

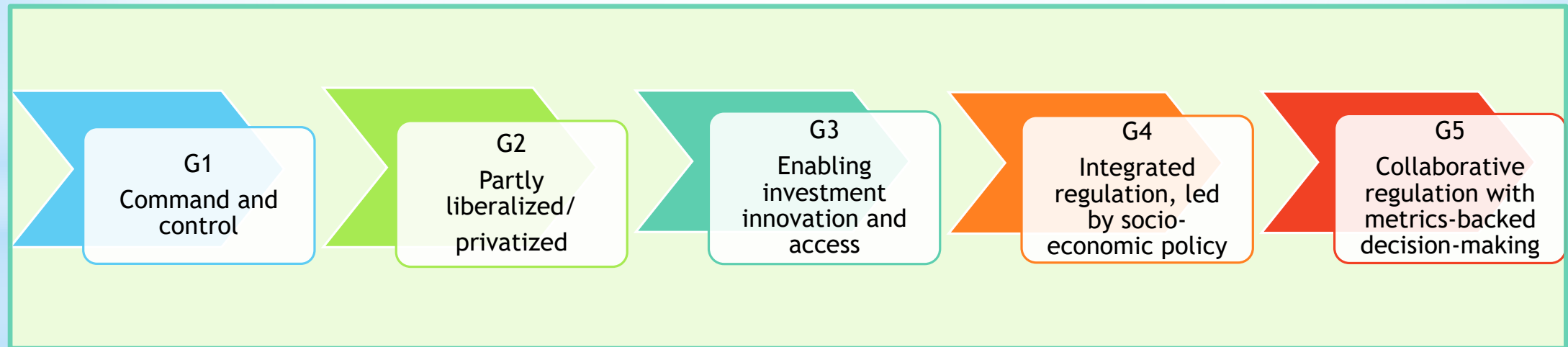
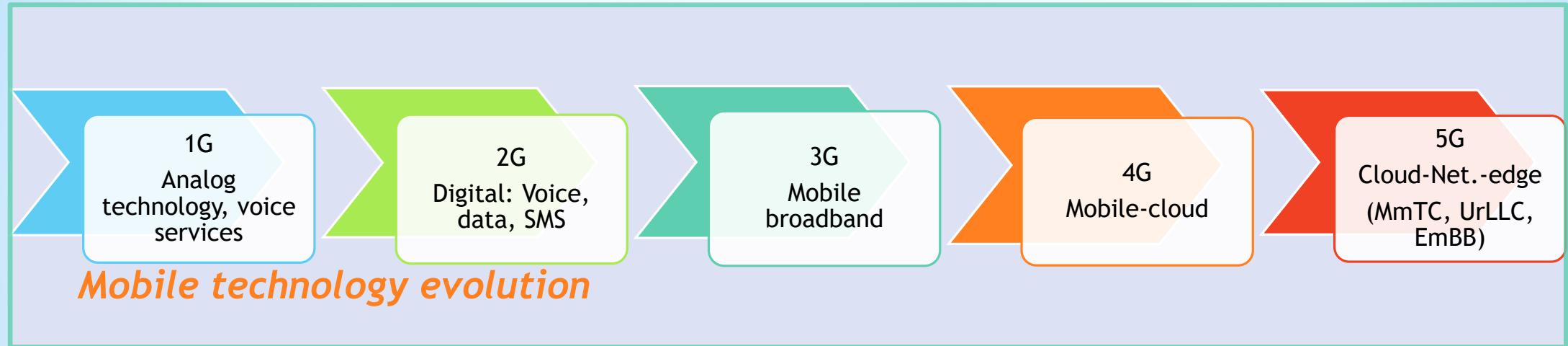
International Regulatory Conference 2023, Struga, Macedonia

5G Deployment - Current Broadband Developments

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Generations of Regulation



Principles for Regulation (Article 3, Law on Electronic Communications)

The regulation of electronic communications activities shall be based on the principles of effective management and use of scarce resources, technological neutrality, functional equivalence, proportionality, minimal necessary regulation, legal certainty in a dynamic market, economic development, ensuring effective competition, consumer rights protection, objectivity of regulatory criteria, conditions and procedures, transparency and non-discrimination.

Current Regulatory Framework

- **The Law No.04/L-109 on Electronic Communications**

Access Directive
2002/19/EC→2009/140/EC

Framework Directive
2002/21/EC→2009/140/EC

Universal Service Directive
2002/22/EC→2009/140/EC

- **The Law No.06/L-014 on Critical Infrastructure**

The Telecommunications are one of the Sectors of National Critical Infrastructure of the Republic of Kosovo.

- **The Law on Electronic Communications to be adopted by the end of 2023**

DIRECTIVE (EU) 2018/1972 (EECC)

- **The Law on Measures to reduce the cost of Deploying High-Speed Electronic Communication Networks (2021)**

Directive 2014/61/EU (Cost Reduction Directive)

Regulatory Framework- Digital Agenda for Kosovo

New Digital Agenda (2023-2030) – Build Gigabit Digital Infrastructure

- Introducing 5G networks;
- Upgrade existing fixed networks to symmetric Gigabit connectivity;
- Monitor the development of broadband network.

New Digital Agenda to be approved by 2023

TARGET DA 2030 ACHIEVEMENTS

2025

FULLY DIGITALIZED FIXED BROADBAND INFRASTRUCTURE ATLAS

2026

AVAILABLE GIGABIT CONNECTION TO ALL PUBLIC INSTITUTIONS

2030

ADVANCED NATIONAL 5G COVERAGE

AVAILABLE GIGABIT CONNECTION TO ALL HOUSEHOLDS AND BUSINESSES

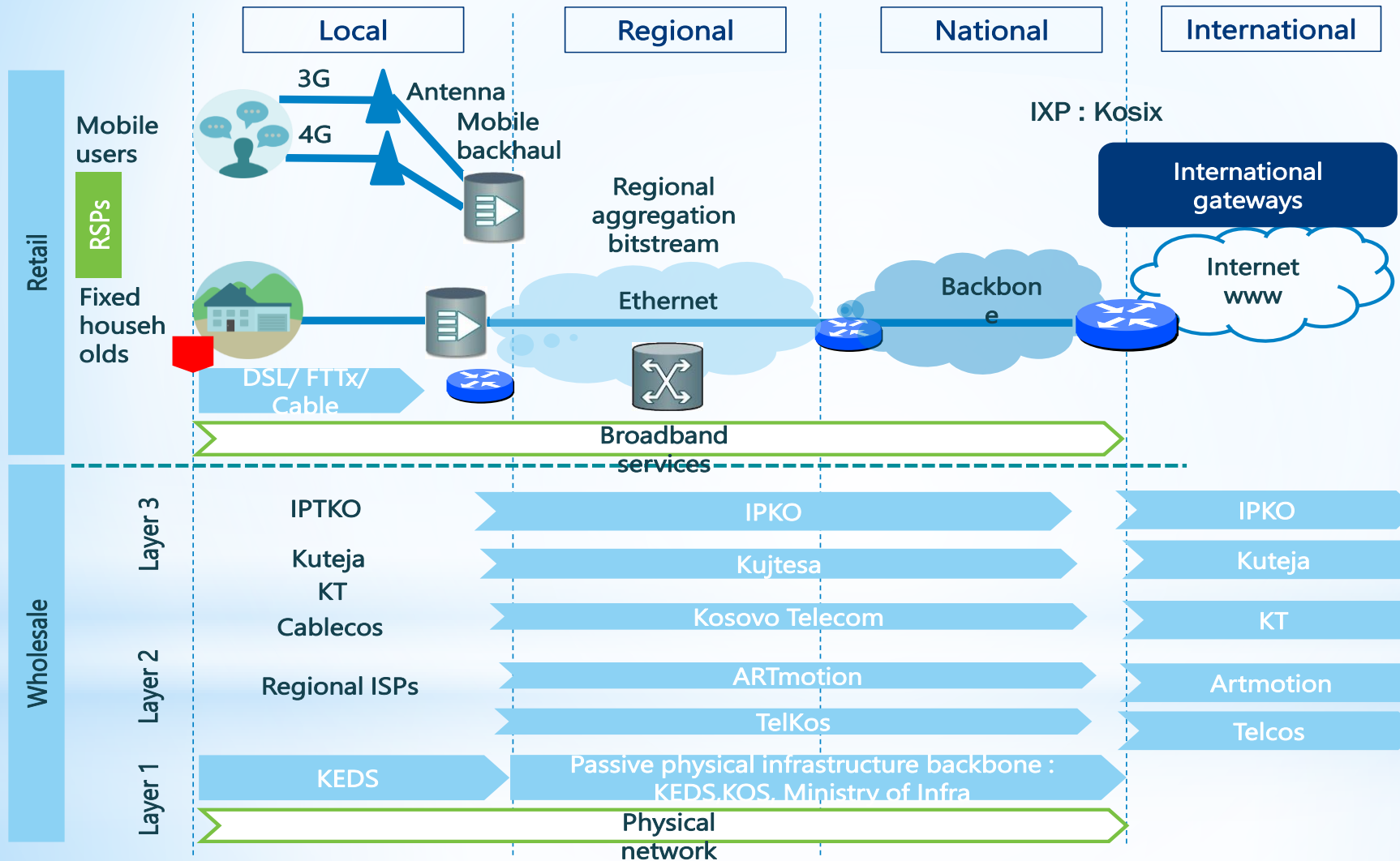
80% OF KOSOVO COMPANIES USING CLOUD / AI / BIG DATA

100% OF KOSOVO SMEs WITH BASIC LEVEL OF DIGITALISATION

100% OF KEY PUBLIC SERVICES ONLINE

100% OF MEDICAL RECORDS AVAILABLE IN DIGITAL FORM ONLINE

Broadband value chain

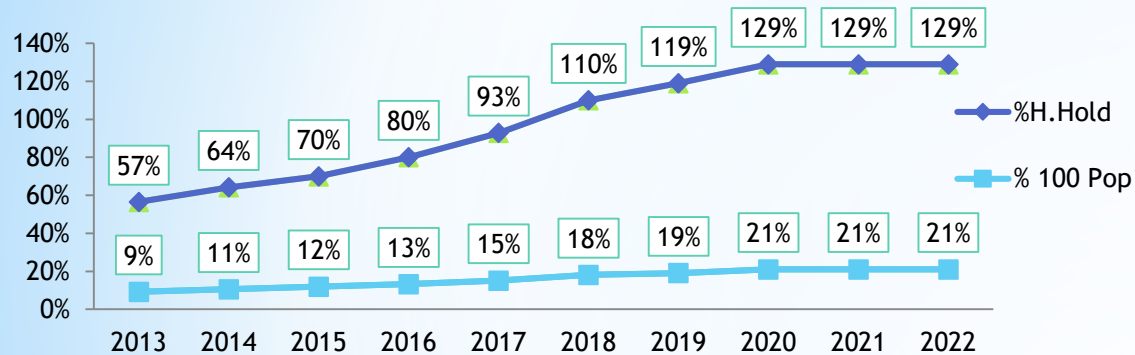


According to the **“Future of the IT Report 2023”**, published by Emerging Europe, Republic of Kosovo is:

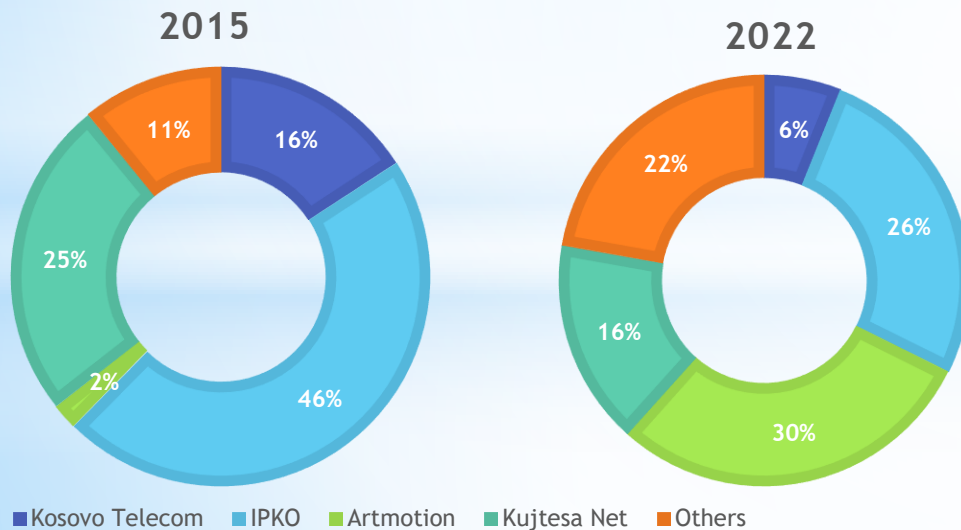
- 2nd in Europe for IT infrastructure, and
- 1st for number of ICT students per 100 pop.
- 4th in Europe in E-participation index - High level engagement in digital services.

Broadband insights - Fixed market

Fixed Internet Penetration rates [%]



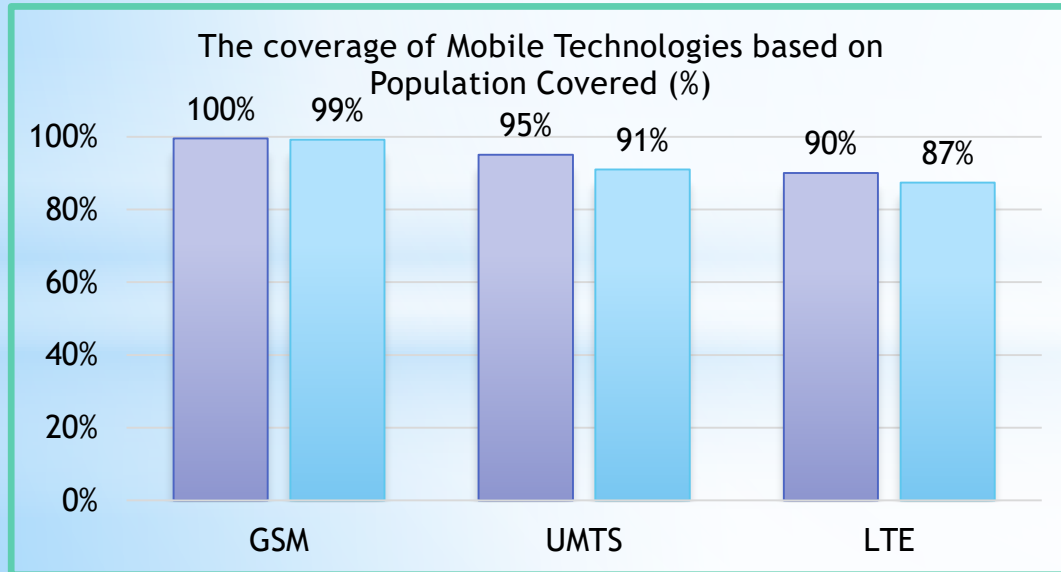
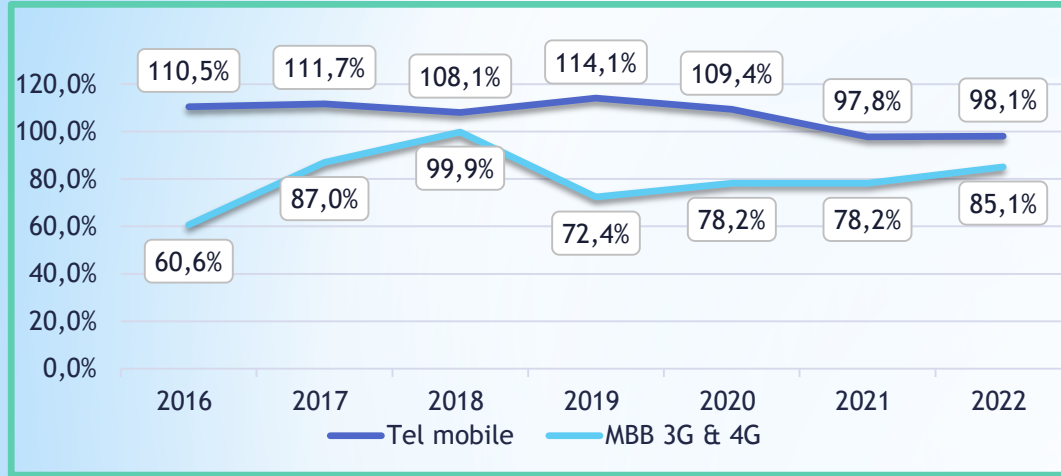
Market shares (% subscriptions)



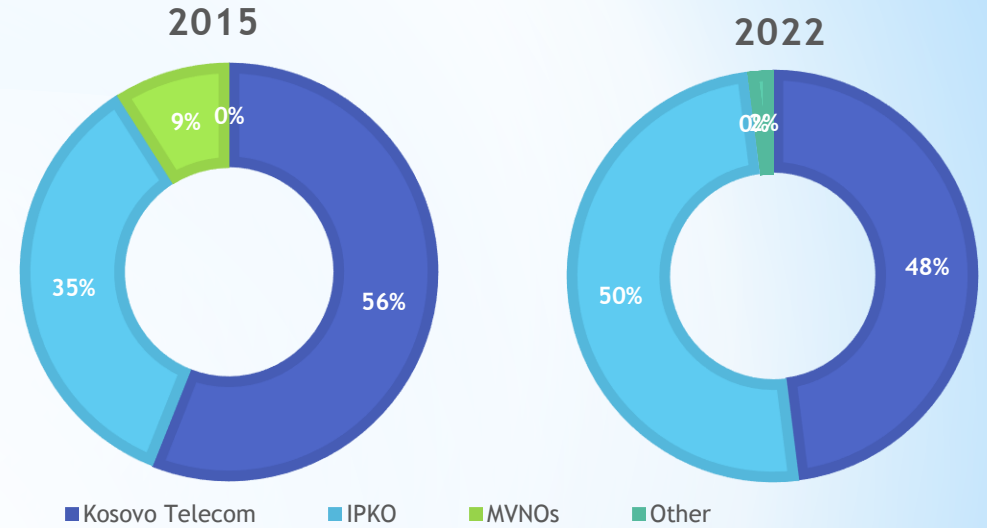
- Fixed Broadband penetration has reached **129%** per household.
- The number of ISPs active in the market may appear impressive in Kosovo-Above 50.
- Incumbent Fixed operator owns around 6% of market.

Broadband insights - Mobile Market

Mobile Broadband [%]



Market shares (% subscriptions)

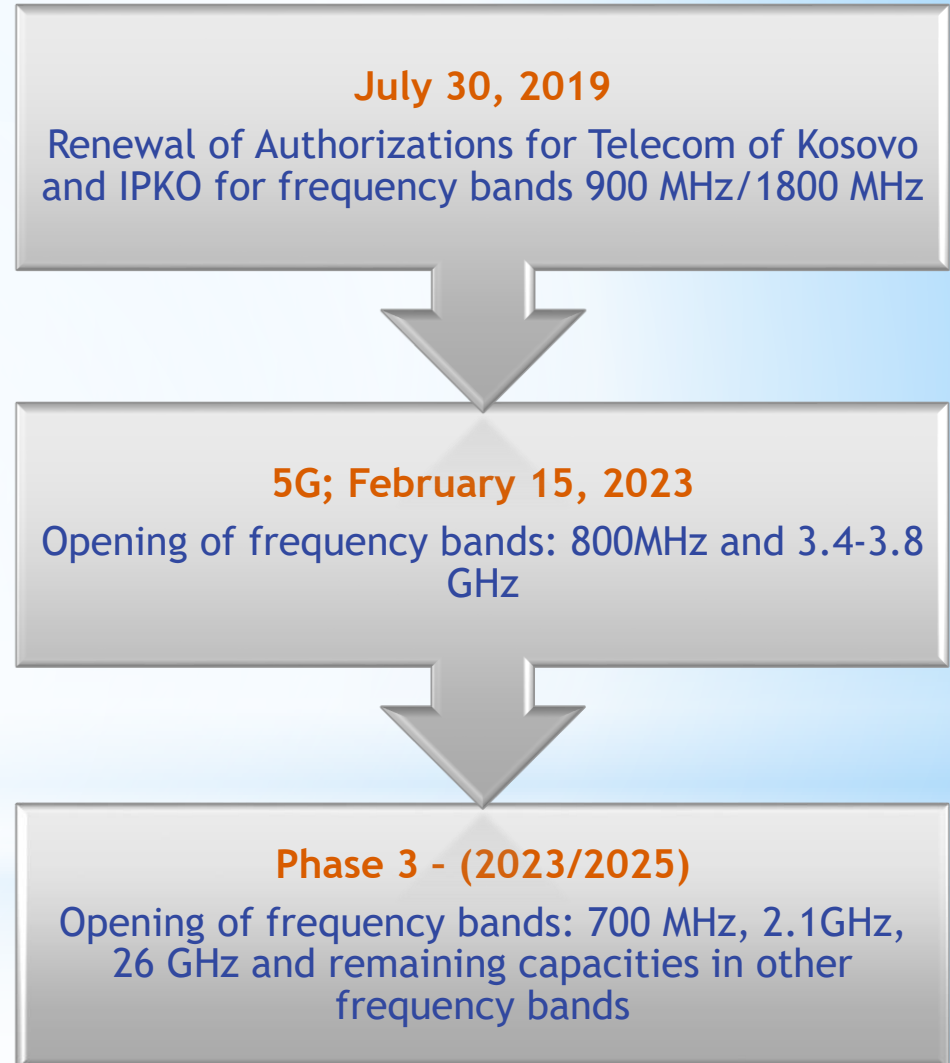


- Three mobile operators (2 MNO & 1 MVNO) are active in the market.
- Technologies in use: 3G (UMTS/HSPA), 4G (LTE), 5G NSA. 3G networks are scheduled to shut down (Phase out) by MNOs in the near future.
- MVNO provides only M2M services.
- By the end of 2022, the penetration of Mobile Broadband above 85% of total population.

Frequency Release Plan (1)

❑ FSP approved by ARKEP in 2022 with following objectives:

- extending the number of new services that will be available to end users,
 - enabling of broadband access to the remote areas, such as rural areas and isolated locations,
 - enhancing further competition in the electronic communications market,
 - ensuring greater speed and better quality of mobile broadband services,
 - effective and efficient utilization of frequency as scarce resources,
 - fulfilment of obligations in using spectrum resources in accordance with the EU Regulatory Framework and the regulatory objectives in the country, and
 - further increase the level of penetration of broadband communications services.
- **To achieve above, it is necessary to make available suitable spectrum in a timely manner and at the appropriate prices.**



Frequency Release Plan (2) - 800MHz and 3.5GHz

800 MHz (20 MHz per operator)

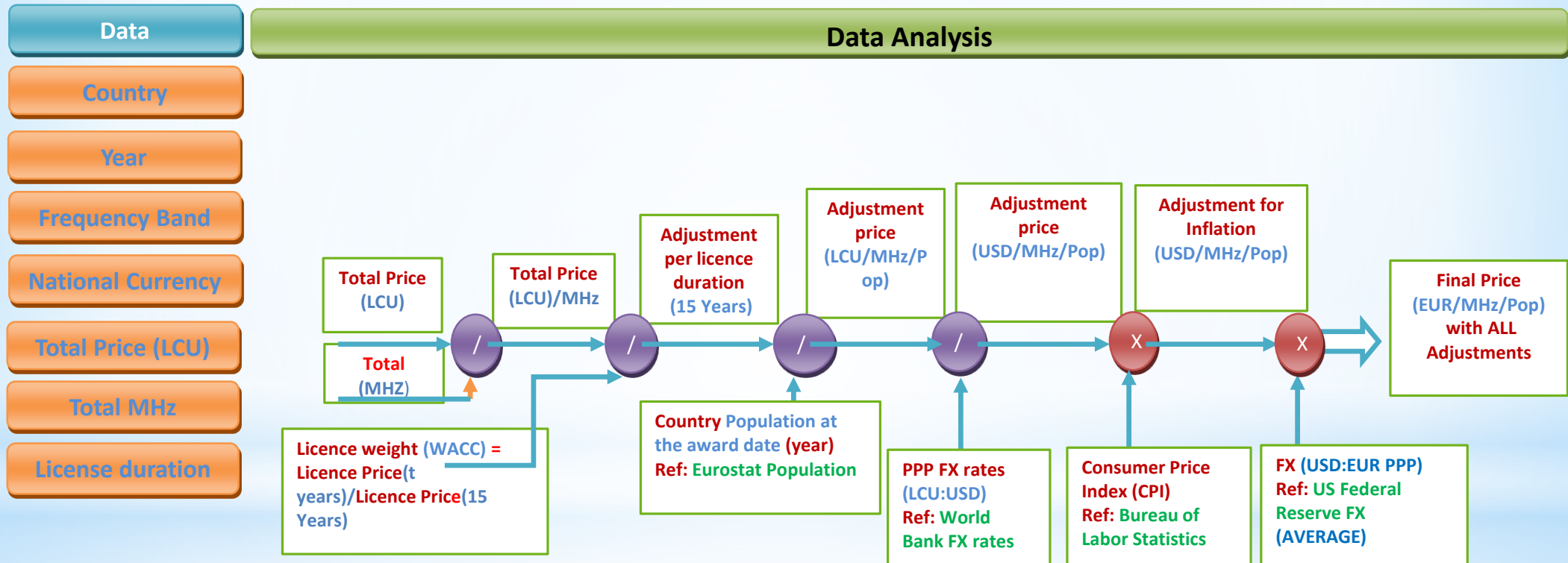
Operator	Frequency capacity	Uplink/Downlink
A1	2 x 10 MHz	791-801 / 832 -842 MHz
A2	2 x 10 MHz	801 - 811/842 -852 MHz
A3	2 x 10 MHz	811-821 / 852-862 MHz

3.5 GHz (Min. allowed capacity 80 MHz, Max. 100MHz)

Operator	Frequency capacity	Application
A1	1 x 100 MHz	National Level (3410 - 3710 MHz)
A2	1 x 100 MHz	
A3	1 x 100 MHz	
B	1 x 90 MHz	Local/Industry (3710-3800MHz)

Spectrum price - ARKEP's valuation Methodology

- ❑ Benchmarking ARKEP's methodology: Transparent, reflects actual price, transparent.
- ❑ 14 Auctions in Europe have been used.



Spectrum Price - “One-off” fee

Frequency Band	One-off fee €/MHz/pop.	After applying 50% discount
800 MHz	0.1770	0.0885
3.6 GHz	0.0238	0.0119

Spectrum price(15 years)
 $= C_{MHz/POP} \times BW_{MHz} \times Population$

$C_{MHz/POP}$ - Price/MHz/pop.
 BW_{MHz} - Total Bandwidth
 $WACC$ - 11.3

Spectrum price (N years)

$$= \frac{Spectrum\ price_{15years}}{\sum_{t=0}^{14} \left(\frac{1}{1+WACC} \right)^t} * \sum_{t=0}^{N-1} \left(\frac{1}{1+WACC} \right)^t$$

Spectrum price (M months)

$$= \frac{Spectrum\ price_{15years}}{\sum_{t=0}^{179} \left(\frac{1}{1+WACC} \right)^{t/12}} * \sum_{t=0}^{M-1} \left(\frac{1}{1+WACC} \right)^{t/12}$$

5G Authorizations - Final results (1)

On February 15, 2023 ARKEP issued two 5G authorizations for TK and IPKO. “Grace” period is introduced for the first time.

Operator	Capacity(MHz)	Frequency Band	License duration	Number of Instalments
Telecom of Kosovo	2 x 10 MHz (20 MHz)	811 - 821 & 852 - 862 MHz	20 years	10
	1 x 100 MHz (100 MHz)	3510 - 3610 MHz	20 years	10
IPKO	2 x 10 MHz (20 MHz)	791 - 801 & 832 - 842 MHz	20 years	//
	1 x 80 MHz (80 MHz)	3430 - 3510 MHz	20 years	//
	1 x 20 MHz (20 MHz)	3410 - 3430 MHz	17 years	//

5G Authorizations - Final results (2)

□ Coverage obligations:

- By the end of 2025, 50% of population,
- By the end of 2027, 70% of population,
- By the end of 2029, 90% of population.

□ Obligations for High risk vendors (untrusted vendors).

□ Max. 10 instalments are allowed (2, 3, 5, 7 and 10 instalments) with an interest rate based on the weighted average of Treasury Bonds:

- First Instalment:

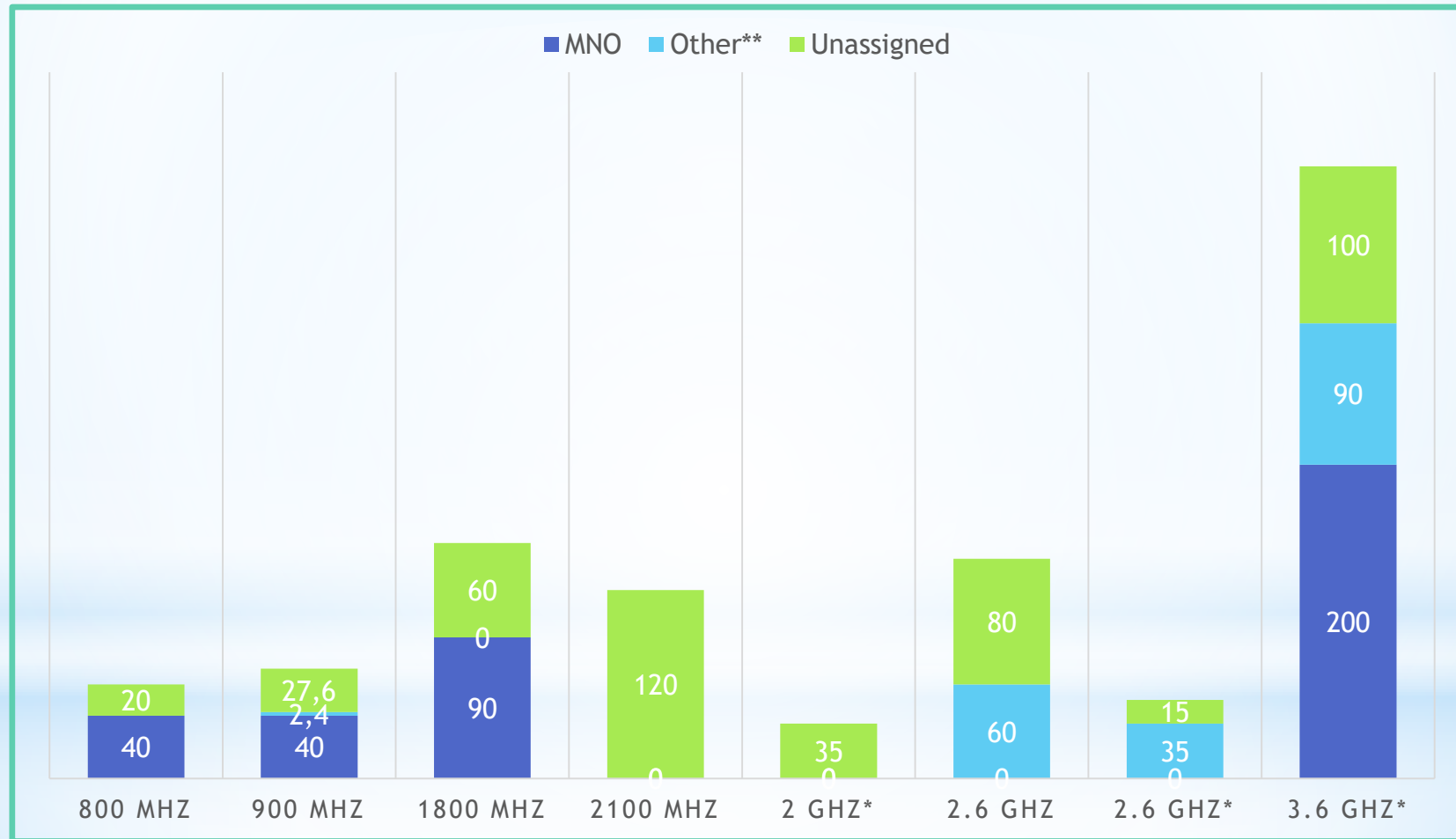
$$P1 = \frac{\text{Value of the Band}_D}{D}$$

- Other Instalments (Annual):

$$\text{Annual Instalment} = (\text{Value of the Band}_D - P1) \times \frac{i}{1 - (1 + i)^{1-D}}$$

Assigned and unassigned spectrum in Kosovo

Still Significant amount of unassigned IMT spectrum ...



Current 5G Deployments

- 5G technology is already deployed in the center of Prishtina.
- Next step expanding the coverage of 5G technology to: Ferizaj, Gjilan, Mitrovice, Fushe Kosove, Gjakove, Prizren, Peja, etc.
- Incumbent operator is planning to launch 5G services by the end of 2023.
- Through the KODE Project, Ministry of Economy is financing the connection of BS with fiber, to facilitate the deployment of 5G.
- From April, 2023 eSIM technology is available.

NR+LTE PHY Throughput Multi-RAT DL				
Mean [Mbps]	Median [Mbps]	5 th Percentile [Mbps]	95 th Percentile [Mbps]	Maximum [Mbps]
399.7	396.1	0.2	851	1187.2

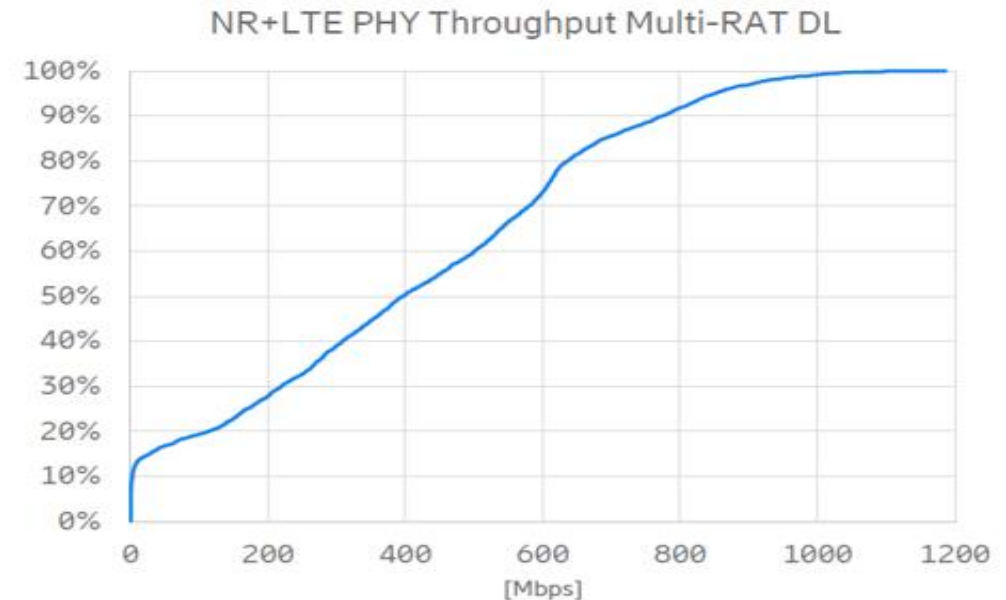


Figure 7 NR+LTE PHY Throughput Multi RAT DL

Private 5G - First Authorization

- First 5G authorization for private use, issued on February 2023 to “Next Generation Network Institute”.
- Annual fee: 507 €.
- Total Fee [€] = $500 + B \cdot t \cdot 5 (6a1 + a2)$
 - B - Frequency Band in MHz;
 - t - time period/license duration;
 - a1 - geographical zone in urban area in km²;
 - a2 - geographical zone in rural area in km².
- Two Authorizations for 5G testing in University Campuses: University of Prishtina, and UBT.
- Ministry of Economy project on Private 5G in 2023.



Thank You!

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