# Affordable Spectrum for a thriving 5G era

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# Introduction


## Luciana Camargos

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# The impact of affordable spectrum

**Pau Castells**

**Head of Economic Studies, GSMAi**

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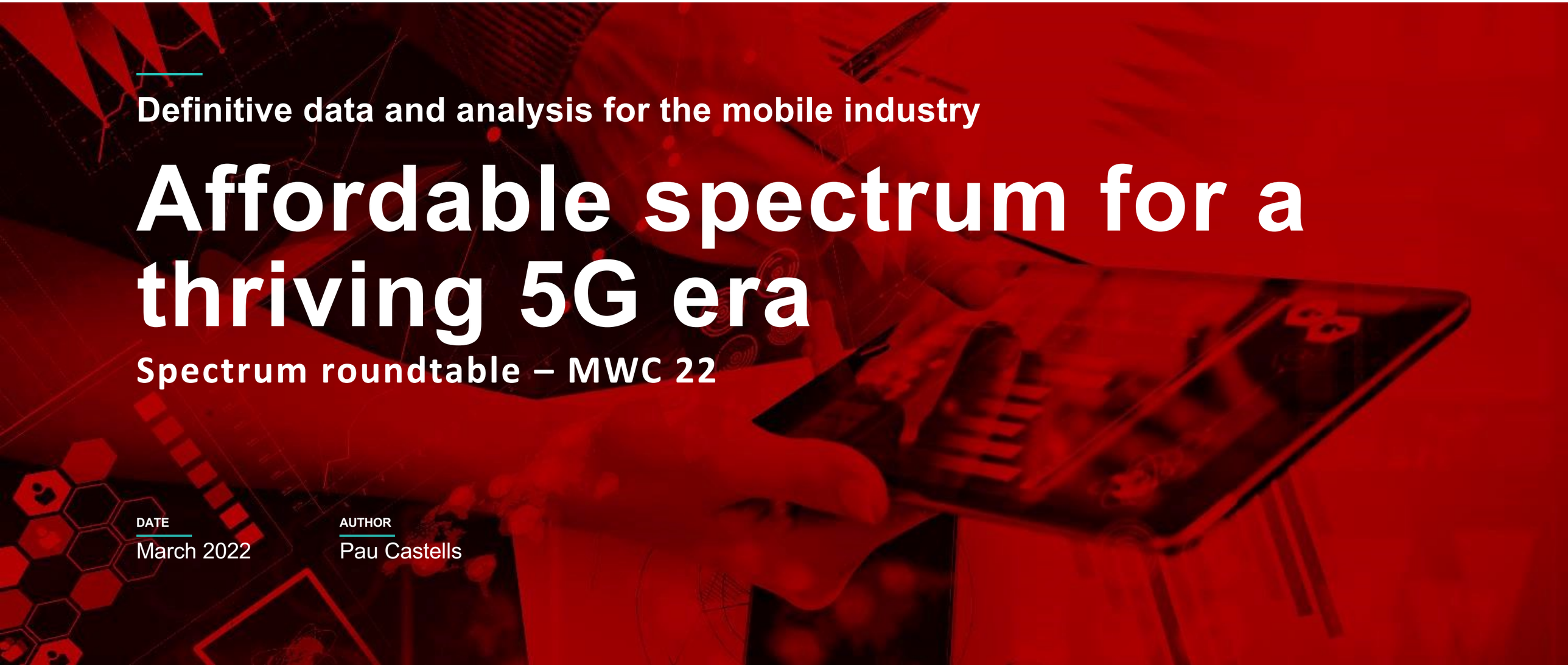


Definitive data and analysis for the mobile industry

# Affordable spectrum for a thriving 5G era

## Spectrum roundtable – MWC 22

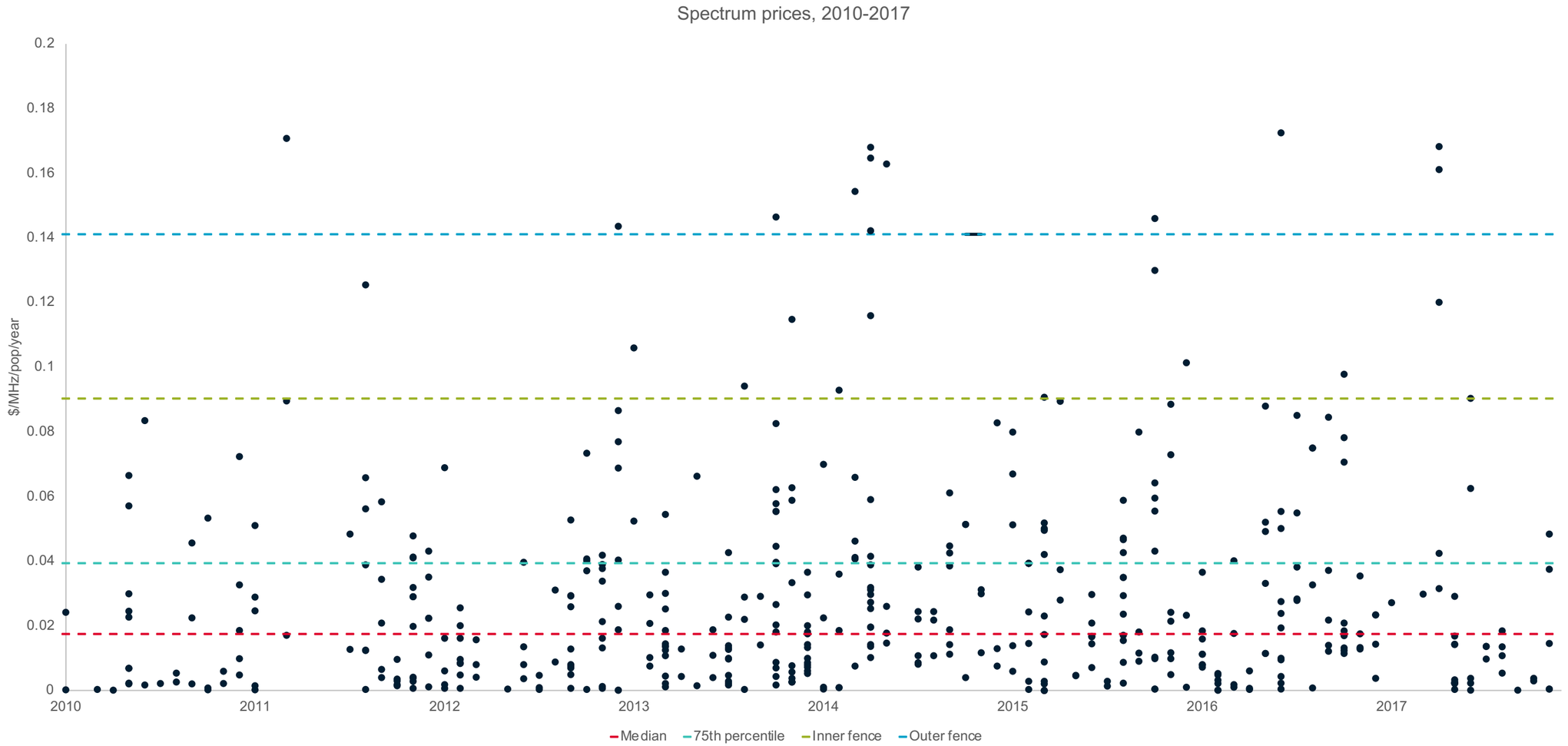

DATE
March 2022

AUTHOR
Pau Castells

# The impact of spectrum assignment policies on mobile consumers


- In 2019, GSMA carried out a study to assess the impact of spectrum pricing on mobile markets and consumers
- Academic version of the report published in Telecommunications Policy in 2021. With a wider scope – not just prices but also assignments and other policy aspects.
- We analysed 229 operators in 64 countries (34 high income and 30 middle and low income) between 2010-2017.
  - Most comprehensive study to date on the impact of spectrum assignment policy on consumers.
  - Econometric model that assesses the impact of spectrum cost on coverage, network quality and final prices for users.
  - Robust statistical methods that isolate the effect and its direction from other factors.

# Significant variation in spectrum prices




*Source: GSMA Intelligence. Spectrum prices ($/MHz/pop/year) have been adjusted by inflation, PPP (2016 prices) and licence duration, and aggregated by country, band, generation and assignment. The IQR is defined as the observations between the 1st and 3rd quartile. Outliers are classified as being above an "inner fence", i.e. above 3rd quartile + 1.5*IQR. Extreme outliers are classified as being above an "outer fence", i.e. above 3rd quartile + 3*IQR.*

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# What drives higher spectrum prices?

Demand and willingness to pay (market factors)

**But also spectrum policy…**

- Very high (reserve) prices and/or fees
- Limited supply of spectrum
- Not publishing a spectrum roadmap
- Award rules (such as auction formats)

**SINGLE SELLER OF SPECTRUM (GOVERNMENT) HAS MARKET POWER**

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# The evidence before our study…

| Paper | Finding | Scope |
|---|---|---|
| Cambini and Garelli (2017) | Spectrum availability and spectrum fees are not significantly correlated with mobile industry revenues. | 24 countries (mostly developed), 2005-2014 |
| GSMA (2017, 2018) | Link between high spectrum prices and negative outcomes for consumers (higher prices and lower network coverage and quality). | *Global* - 60 countries, 2000-2016; *Europe* - 30 countries, 2007-2016; *Latin America* - 15 countries, 2010-2017; *Developing* - 102 countries, 2010-2017 |
| Kuroda and Baquero (2017) | Spectrum auctions reduce 3G diffusion rates (take-up is 2-9% lower). When used to raise public revenues, auctions sacrifice consumer surplus. | 47 OECD countries, 2000-2008 |
| Madden et al (2014) | Probability of new entry in a market is enhanced by using auction assignments and excess licenses. | 49 assignments, 1999-2008 |
| Zaber et al (2012) | Spectrum management policies have a significant impact on 3G take-up | 126 countries, 2000-2009 |
| Park et al (2011) | No effect of auction or spectrum fees on prices, competition (HHI) or investment. | 21 OECD countries, cross-section |
| Hazlett, Munoz (2009) | The amount of spectrum and degree of market competitiveness are key drivers of retail market outcomes. Auction rules that focus on revenue extraction may conflict with the goal of maximizing social welfare. | 28 countries, 1999-2003 |
| Gruber (2007) | 3G diffusion primarily impacted by market structure and not spectrum assignment method (auctions are not superior to other methods) | 17 European countries, cross-section |
| Bauer (2003) | No relationship between spectrum fees and price of voice | 18 countries, cross-section |

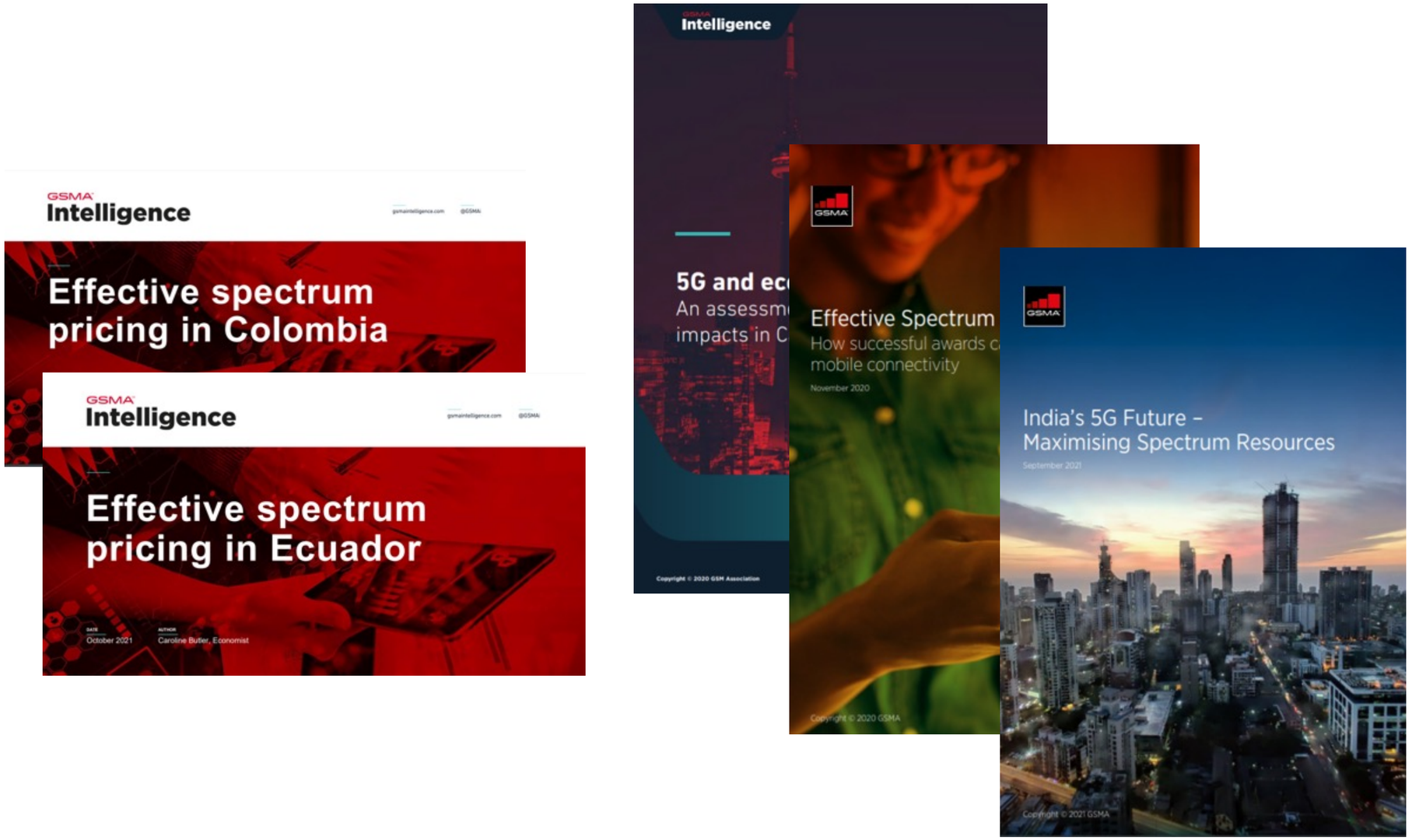
# Impact of the amount and timings of spectrum assignments

| | All countries |
|---|---|
|  Network Coverage | • **More licensed spectrum drives higher coverage**<br>• Additional 20 MHz increases 4G coverage by 2-4 percentage points<br><br>• **Early spectrum release drives higher coverage**<br>• Assigning spectrum at least two years earlier increases 4G coverage by 11-16pp and 3G coverage by 20pp (all else equal) |
|  Network Quality | • **More licensed spectrum drives higher network quality**<br>• Additional 20 MHz of 4G spectrum increases average download speeds by 1-2.5 Mbps |

# Impact of higher spectrum prices

| | Developing Countries | Developed Countries |
|---|---|---|
| Network Coverage | **Slower deployment of 4G and 3G networks** | **Slower deployment of 4G networks** |
| Network Quality | **Poorer network quality (overall and for 3G)** | **Slower 4G download speeds** |
| Consumer Prices | Some evidence of higher prices but not conclusive | Inconclusive – better data needed |

# What does this mean for specific markets?




- A range of reports analyse how alternative spectrum assignment practices would impact the development of the mobile market in several constituencies

# Recap (I) – What have we learned from empirical research

- Spectrum prices are not just driven by demand and market factors
- Short-term public finance considerations are driving some Governments to prioritise revenue maximisation
- This has repercussions for consumers and businesses

Poorer coverage

More expensive services

Slower speeds

# Recap (II) – What to do when planning spectrum awards?

**We are NOT saying…**

- Auctions are a bad award mechanism ☒
- “High” spectrum prices are always bad ☒
- Raising state revenues through auctions is bad ☒

**We ARE saying…**

- Policies that distort spectrum assignments can harm consumers ☑
- The right spectrum price is never more than the true market value ☑
- Spectrum prices in line with market dynamics are essential for a healthy 5G future ☑

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# Conclusions

| | |
|---|---|
| 1 | High spectrum prices slowed the roll-out of next-generation networks in developed and developing markets in 2010-17 |
| 2 | More expensive spectrum reduced network quality in both developed and developing markets |
| 3 | Higher spectrum prices are associated with higher consumer prices in developing countries, but further research is needed |
| 4 | Early release of spectrum and sufficient amounts of licenced spectrum are important drivers of consumer welfare |

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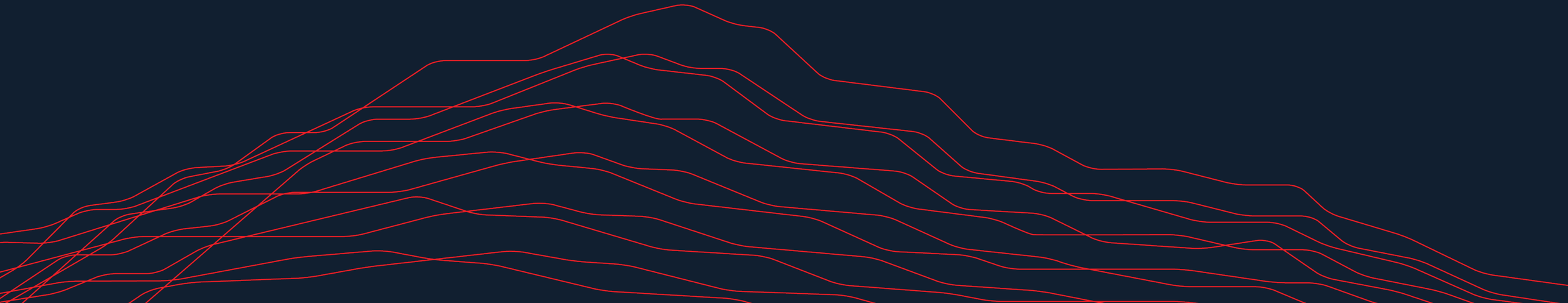

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# Approaches for a 5G success


**Verena Weber**

**Head of the Communication Infrastructures and Services Policy Unit**
**OECD**

# TRENDS IN SPECTRUM ASSIGNMENT IN OECD COUNTRIES

Roundtable discussion “Affordable spectrum for a thriving 5G era”, MWC22 Ministerial Programme
1 March 2022

Verena Weber
Head of Unit, Communication Infrastructures and Services Policy, OECD

OECD
BETTER POLICIES FOR BETTER LIVES

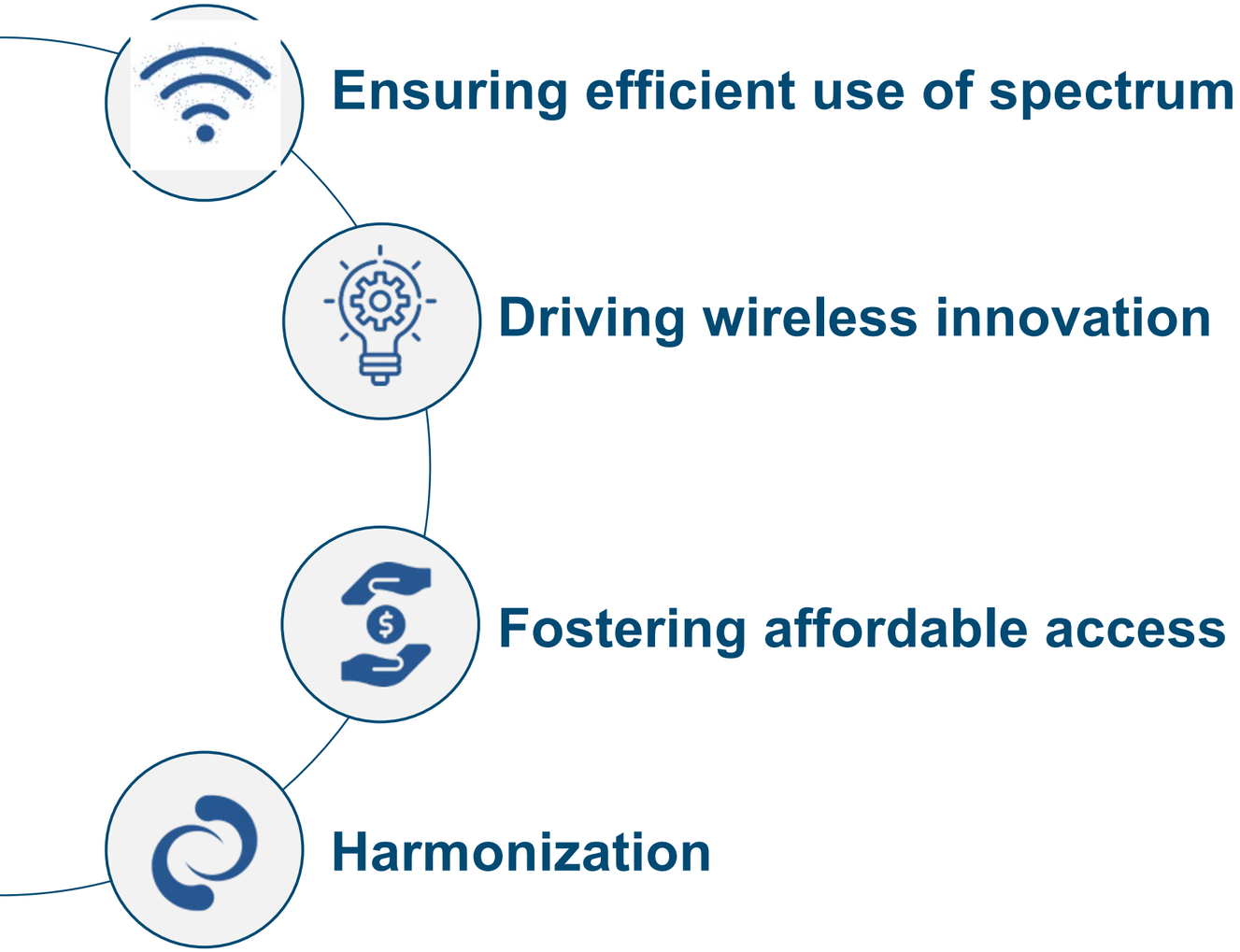
# The importance of efficient spectrum management

## Spectrum is the primary essential input for wireless communications

- Spectrum is important to meet the growing demand for mobile broadband services
- The timely availability of spectrum is crucial for 5G deployment
- Spectrum management impacts the cost of network deployment and is one of the most important tools for regulating competition in mobile markets

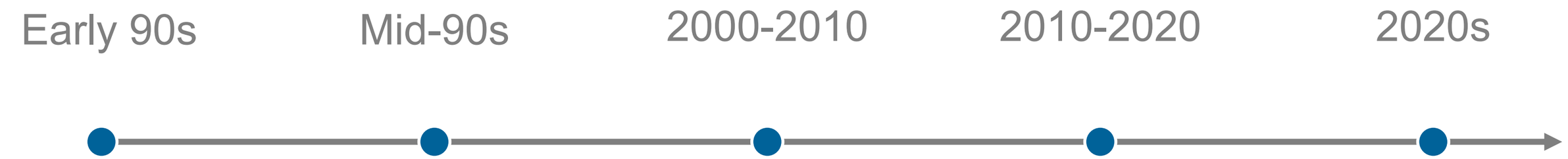
**All sectors of the economy**, from education to health care, Industry 4.0, or SME productivity, **could benefit from more widely available access to spectrum**, including for the provision of affordable and high quality broadband services

# Policy vision guiding spectrum management




- The overall goal of increasing **economic & social welfare** can be broken down into several policy objectives
- **Spectrum policy "visions"** may differ (historical context)
- **Policy objectives** can be achieved through:
  - **Availability** of spectrum
  - Fostering its **efficient use**

# Evolution in spectrum management: From “command and control” to flexible licensing frameworks




**“Pure command and control”**

**Market based approach to licensing introduced**

**Promotion of market-based assignments (e.g. auctions)**

**Flexible approach: shared use of spectrum**

**Balancing flexibility for innovation and investment certainty**

How to balance competing demands?

How to adapt licensing for higher bands (mmWave)?

# Regulatory options for spectrum licensing and approaches to access spectrum

## Individual license

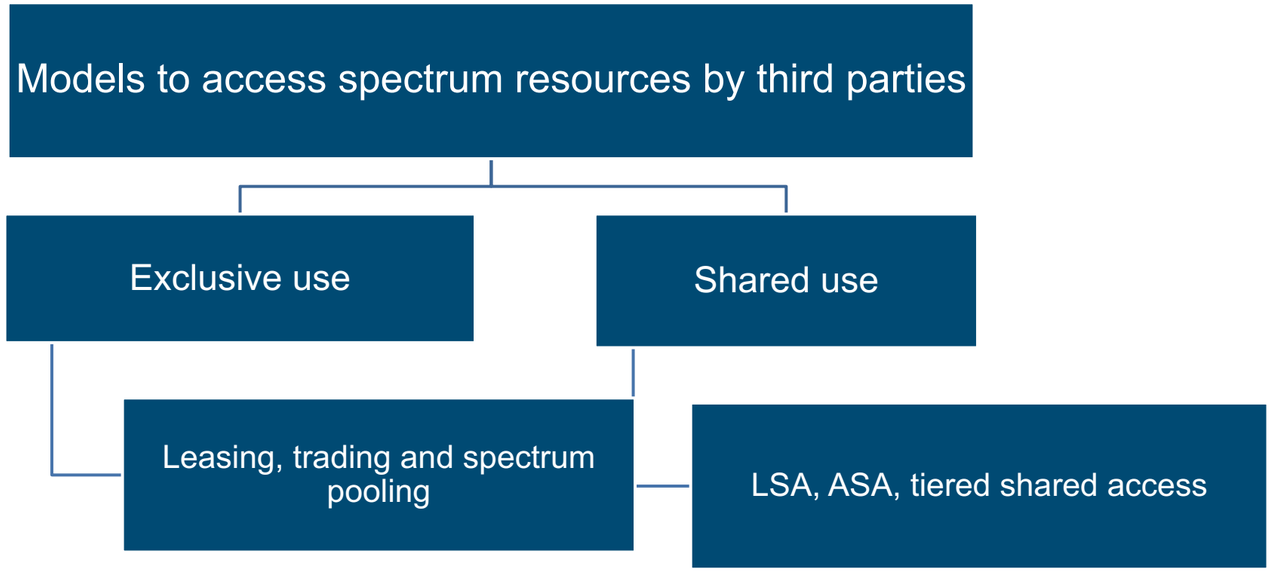
Traditional procedure for issuing licenses

## Light licensing

Simplified procedure |
Only registration and/or notification

## License exempt

No registration nor notification required




Source: OECD based on ECC Report 132, www.erodocdb.dk/docs/doc98/official/Pdf/ECCRep132.pdf and GSMA (2022), Spectrum-Leasing-5G-Era.pdf (gsma.com).

# Auction theory: Why do we use auctions to assign (IMT) spectrum?

**Spectrum auctions have been effectively used in OECD countries for more than two decades to assign licensed spectrum**

Transparent and explainable outcomes

Market discovery tool: Industry players better placed to assess market value of spectrum

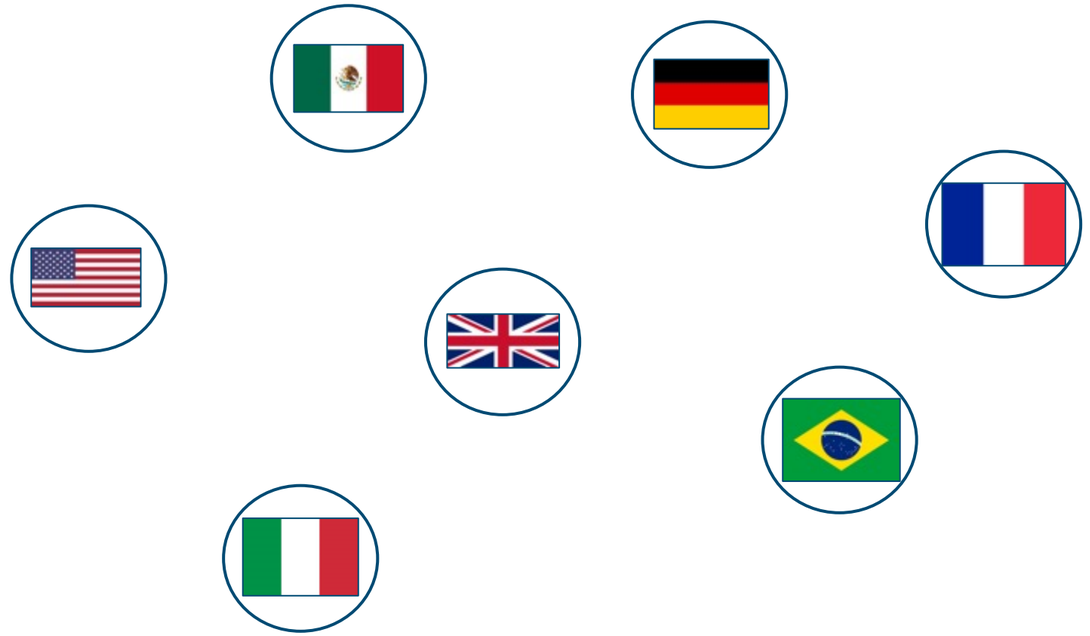
Alternative mechanisms to assign spectrum (e.g. comparative selection or lotteries) often led to suboptimal outcomes in terms of the value captured by successful parties relative to policy objectives

# Spectrum (IMT) auctions in practice across the world

Spectrum **assignment (licensing) procedures &** embedded policy considerations in their design:

- **Coverage** obligations
- Spectrum **caps**
- **Reserving** blocks
- Licence **renewal** policies

Many auctions have taken place since 2016 to foster 5G deployments…



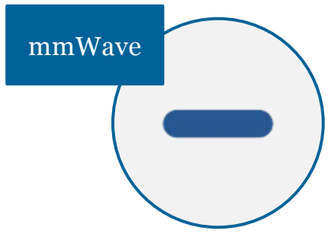
# Auctions in practice: Auction design determines outcome (spectrum pricing)

# Developments in mmWave & fostering 5G for industrial applications

**5G** commercial deployments in **33/38 OECD countries** (Jan 2022)

Most relying on mid-range and lower-bands (sub 6 GHz bands), and a few mmWave (e.g.US, AUS, JAP)


Availability of spectrum and wider channels that may increase spectral efficiency




Propagation features requires network densification ($ and energy) and potentially the use of complementary connectivity solutions

**Are current licensing frameworks fit for purpose as we go towards higher bands (e.g. mmWave)?**
**5G private networks are a rising trend. Regulators can follow diverse approaches to foster local wireless networks for industrial use cases**

# Main takeaways

- **Spectrum management vision:** increase **economic & social welfare** through **efficient** spectrum use
- **Evolution of spectrum management**: Legal certainty through well-designed licensing regimes
- **Auctions work:** Enable licenses to go to the parties that will make **the most efficient use of spectrum**
- **Auction design matters:** Design as a result of policy objectives. Determines outcome
- **Looking ahead:** Public consultations on **mmWave to explore best licensing frameworks**
- **Coming up soon: OECD** report **Trends in Spectrum Management for the Digital Transformation**

# THANK YOU

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https://www.oecd.org/digital/broadband/broadband-statistics/

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# The Brazilian Auction


## Otávio Caixeta

**Diretor do Departamento de Inovação, Regulamentação e Fiscalização, MCom Brazil**

# Brazilian 5G Auction

Designed to make spectrum affordable, foster investment and competition

# Pricing

# Greenfield Investment Model

+ Spectrum Auction: 700 MHz / 2,3GHz / 3,5 GHz / 26 GHz

+ Greenfield Assumption: Anatel built investment models for each auctioned frequency band.

+ The model supposes building new infrastructure from ground up to estimate the economic value of the spectrum to be auctioned and assign the **Net Present Value** related to each band.

+ This investment model fosters competition since it enables pricing for a new company to start exploring the market.

# National and Regional Auction Lots

# Competition

- Spectrum bands were distributed into national and regional lots.
- Due to spectrum caps, major players couldn’t compete in some national lots.
- Opportunities were created for regional fixed service players to engage in the mobile market.
- **Results**: One more national player in 700 MHz, 4 new competitors in 2,3 GHz regional services, and 2 new players in the 26 GHz.

# Investment Obligations

# Investment Obligations (I)

+ With the net present value, Anatel estimated the administrative cost of the auction (less than 10%). This administrative cost was fixed as a **minimum bid for the Auction – reserve price**.

+ The difference between the minimum bid and the net present value (around 90% of NPV) was destined to **investment obligations**.

+ **Novelty:** the auction's premium (difference between the winning bid and the reserve price) was also destined to investment obligations.

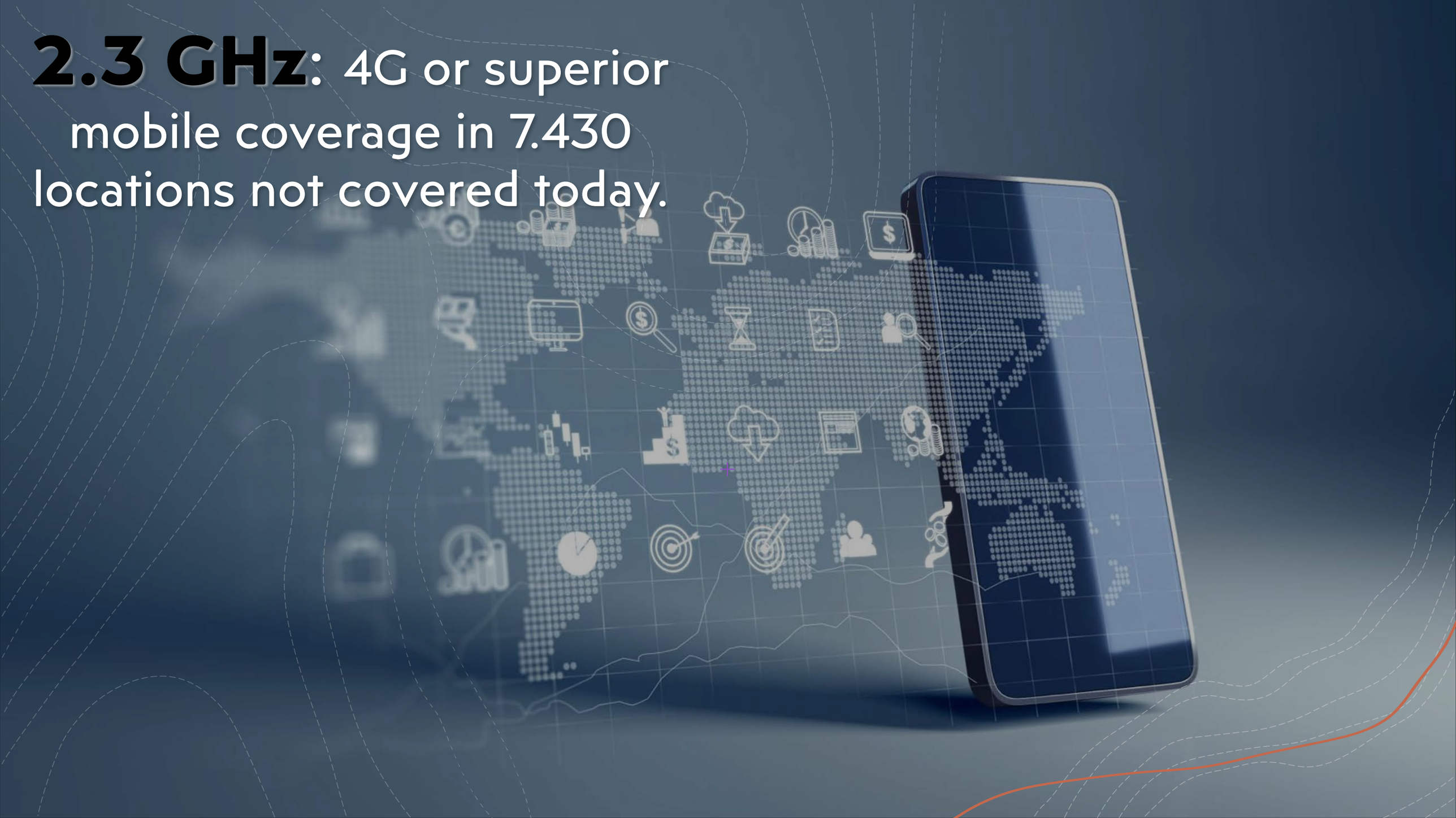
# Investment Obligations (II)

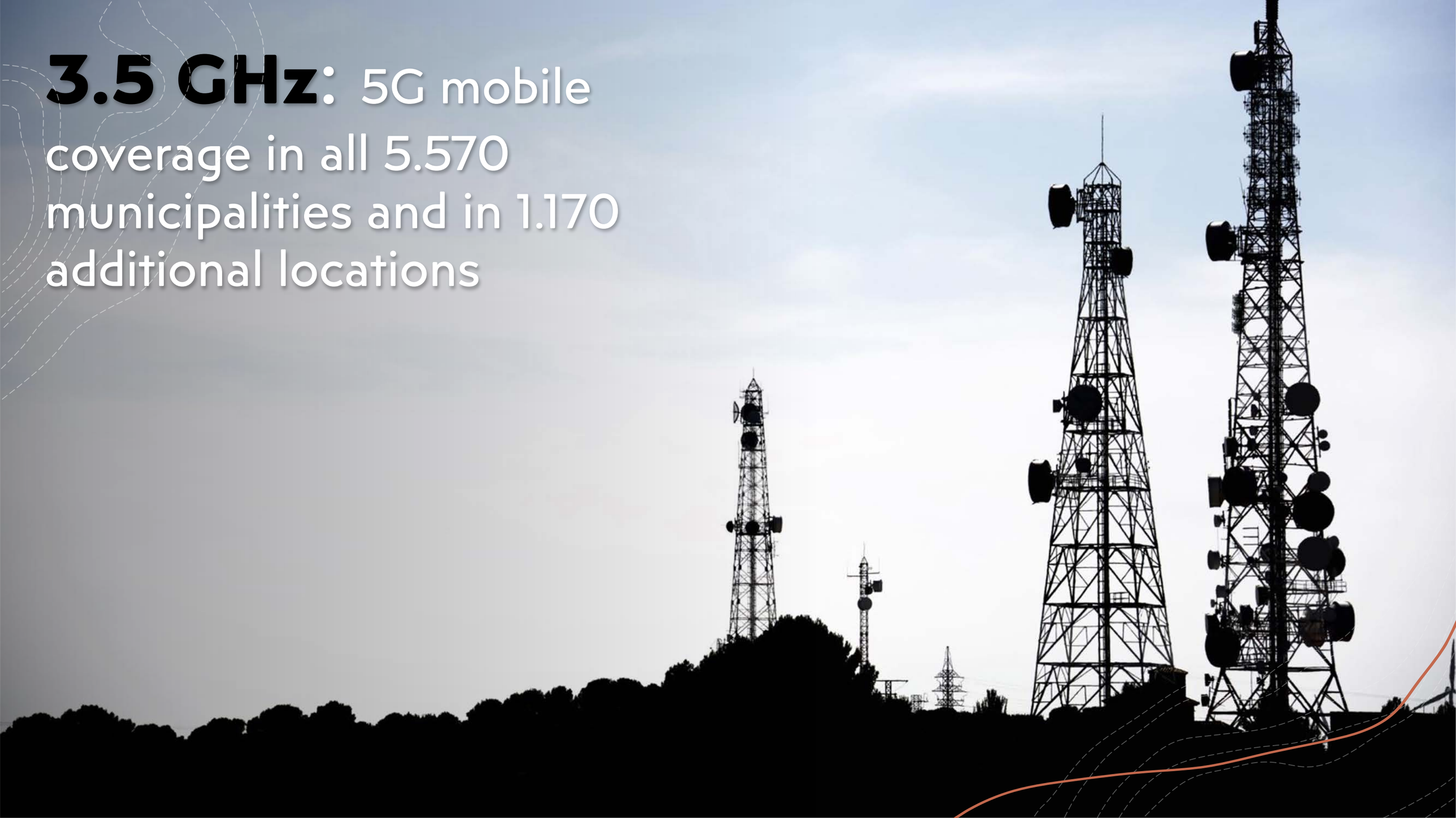
+ Following the Ministry of Communications directives, Anatel established a group of obligations for each auctioned frequency band.

+ All obligations have negative net present value.

**700 MHz:** 4G or superior mobile coverage in 35.784 km (22,235 miles) of federal roads and highways

**2.3 GHz**: 4G or superior mobile coverage in 7.430 locations not covered today.



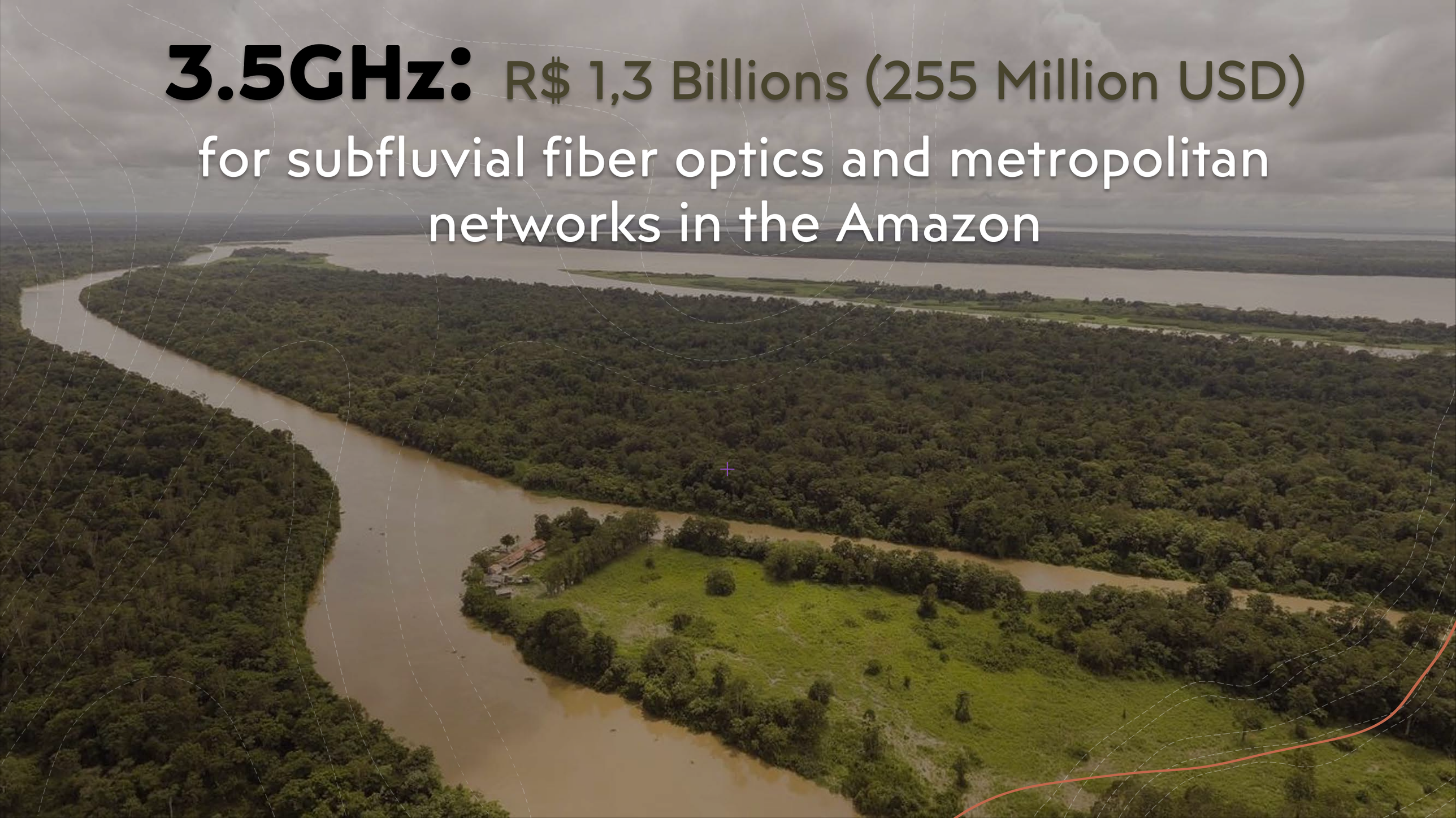


**3.5 GHz:** 5G mobile coverage in all 5.570 municipalities and in 1.170 additional locations


**3.5GHz:** Fiber optics backhaul in 530 cities not covered today

# **3.5GHz:** R$ 3 Billion (588 Million USD) for Spectrum Refarming


3.5GHz: R$ 1 Billion (196 Million USD)
for Federal Private Network


3.5GHz: R$ 1,3 Billions (255 Million USD)
for subfluvial fiber optics and metropolitan networks in the Amazon

**26GHz:** R$ 3.1 Billion (*609 Million USD*) for Public School Connectivity Projects

# Thank You

Ministry of Communications

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# The Brazilian Auction


## Vinícius Caram

**Superintendente de Outorga e Recursos à Prestação**
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# Discussion

## Moderator: Lucas Gallitto

**Head of LATAM, GSMA**