

# Coordination and observation of radio frequencies

Informative update on the focus  
Many years of radio frequency monitoring  
in content and event production  
10<sup>th</sup> November 2022

Dipl. Ing. Ing. Ing. Matthias Fehr



# \*Introduction

The APWPT e.V. team, together with many organisations, has participated in event productions over the years, observing and recording, where possible, their frequency use, including wireless microphones, their backlinks (IEM), cameras, audio and video links, effects control and team communication.

Results of this work were/are taken into account in publications, scientific papers, studies and (inter-)national working groups (e.g. CEPT, ETSI, ITU-R).

In the following, we present a lot of new and updated information, with a focus on the UHF TV frequency range.

# \*Today's focus

- **Frequency data on observed event groups**
  - Productions in the cultural, political and sports environment
- **Trend summary**
  - Coordinated / observed links in the UHF TV range
  - Trend of the existing frequency spectrum for use by wireless production tools
- **Not to be presented today**
  - Other uses outside the UHF TV range
  - Methodology for frequency monitoring/data evaluation

Please send your questions to: [matthias.fehr@apwpt.org](mailto:matthias.fehr@apwpt.org)

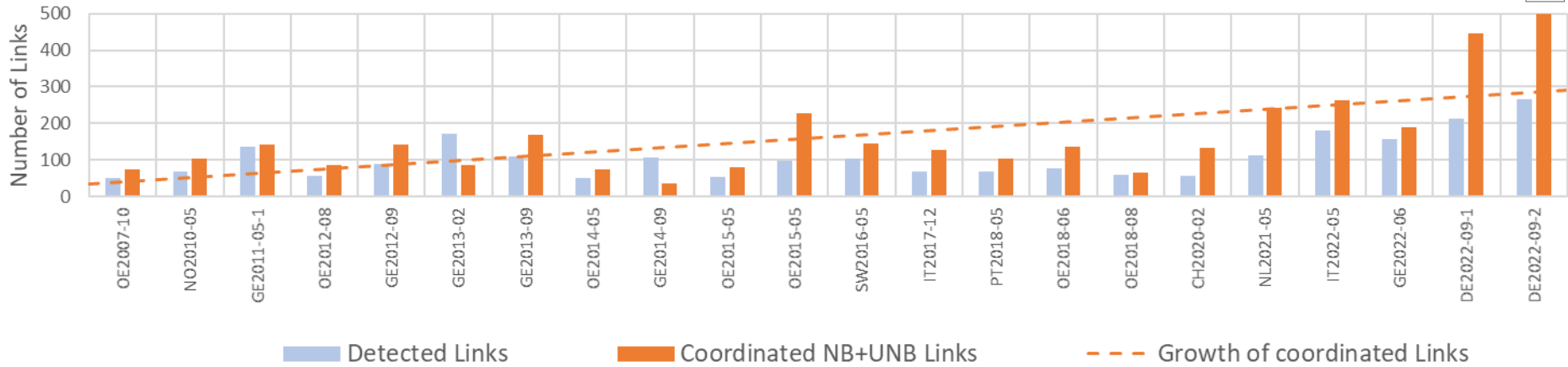
# **Productions in the cultural environment**

# List of productions in the cultural environment

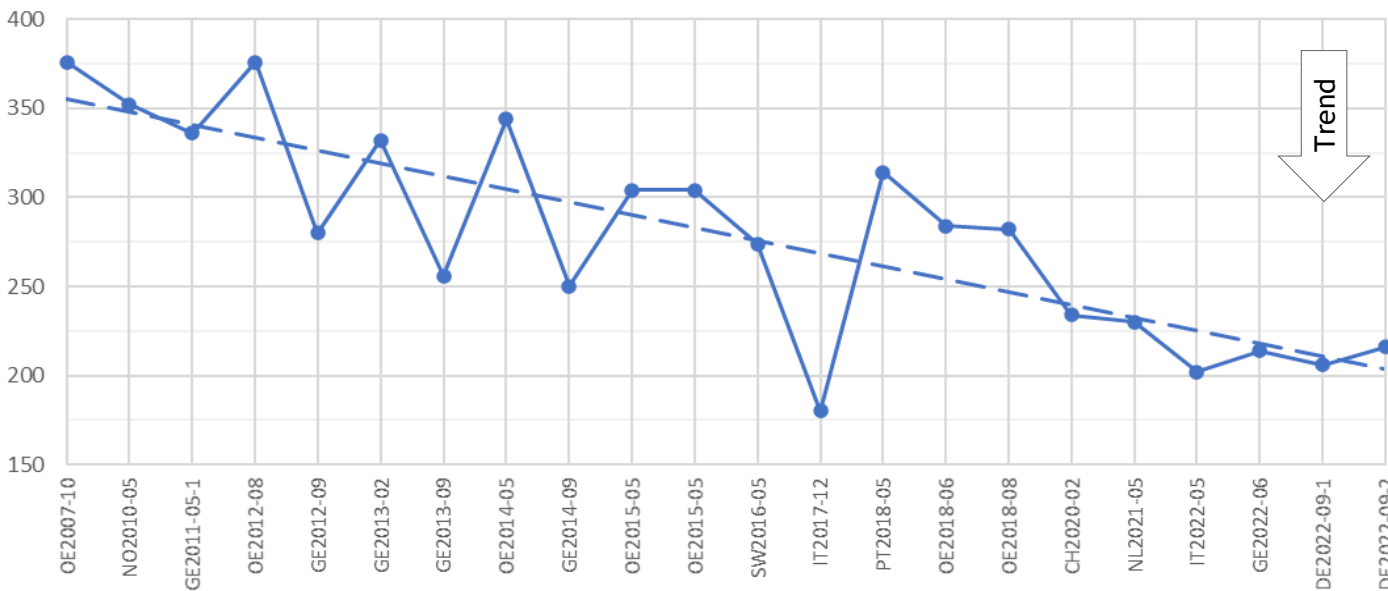
1	Festival 2007, Seebühne Bregenz, Austria	OE2007-10
2	ESC 2010, Oslo (Coordination only)	NO2010-05
3	ESC 2011, Düsseldorf, Germany	GE2011-05-1
4	OPEN Air Festival 2012 in Villach, Austria	OE2012-08
5	179th Oktoberfest Munich 2012	GE2012-09
6	ESC 2013, national preliminary decision in Hanover	GE2013-02
7	180th Munich Oktoberfest 2013	GE2013-09
8	Lifeball Vienna 2014	OE2014-05
9	181st Oktoberfest, Munich 2014	GE2014-09
10	Lifeball Vienna 2015	OE2015-05
11	ESC 2015, Vienna, Austria	OE2015-05
12	ESC 2016, Stockholm	SW2016-05
13	La Prima della Scala, Teatro alla Scala, Milano	IT2017-12
14	ESC 2018, Altice Arena, Lisboa	PT2018-05
15	Lifeball Vienna 2018	OE2018-06
16	OPEN Air Festival in Villach 2018	OE2018-08
17	Swiss Music Awards 2020, Lucerne, Switzerland	CH2020-02
18	ESC 2021, Rotterdam, Netherlands	NL2021-05
19	ESC 2022, Turin, Italy	IT2022-05
20	Berlin International Aerospace Exhibition 2022	GE2022-06
21	DIGITAL X Cologne 2022, Volksbühne and Mediapark	DE2022-09-1
22	Lollapalooza Berlin 2022	DE2022-09-2

# Graphics on the cultural environment - 470 to 862 MHz

## Number of Links detected and coordinated - 470 to 862 MHz



## Available Spectrum [MHz] - 470 to 862 MHz

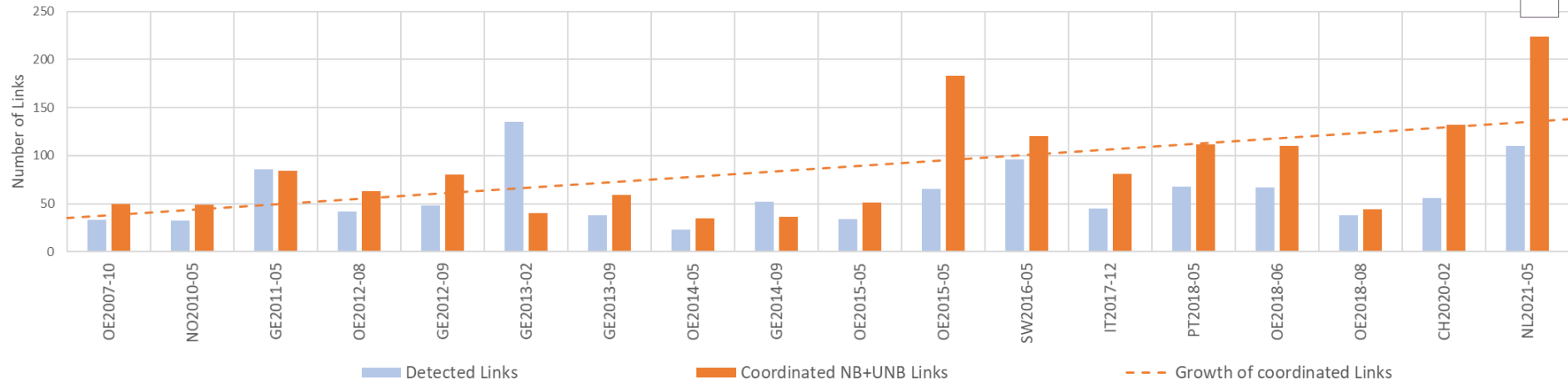


### Change in DE

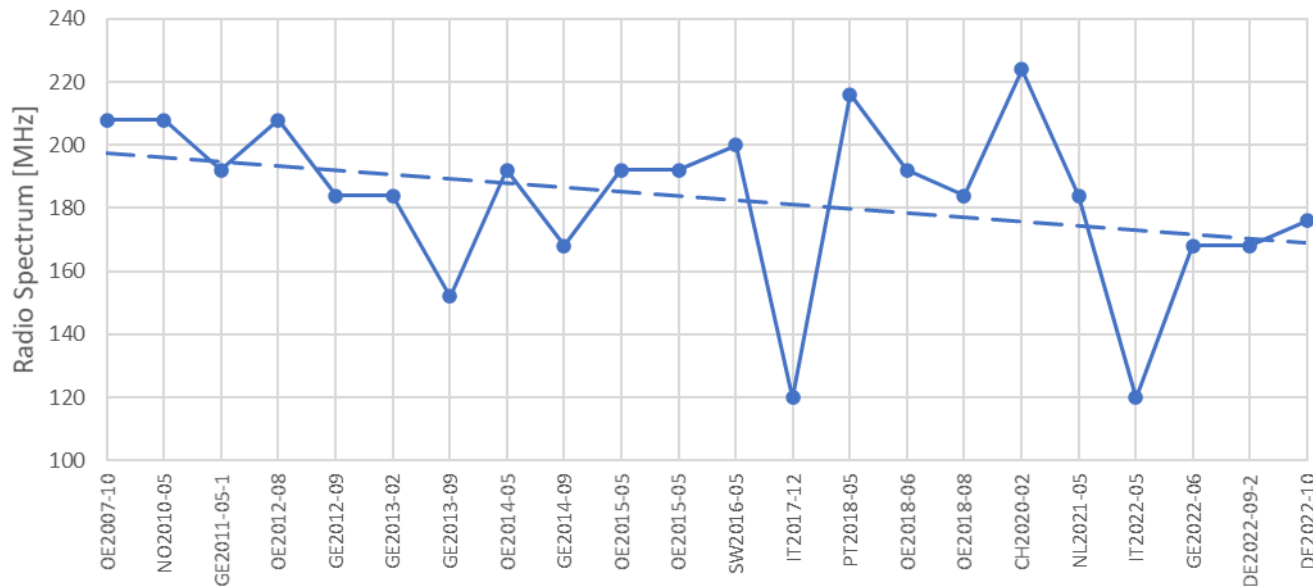
- 700 MHz DG
- 694-698 MHz
- 821-823 MHz

# Graphics on the cultural environment - 470 to 694 MHz

Number of Links detected and coordinated - 470 to 694 MHz



Available Spectrum - 470 to 694 MHz

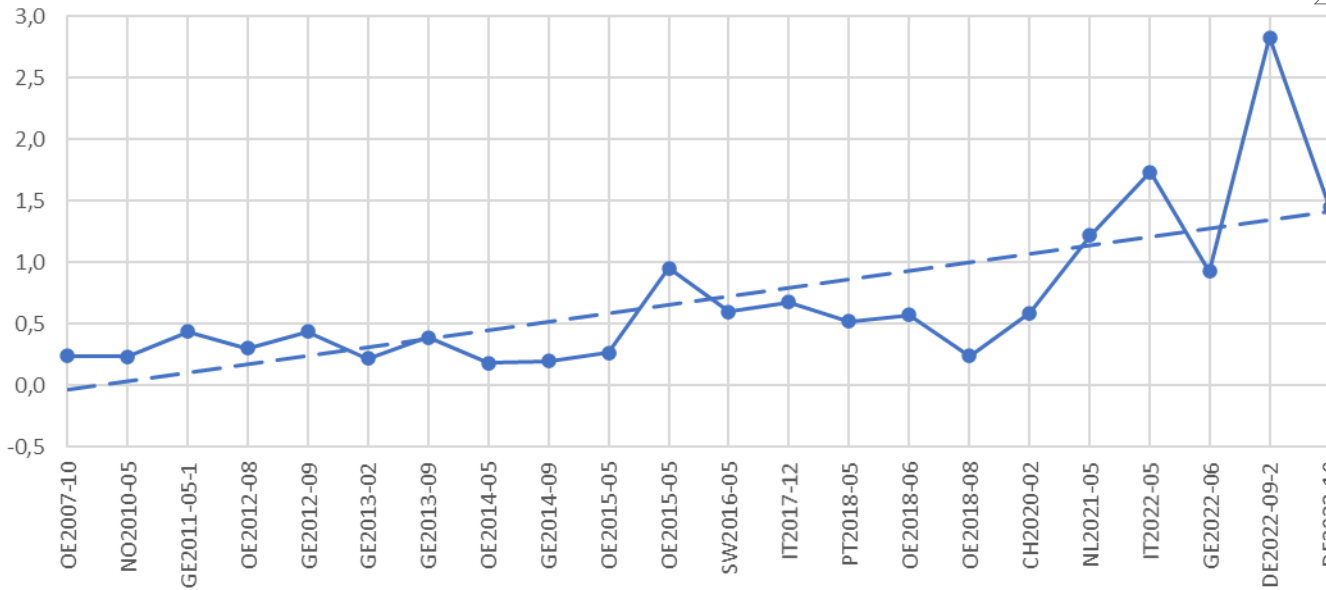


## Change in DE

- 700 MHz DG
- 694-698 MHz
- 821-823 MHz

# Trend estimate for the cultural environment

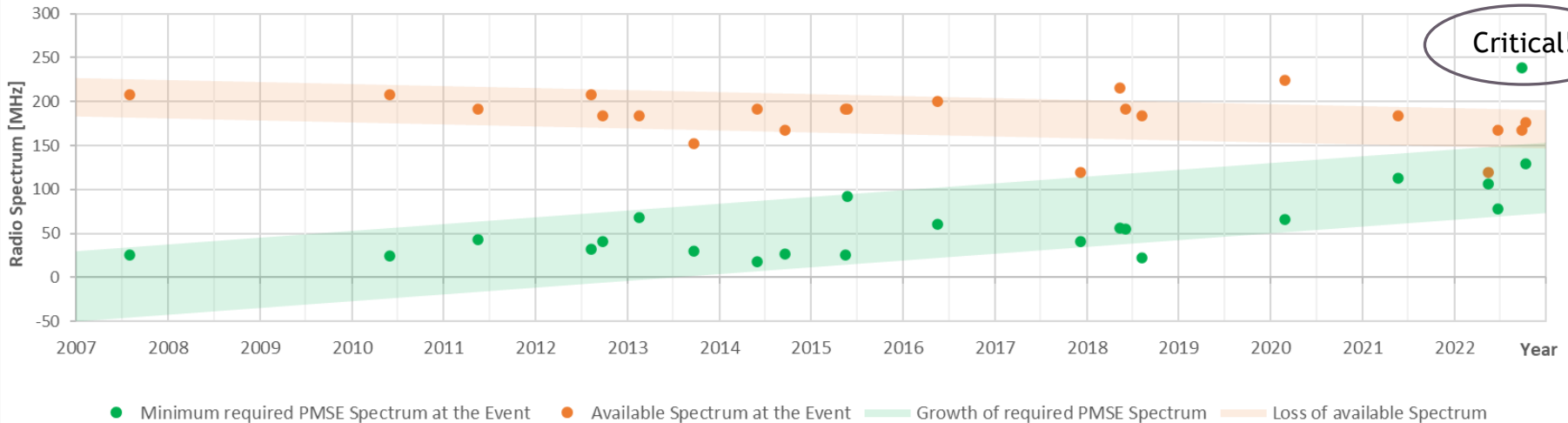
Link Density - 470 to 694 MHz [Links/MHz]



Note:

The link density presented does not take into account required guard bands, e.g. for Microphones, IEM, Audio Links, Effect Control or Team Communication Equipment.

Trend of minimum required and available Spectrum for Audio PMSE in 470-694 MHz

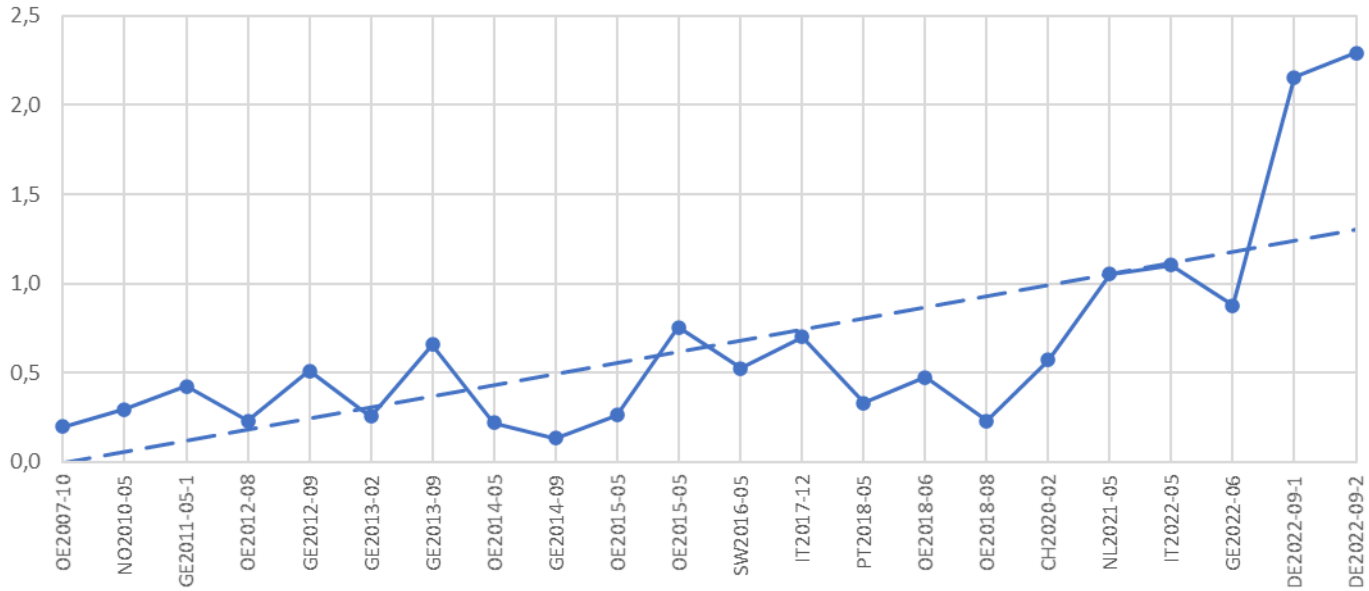


Critical!



# Trend estimate for the cultural

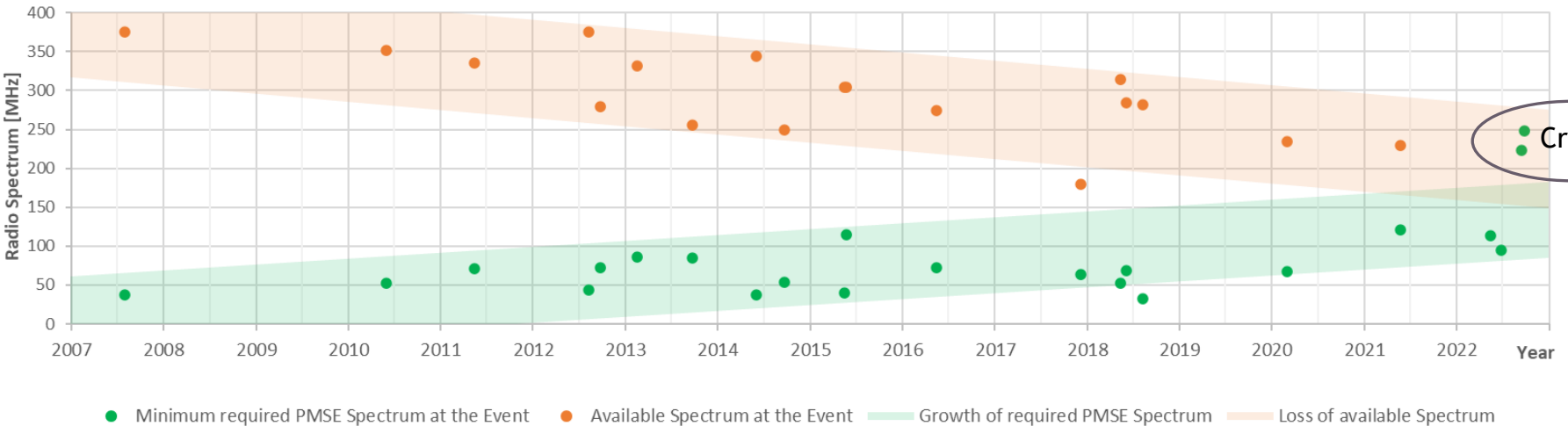
Link Density - 470 to 862 MHz [Links/MHz]



Note:

The link density presented does not take into account required guard bands, e.g. for Microphones, IEM, Audio Links, Effect Control or Team Communication Equipment.

Trend of minimum required and available Spectrum for Audio PMSE in 470-862 MHz



Critical!

# **Productions in the political environment**

# List of productions in the policy environment

## - Part 1 -

1. Landtag Election Lower Saxony 2008 GE2008-01
2. Hamburg City Parliament Election 2008 GE2008-02
3. Bavarian State Election 2008 GE2008-09
4. Hamburg City Parliament Election 2011 GE2011-02
5. Landtag Election Saxony-Anhalt 2011 GE2011-031
6. State Election Baden-Württemberg 2011 GE2011-032
7. State Election Rhineland-Palatinate 2011 GE2011-033
8. Bremen Parliamentary Election 2011 GE2011-05
9. State Election Mecklenburg-Western Pomerania 2011 GE2011-091
10. Election to the Berlin House of Representatives 2011 GE2011-092
11. Election to the Schleswig-Holstein Parliament 2012 GE2012-051
12. Landtag Election North Rhine-Westphalia 2012 GE2012-052
13. State Election Lower Saxony 2013 GE2013-01
14. Bavarian State Election 2013 GE2013-09
15. National Council Election Austria, Vienna 2013 AE2013-09
16. Hamburg City Parliament Election 2015 GE2015-02

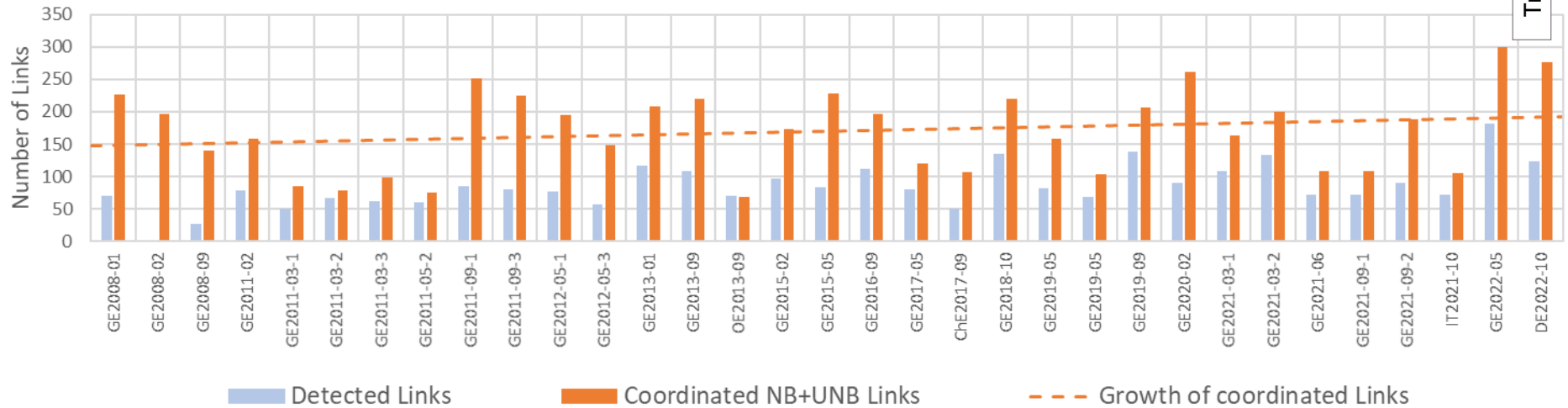
# List of productions in the policy environment

## - Part 2 -

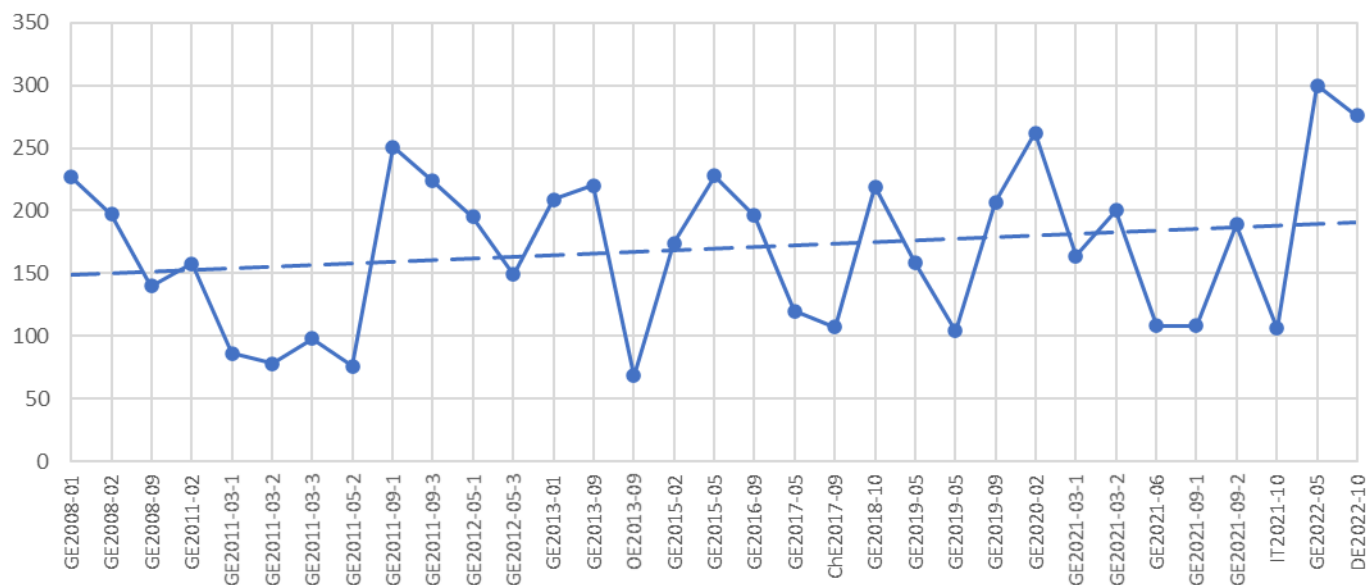
17. Bremen Parliamentary Election 2015 GE2015-05
18. State Election Mecklenburg-Western Pomerania 2016 GE2016-09
19. State Election North Rhine-Westphalia 2017 GE2017-05
20. Swiss Federal Council elections, Bern (CH) 2017 ChE2017-09
21. Bavarian State Election 2018 GE2018-10
22. Bremen Parliamentary Election 2019 GE2019-05
23. Local Election Brandenburg 2019 GE2019-05
24. Landtag Election Saxony 2019 GE2019-09
25. Hamburg Parliamentary Election 2020 GE2020-02
26. State Parliament Election Baden-Württemberg 2021 GE2021-03-1
27. State Election Rhineland-Palatinate 2021 GE2021-03-2
28. State Election Saxony-Anhalt 2021 GE2021-06
29. Election to the Berlin House of Representatives 2021 GE2021-09-1
30. State Election Mecklenburg-Western Pomerania 2021 GE2021-09-2
31. International Forum G20, October 2021, ROMA IT2021-10
32. Landtag election Schleswig Holstein, Kiel 2022 GE2022-05
33. State Parliament Election Lower Saxony, Hanover 2022 DE2022-10

# Policy Environment Graphics - 470-694 MHz

## Number of Links detected and coordinated - 470 to 694 MHz



## Links in 470 to 694 MHz



# **Productions in the sports environment**

# List of productions in the sports environment

## - Part 1 -

1. Road Cycling World Championship, Stuttgart 2007 GE2007-09
2. Allianz Arena Munich, Sport, September 2011 GE2011-09-1
3. Weserstadion Bremen, Sport, September 2011 GE2011-09-2
4. DFB Cup Final Berlin, May 2012 GE2012-05
5. Bundesliga match Dortmund vs Schalke, March 2014 GE2014-03
6. DFB Cup Final, Berlin, May 2014 GE2014-05
7. DFB Cup Final, Berlin, May 2015 GE2015-05
8. UEFA Cup Final, Berlin June 2015 GE2015-06
9. World Class Zurich, September 2015 CH2015-09
10. FIFA Ballon d'Or, Zurich 2016 CH2016-01
11. UEFA Europa League Final, Basel 2016 CH2016-06
12. World Ski Championships 2017, St. Moritz, CH2017-02
13. Swiss Cup Final, Geneva 2017 CH2017-05
14. Formula 1, Monza, Italy, September 2017 IT2017-09-1
15. MISANO MOTO GP 2017 IT2017-09-2
16. World Class Zurich 2017 CH2017-08
17. World Cup Qualification Italy-Sweden, San Siro 2017 IT2017-11
18. Soccer Match Itaquera, Sao Paulo, Brazil, April 2018 BR2018-04
19. Formula 1, Monza, Italy, August 2018 IT2018-08
20. World Class Zurich 2018 CH2018-08

# List of productions in the sports environment

## - Part 2 -

- 21.MISANO, Italy, MOTO GP 2018 IT2018-09
- 22.Formula 1, 2018, Sao Paulo, Brazil BR2018-11
- 23.Ski World Cup 2019, Adelboden (CH) CH2019-01-1
- 24.Ski World Cup Wengen 2019 (CH) CH2019-01-2
- 25.Uefa Champions League 2019, Final, Madrid, Spain ES2019-06
- 26.MotoGP 2019, Misano, Italy IT2019-09
- 27.World Class Zurich 2019 CH2019-08
- 28.Ski World Cup St. Moritz 2019 (CH) CH2019-12
- 29.Ski World Cup Adelboden 2020 (CH) CH2020-01-1
- 30.90th International Lauberhorn Race, Wengen (CH) CH2020-01-2
- 31.Uefa Nations League League A, CH vs GER, Basel CH2020-09
- 32.FIS Alpine Ski World Cortina, Italy IT2021-02
- 33.Euro 2020, Rome, TUR vs Italy, Rome (I) IT2021-06
- 34.Euro 2020, Copenhagen, DEN vs FIN DK2021-06
- 35.Euro 2020, Spain vs Sweden, Sevilla (ES) ES2021-06-1
- 36.Euro 2020, Spain vs Poland, Sevilla (ES) ES2021-06-2
- 37.Euro 2020, Spain vs Slovakia, Sevilla (ES) ES2021-06-3
- 38.Euro 2020, Portugal vs Belgium, Sevilla (ES) ES2021-06-4
- 39.Euro 2020, Bucharest, France vs Switzerland RO2021-06



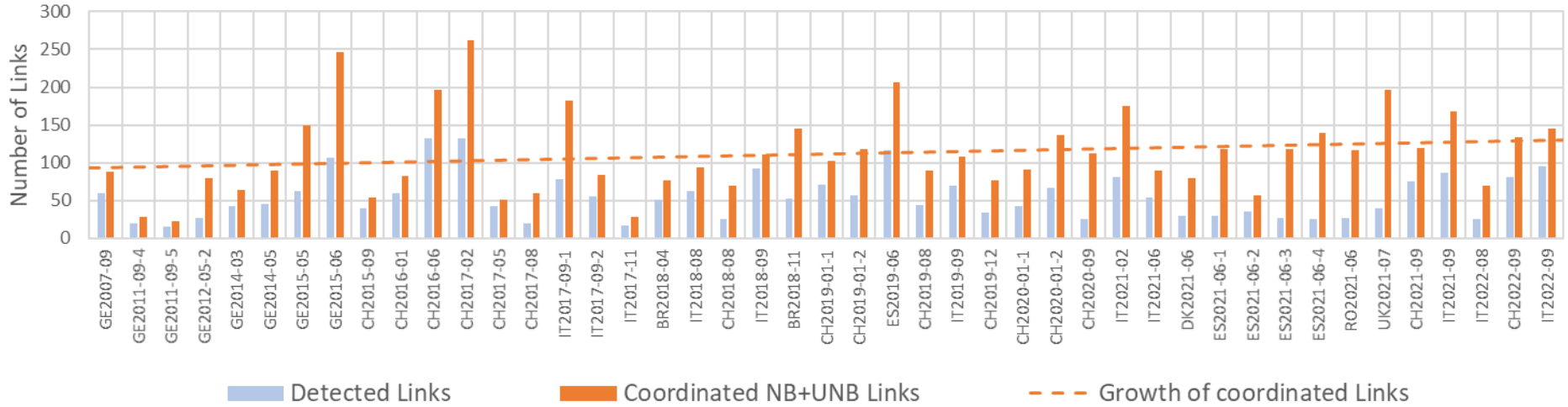
# List of productions in the sports environment

## - Part 3 -

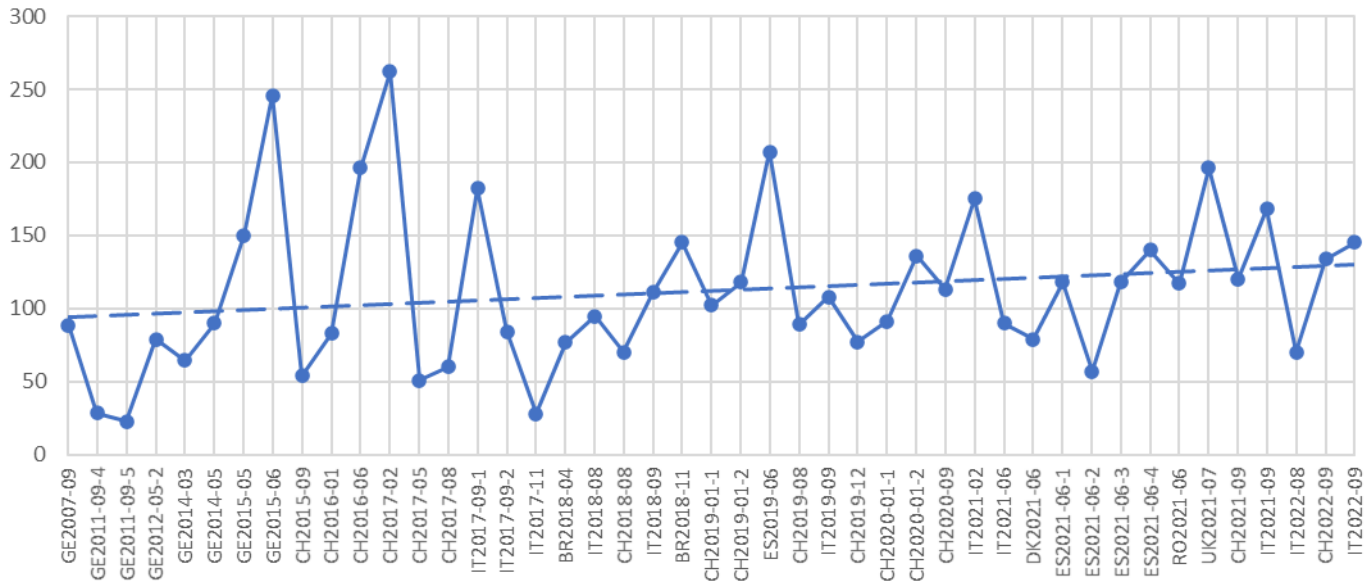
- 40. Euro 2020 final, England vs. Italy, London UK2021-07
- 41. World Class Zurich 2021 CH2021-09
- 42. MotoGP 2021, San Marino, Italy IT2021-09
- 43. European Aquatics Championships Rome IT2022-08
- 44. World Class Zurich 2022 CH2022-09
- 45. MISANO MotoGP 2022 IT2022-09

# Sports Environment Graphics - 470-694 MHz

## Number of Links detected and coordinated - 470 to 694 MHz

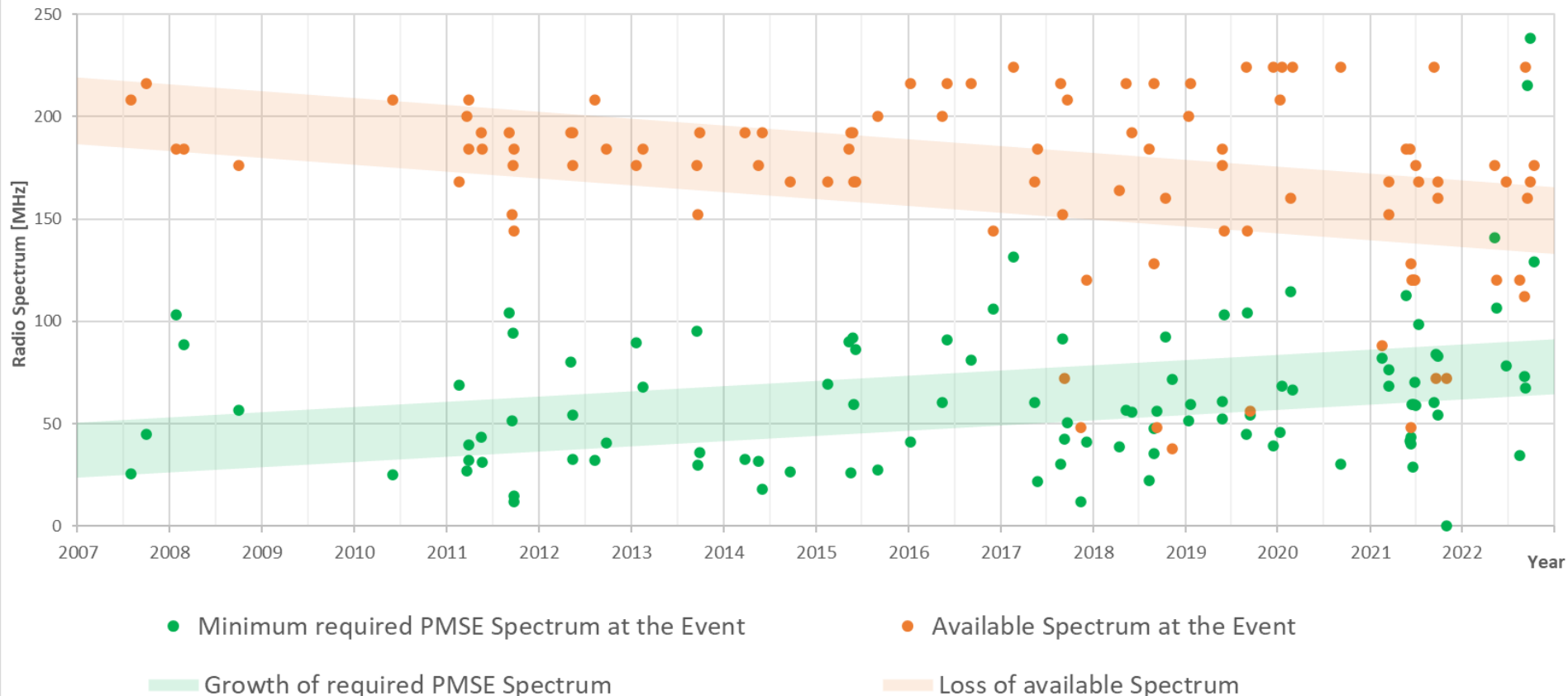


## Links in 470 to 694 MHz



# 102 Productions in brief

Trend of minimum required and available Spectrum for Audio PMSE in 470-694 MHz



Over 17 years, data from more than 100 events were collected and analysed. The trend shows the increasing demand for PMSE radio frequency spectrum with locally reduced available radio frequency resources.

# \* Further information

This presentation is published below.

Further information, including scan evaluations, is published on this technical WEB page:

PMSE Occupation Recorder - <https://pmocre.info/en>

An SRF tool for frequency coordination can be found here:  
FreqCoord - <https://www.freqcoord.com>

In addition, wireless tool manufacturers provide powerful tools for PMSE frequency utilisation.

Close cooperation with the frequency coordinator ensures your success in event production.

# \* Thank you very much!

The many years of work on frequency monitoring was/is only possible through the intensive support of

- Users, Manufacturers
- Event organisations and frequency coordinators
- Scientific institutions
- Committees/Working Groups/Interest Groups
- Relevant authorities

**From my side a very special thank you!**

With your valuable support, this work can continue - within the limits of the resources that can be made available together.

# \* Contact information

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