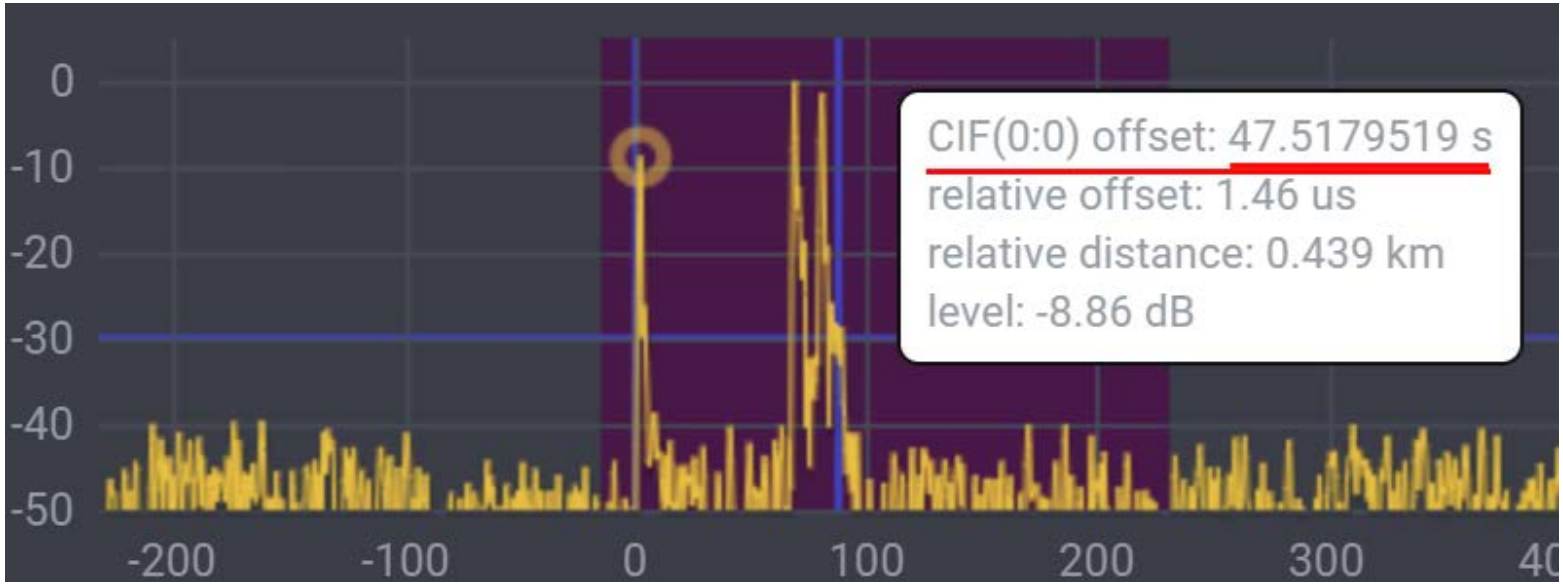


RF level is at about the same level as before (– 62 dB), but SNR is higher than 33 dB what assures a perfect reception




# CIF (0:0) offset is now the same for all three transmitters






Channel Impulse Response where all three transmitters (three yellow peaks), work within the guard interval of 246µs

# What we learned

# Summary



- Modified open-source software is doing its job
- It’s good to use Grafana – very useful open platform for beautiful analytics and monitoring – to see what’s going on with your system
- Regular Internet may be acceptable for small scale DAB solution, but microwave link is more reliable
- SFN is good for urbanized area but synchronization is crucial
- It's good to have friends with perfect measuring devices ☺

# Thank you for your attention.

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