



Next Generation Networks and the Prospect of 5G

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A European perspective

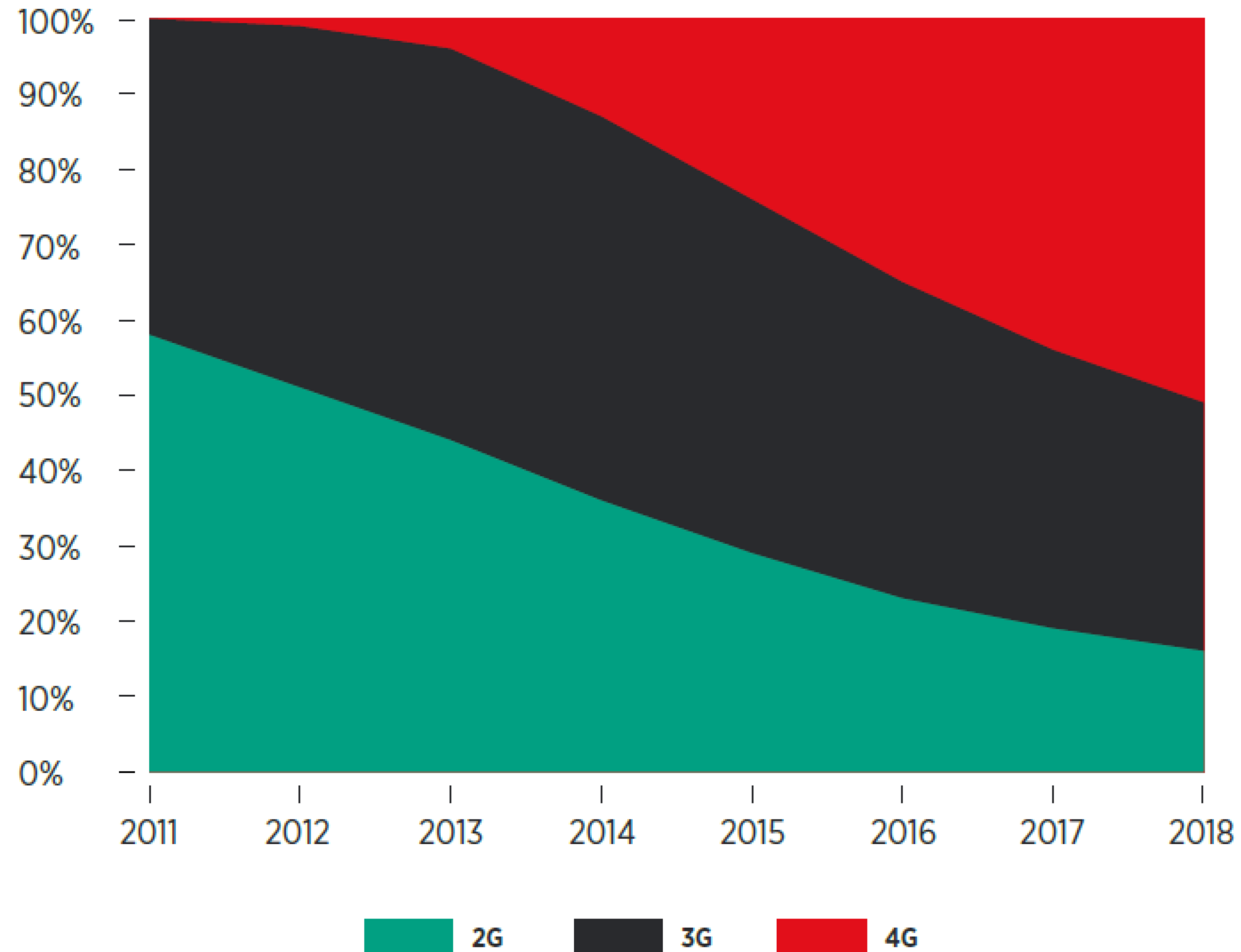
OUTLINE

1. Market structure and performance since the 4G
2. Trends toward 5G networks
3. Network Sharing Agreements in Europe
4. The network sharing in Czech Republic
5. Concluding remarks

1. Market structure and performance since the advent of the 4G technology

The technology

Source: GSMA Intelligence

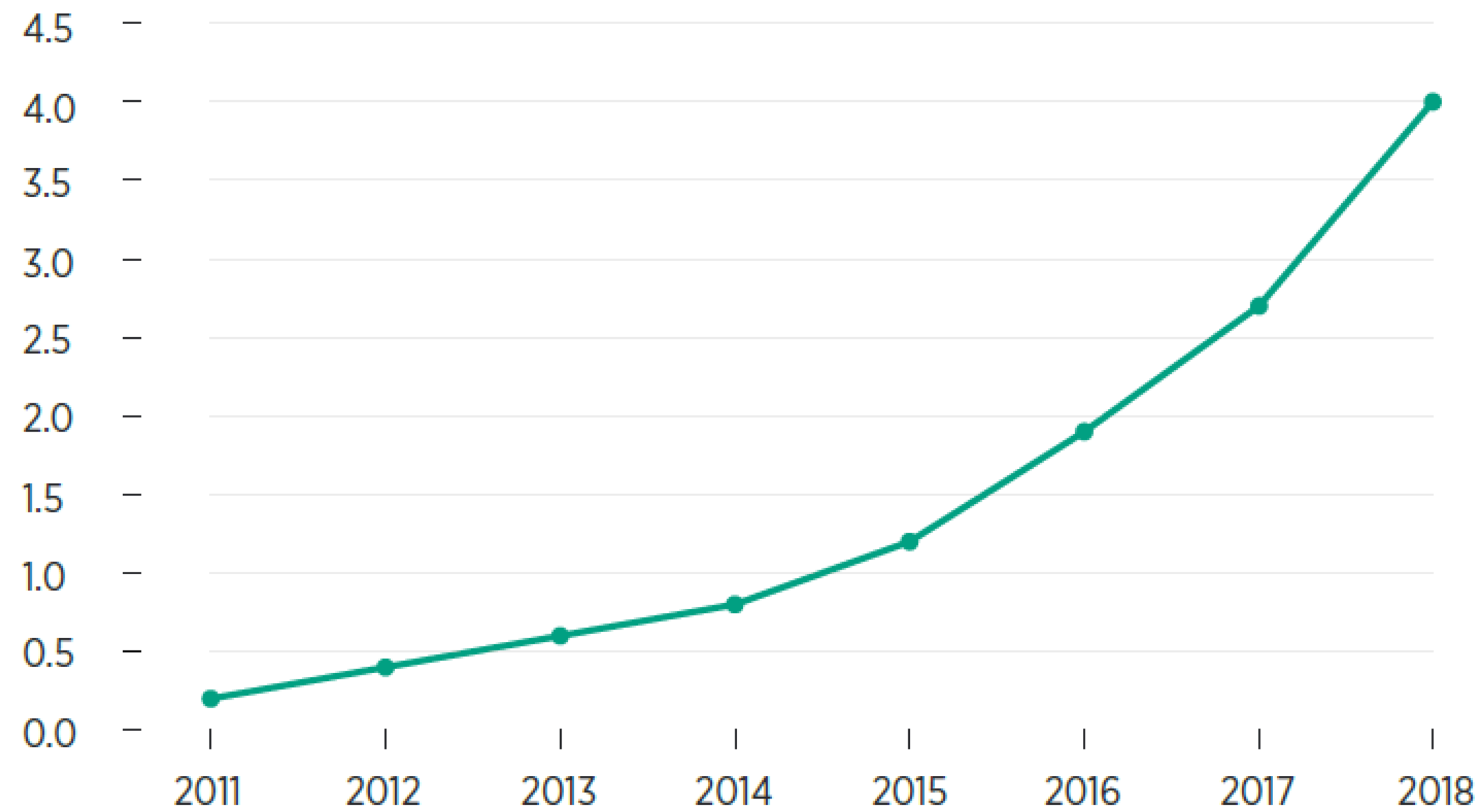


Growth of the market = growth of data usage

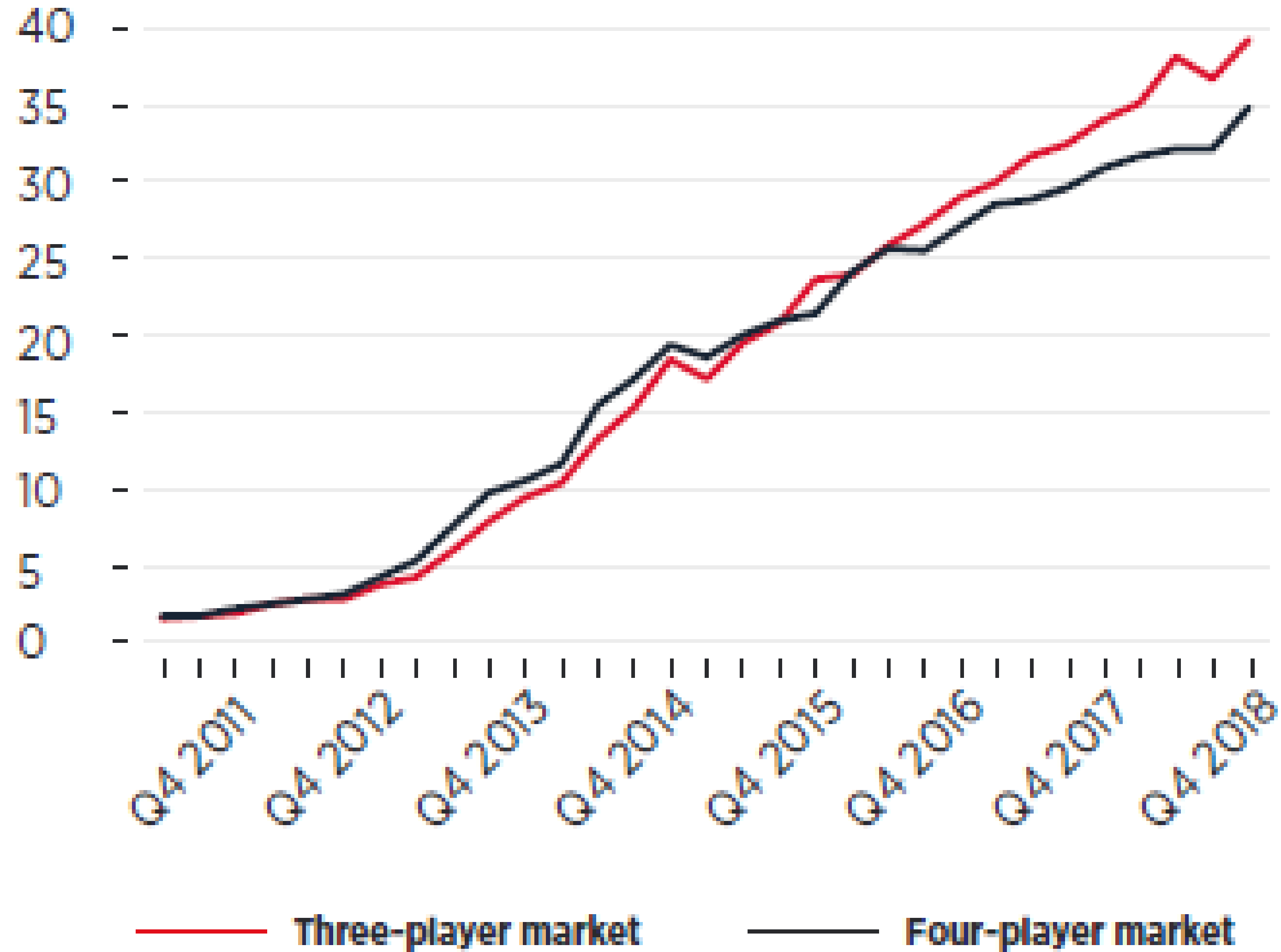
Data usage across Europe has grown more than 14-fold between 2011 and 2018

Exabytes per month

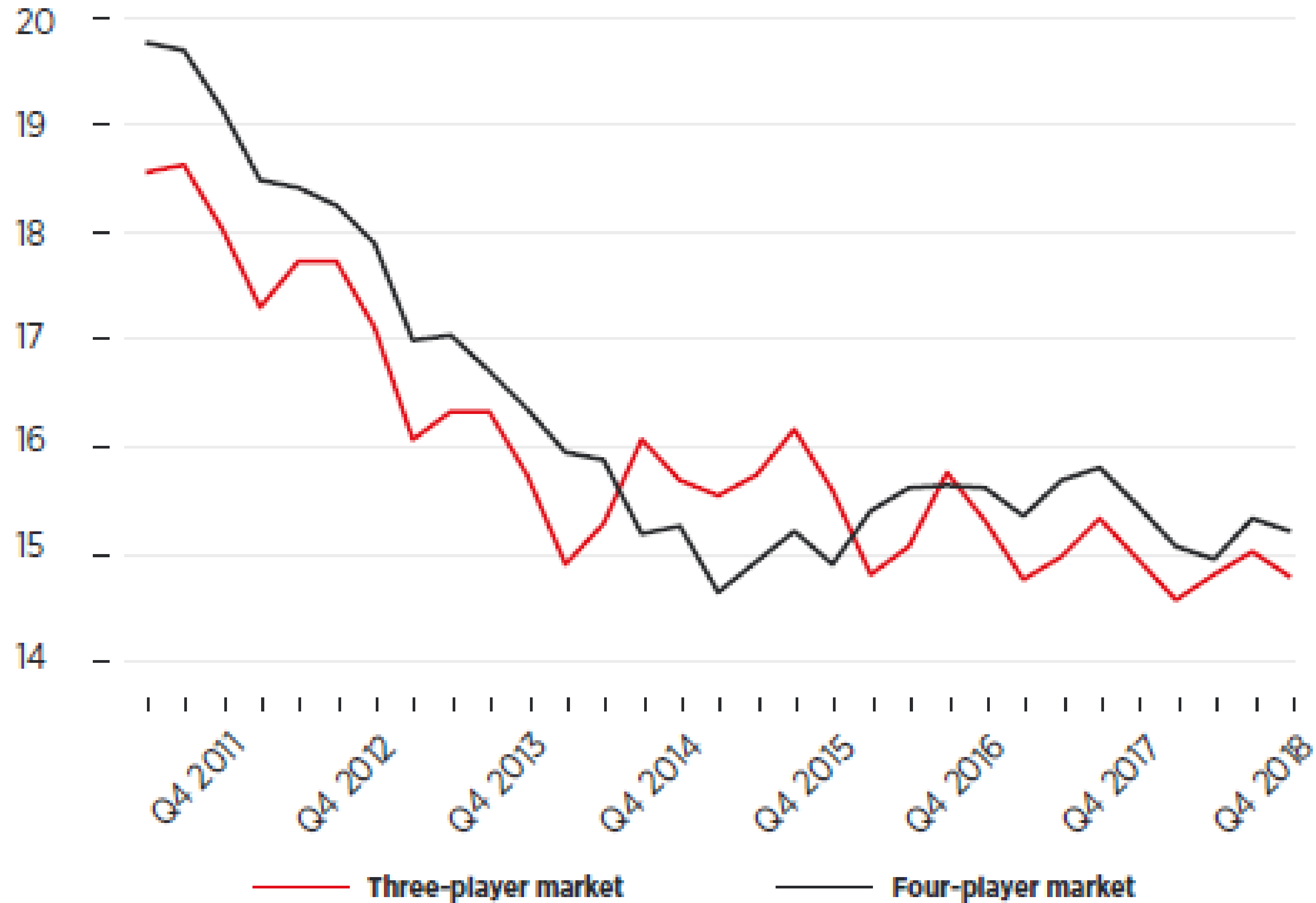
Source: Ericsson*



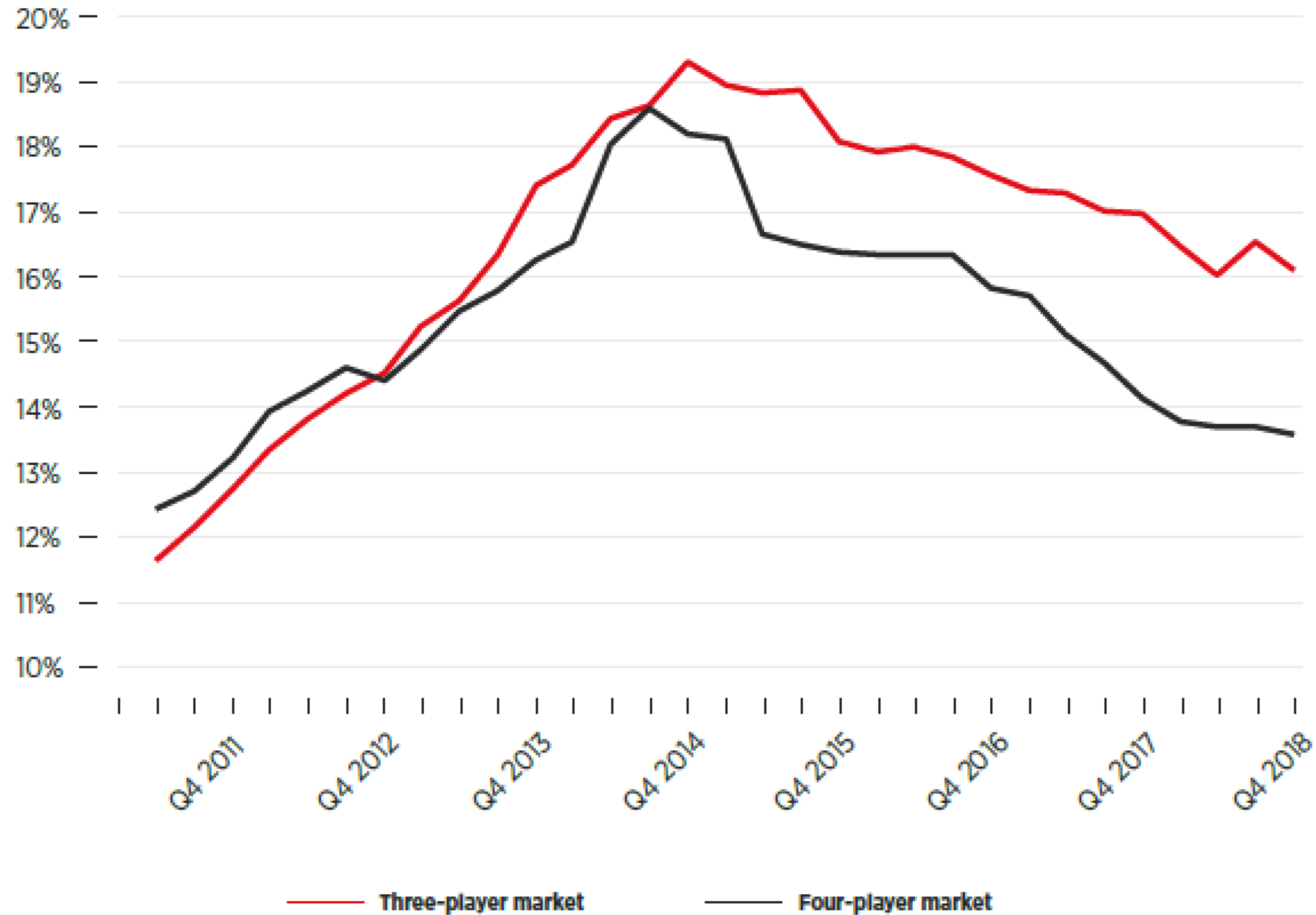
Market performance: Quality (download speed)



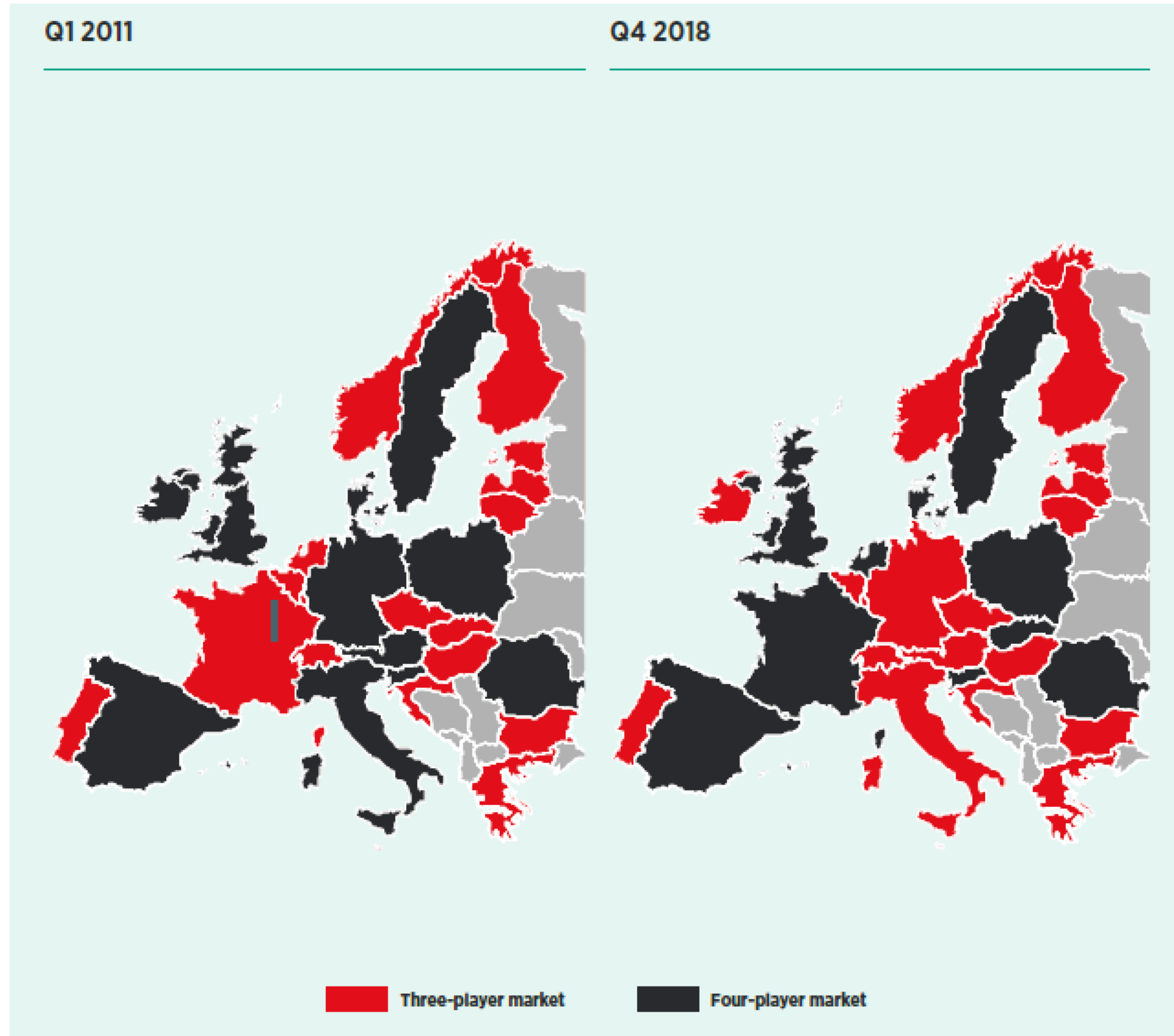
Market performance: Prices (average revenue per user ARPU)



Market performance: Investment (CAPEX)

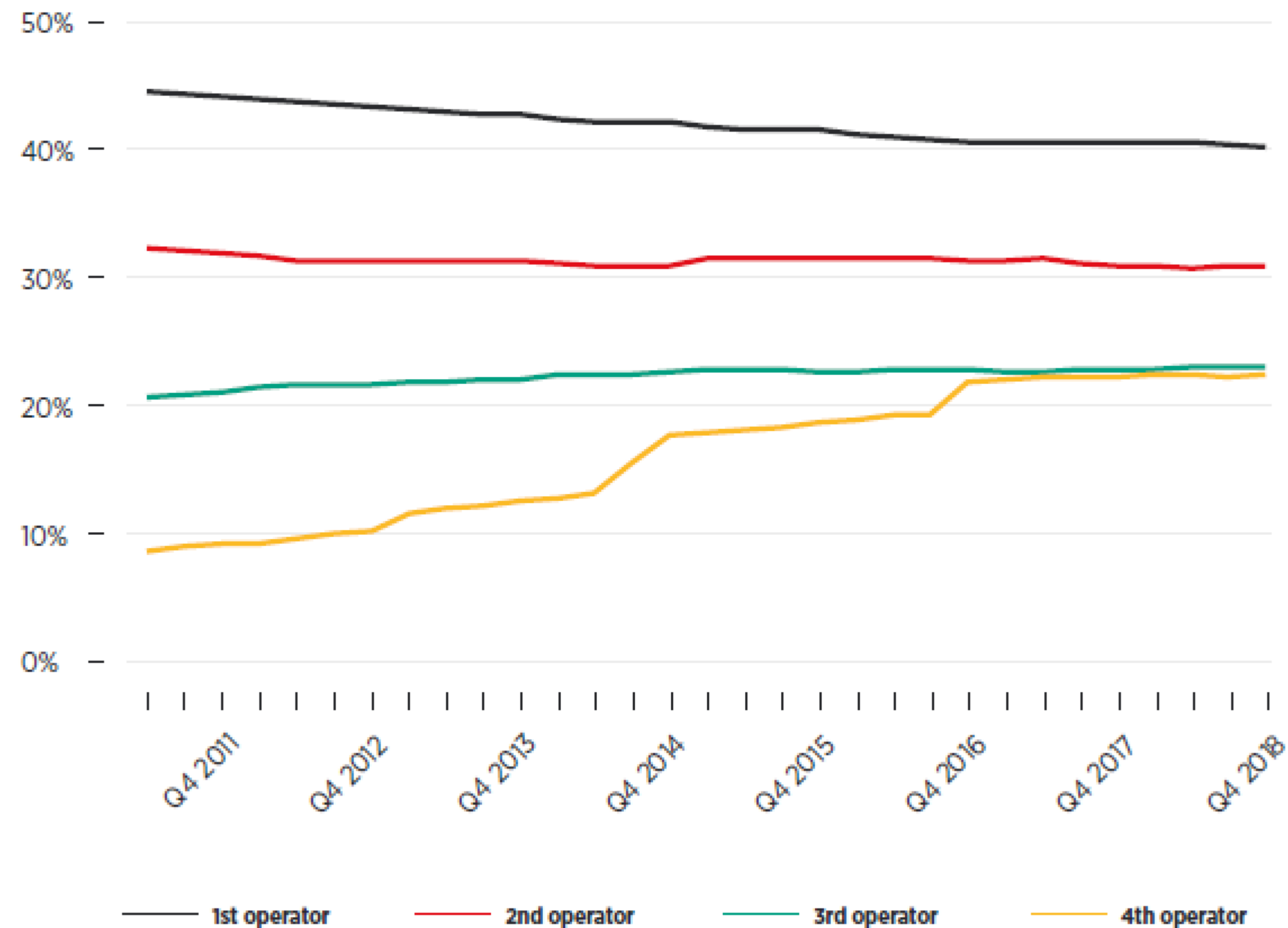


Market structure



Market structure

- Less concentration with less players
 - Market shares are getting more symmetric



2. Trends toward 5G networks

Main facts

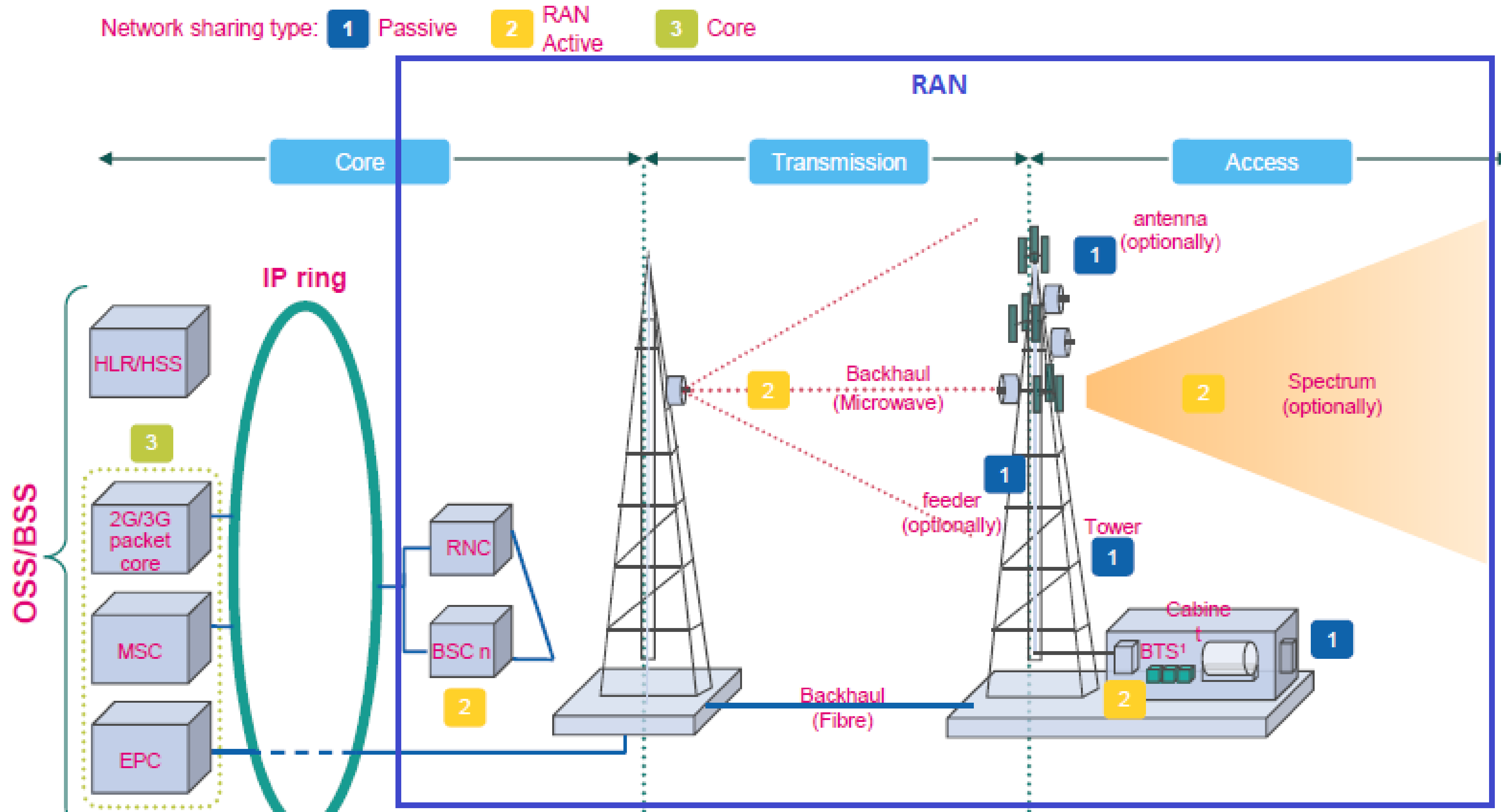
- 5G investment race has started
 - Adoption of 5G at a nascent stage
 - Still investment in the 4G technology (fixed costs to cover)
- 5G deployment = key policy objective of the European Union
 - 5G Action plan and Digital Europe
 - Identify at least one major city to be '5G-enabled' by the end of 2020
 - All urban areas and major terrestrial transport paths under 5G coverage by 2025
 - Policy
 - Accommodative policy for new business models (slicing)
 - Spectrum in the 700MHz frequency
 - Encouraging Network Sharing Agreements (NSAs)

Scope for NSAs

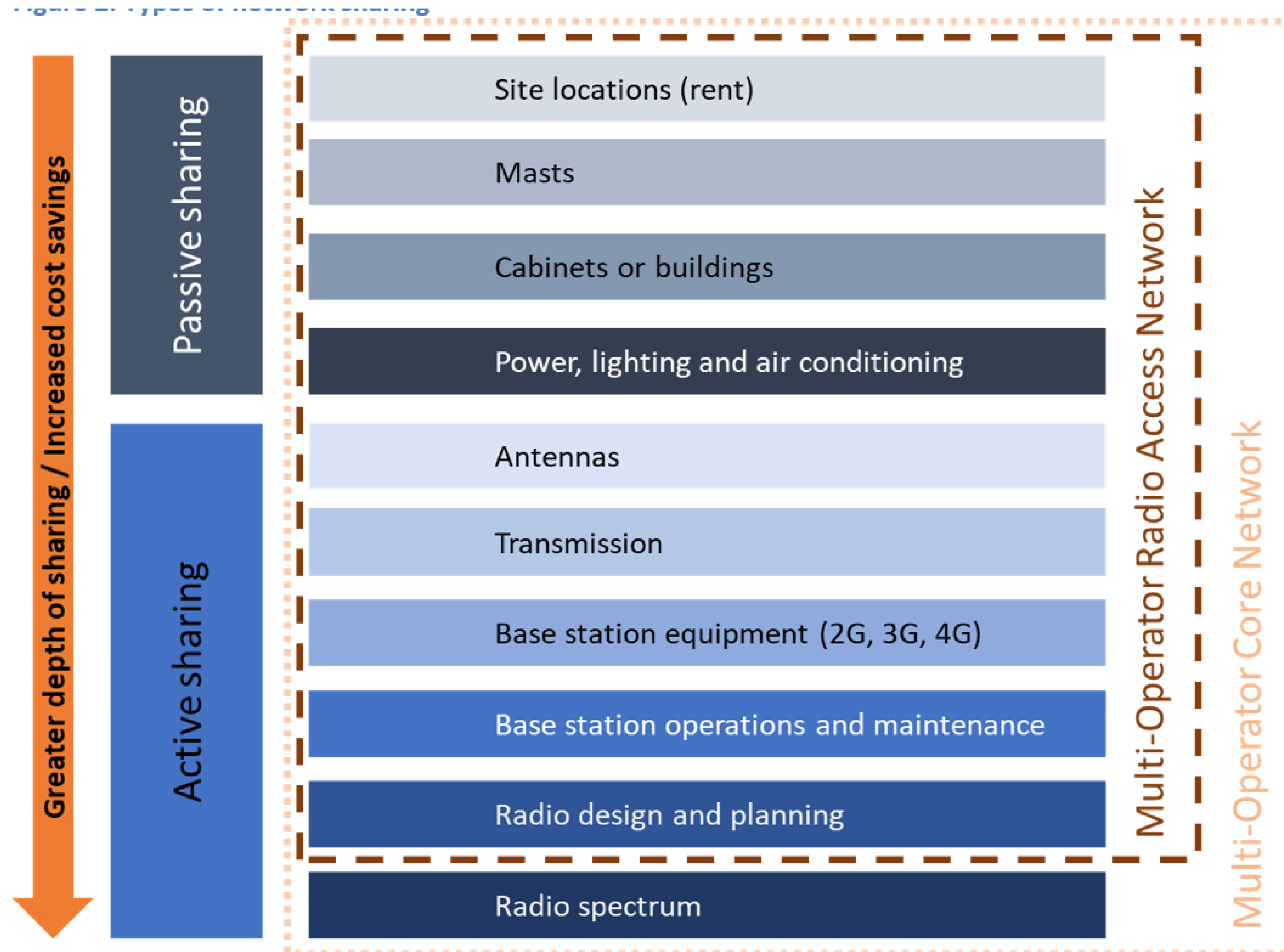
- 5G requires
 - More sites per square meter to achieve indoor coverage
 - Denser network in urban centres

3. Network Sharing Agreements in Europe

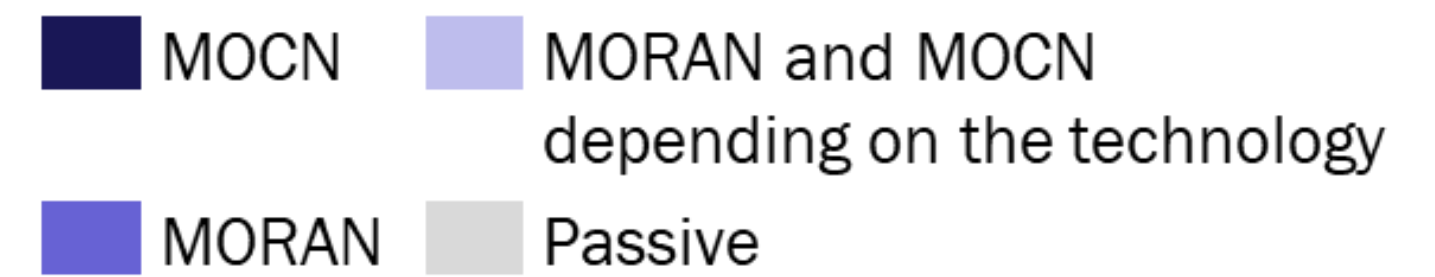
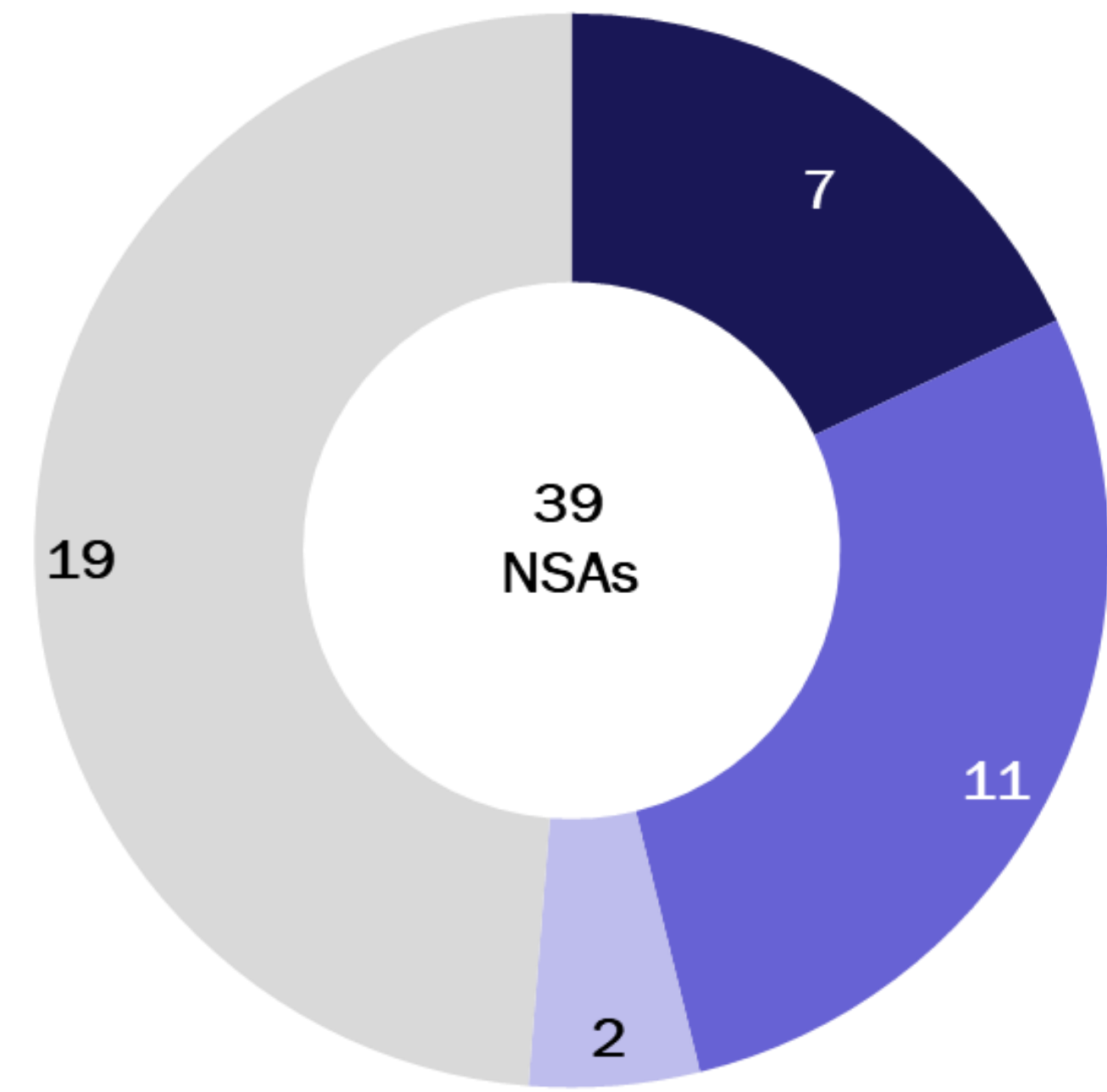
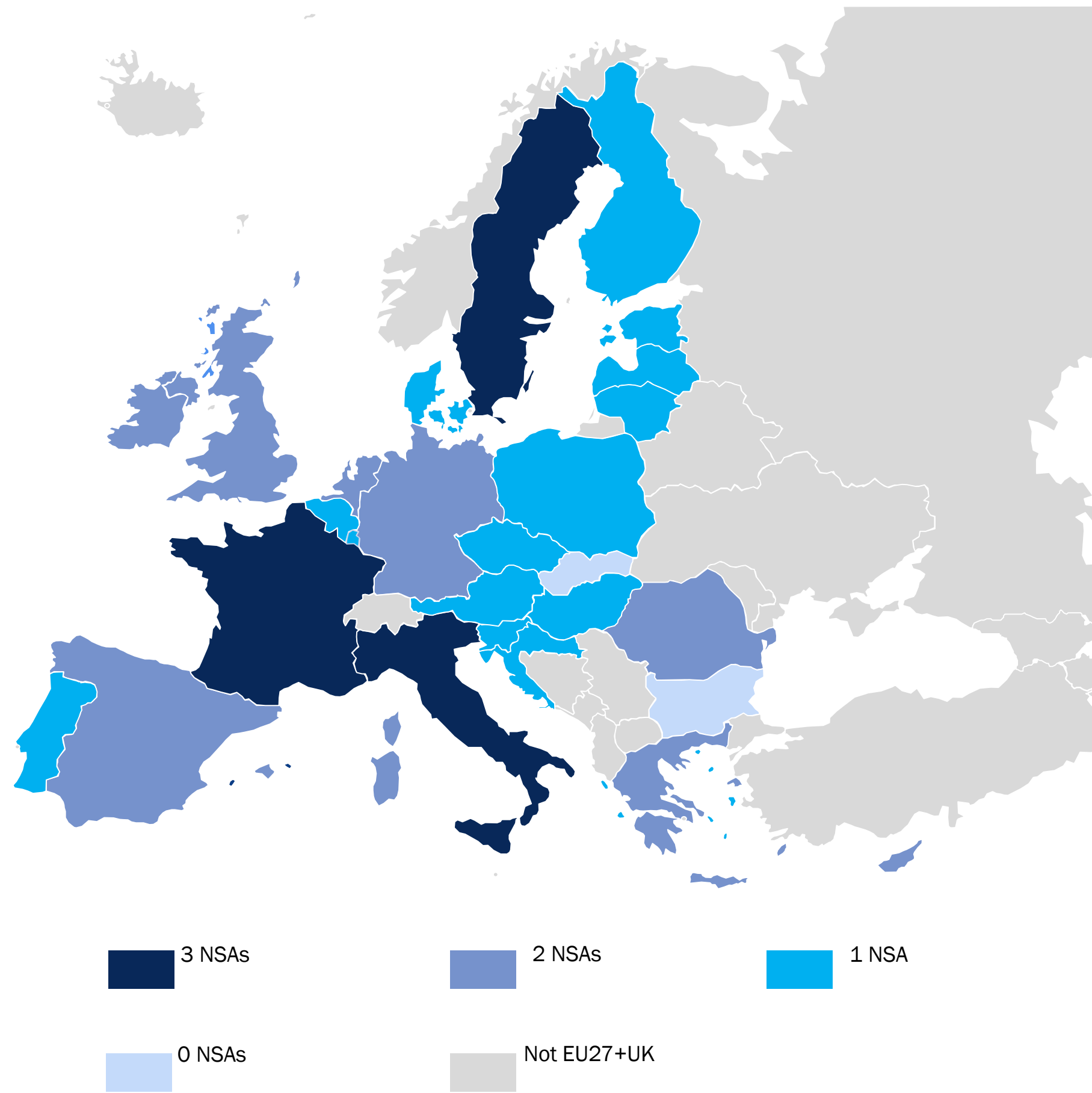
The technology concerned by the NSA



The technology and the types of NSA



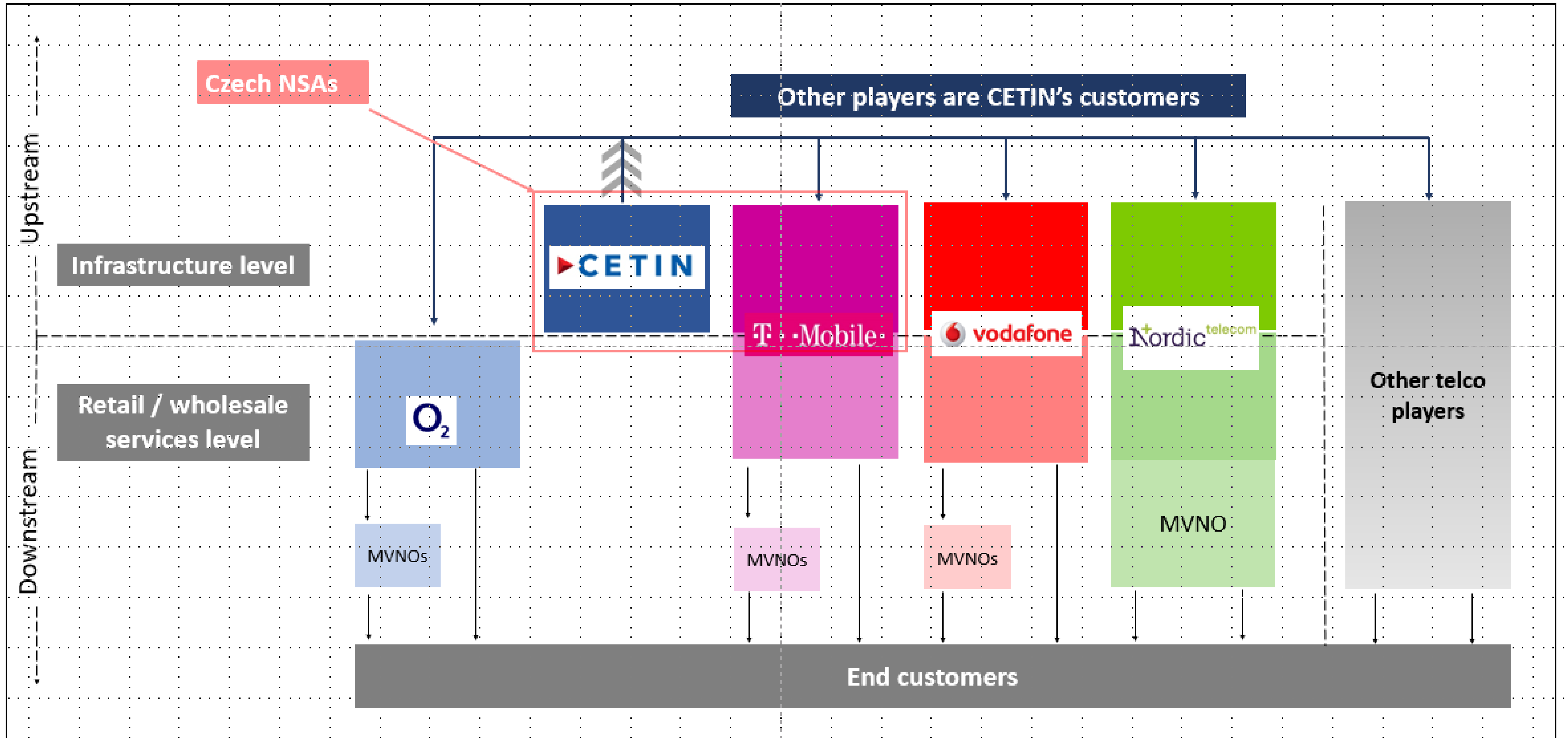
NSAs in Europe



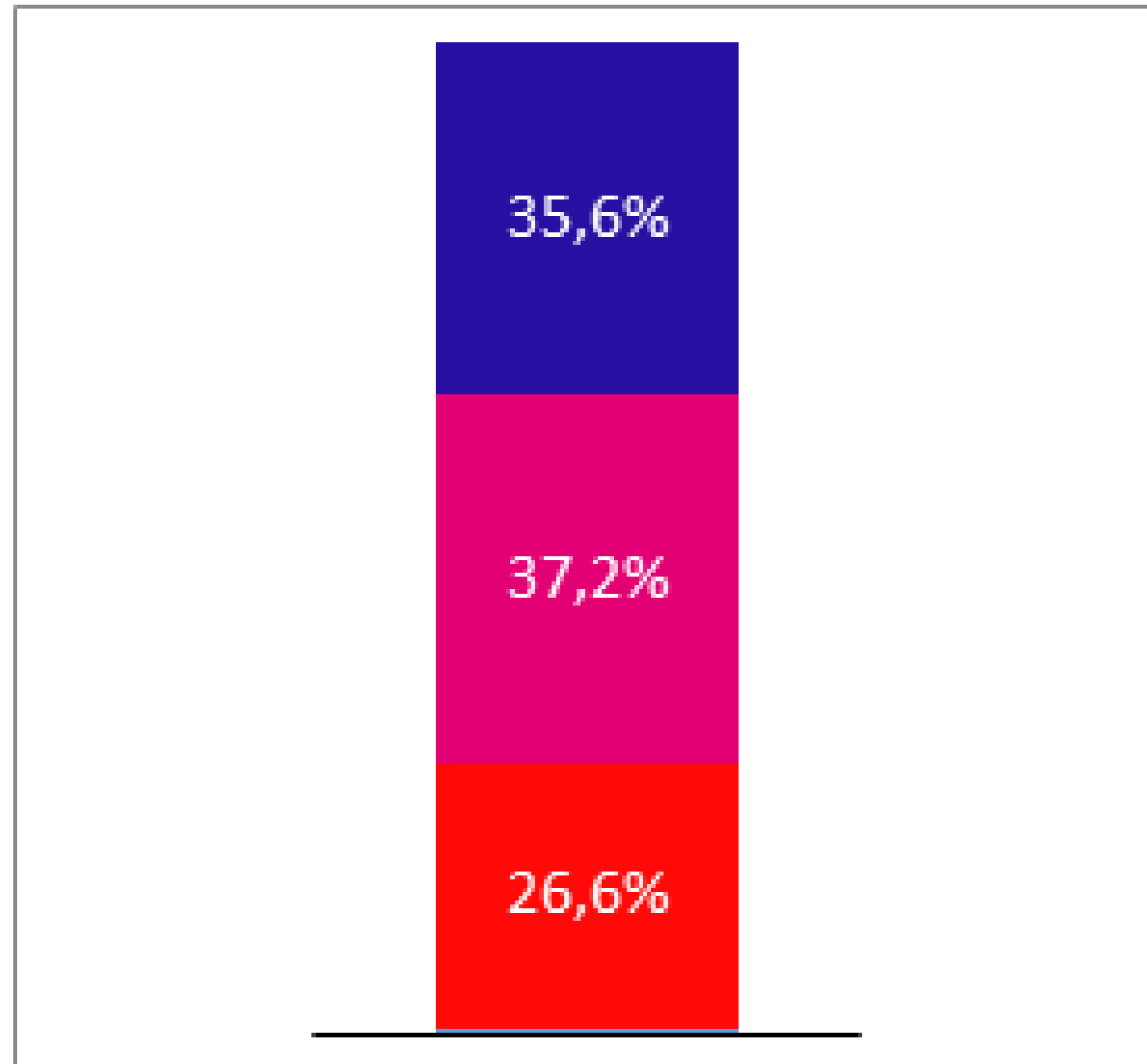
MORAN: Multi-Operator Radio Access Network
MOCN: Multi-Operator Core Network

4. The network sharing in Czech Republic

The CZ mobile telecom market



Market shares in the CZ market



Capacity of CZ operators

	Technology	TM	O2	Vodafone
2012	2G	5125	4760	4020
	3G	2909	3003	2295
	4G	0	0	0
2014	2G	5439	4846	4197
	3G	2999	3141	2337
	4G	1531	742	2036
2017	2G	6147	7083	4843
	3G	3531	3739	2336
	4G	5946	5891	4735

History of agreements between T-Mobile and O2

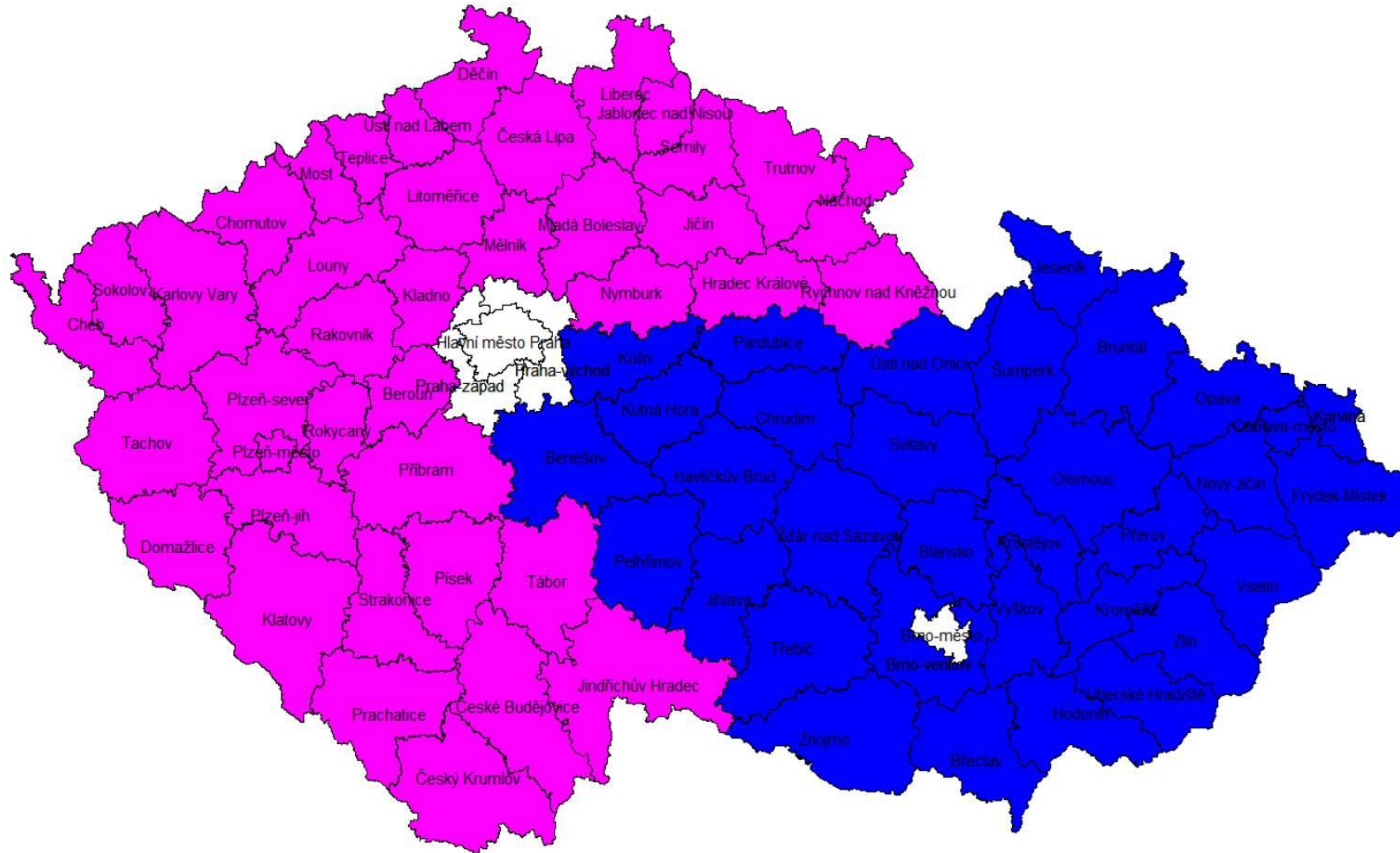
- Initial 3G agreement February 2011
 - 3G MORAN for cities less than 15000 inhabitants
 - 2G not concerned
- 2G/3G agreement October 2013
 - The entire CZ territory (except Prague and Brno)
- LTE agreement May 2014
 - Same geographic agreement for the 4G/LTE technology

Main features

- Objectives
 - Achieving higher speeds of data traffic, more extensive coverage, and greater efficiency and reliability
 - Coordinated optimization of LTE mobile networks
 - Use of the 800 MHz spectrum
- Agreement
 - Sharing of passive and active infrastructure for 20 years
 - CZ entire territory
 - Except Prague and Brno = 17% of the population (20 to 30% of data traffic)
 - Population density, demand level, decommissioning of sites
 - Geo-split

	West	East
Master	TMCZ	CETIN
Visitor	CETIN	TMCZ

Geo-split



Main challenges

- Effect of the NSA on
 - Prices
 - Quality
 - Consumer welfare
- Issue
 - Cooperation on investment
 - Impact on quality and prices
 - Competition on prices and quality
 - Impact on investment
- Questions
 - Is the cooperation of two operators driving the market outcome far from the competitive equilibrium?
 - Is the NSA welfare enhancing compared to a counterfactual without NSA?

Methodology for measuring the effect on quality

- Database
 - Ookla speedtest data
 - Quaterly data 2011 – 2019
 - Only for CZ operators (O2, TMCZ, Vodafone)
- Before – After analysis
 - DID analysis not implementable

Results

After the NSAs :

- Download speed increased on average between 22 and 26%
- Upload speed increased on average between 52 and 62%
- Network latency decreased on average between 27 and 30%

The download speed associated with TMCZ in the East was 16 % lower than in the West in the period Q1-2018 until Q2-2019

It corresponds to a loss of 312 seconds in a year between a user in the East and a user in the West

It represents a loss of consumer surplus of 0.05%

Methodology for measuring the effect on prices

- A difference-in-differences analysis
 - The NSA is a change in the market
 - Identify the average net effect of the NSA in CZ by comparison to countries with no NSA, on the same basis
 - Treatment = CZ
 - Control group = European countries with no NSA
- Database
 - Teligen tariff data
 - Quaterly data from 2010 to 2019
 - Tariffs of two biggest MNOs per country for 36 countries (25 European)
- Challenge
 - Complexity of tariffs of telephone products
 - Bundle of services (voice, messaging, data)
 - Non-linear prices

Temporal pattern of prices

Percentage change in RBE in the Czech Republic

Period	Baskets				
	OECD1	OECD2	OECD3	OECD4	OECD5
	%				
2010Q1 - 2012Q4	5.8	4.4	-7.2	-30.5	27.8
2014Q1 - 2019Q2	-8.1	-11.1	-25.3	-50.0	-16.5

Results

Resulting RBE change for the main specification

Basket	OECD1	OECD2	OECD3	OECD4	OECD5
Year:	----- % -----				
2014	-17.35***	-16.96***	-18.36***	-20.68*	-19.56***
2015	-17.58***	-27.2***	-24.55***	-34.61***	-26.19***
2016	-25.29***	-30.33***	-18.48**	-29.41**	-28.21**
2017	-38.45***	-30.38***	-10.27	-19.5	-29.68**
2018	-45.25***	-33.65***	-2.91	-13.63	-34.22**
2019 Q1-Q2	-43.91***	-39.19***	-4.96	-18.28	-40.9**

Methodology for measuring the effect on consumer surplus

- A price–quality strategic model with differentiated products
 - Hypothesis: Static equilibrium
 - Investment is exogenous
 - Investment affects access and quality costs
 - Possible equilibria
 - Timing
 - Simultaneous: price and quality are simultaneously chosen
 - Two types of behavior
 - Competition in price and quality
 - Coopetition (Hybrid)
 - Cooperation on quality
 - Competition on prices

Demand

- Trade-off quality – price
 - Representative user willing to pay €0.66 for one additional Mbit/s of download speed
- Price elasticities

Own and cross-price elasticities of demand

Operator	NSA	Own price elasticity	Cross price elasticity with respect to a price change by		
			TMCZ	O2	Vodafone
O2	Before	-1.95	1.12	-	0.71
TMCZ		-1.92	-	1.14	0.71
Vodafone		-2.50	1.12	1.14	-
O2	After	-1.47	0.86	-	0.55
TMCZ		-1.39	-	0.85	0.55
Vodafone		-1.98	0.86	0.85	-

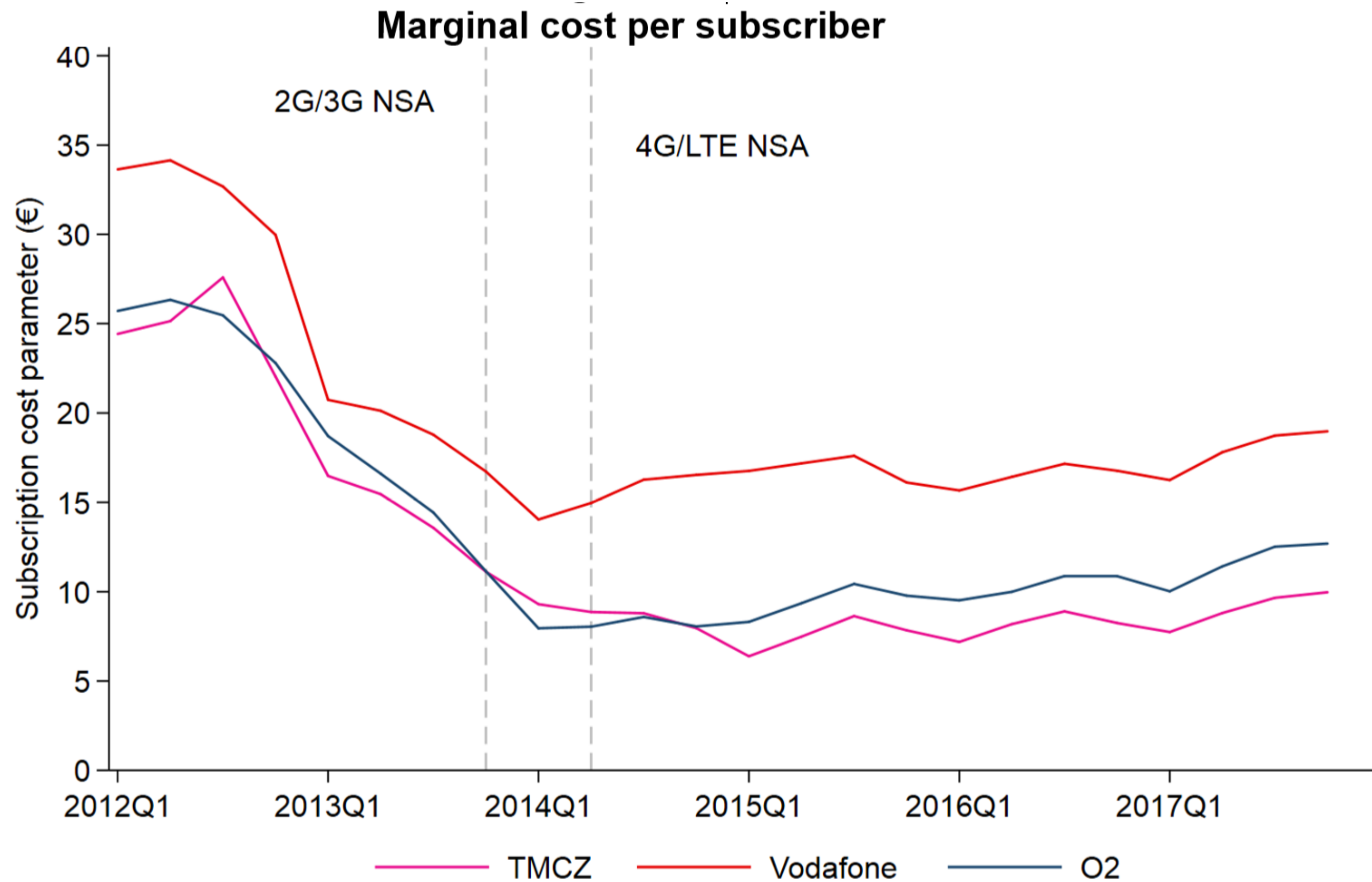
Demand

- Diversion ratio

Diversion ratios before and after the NSAs

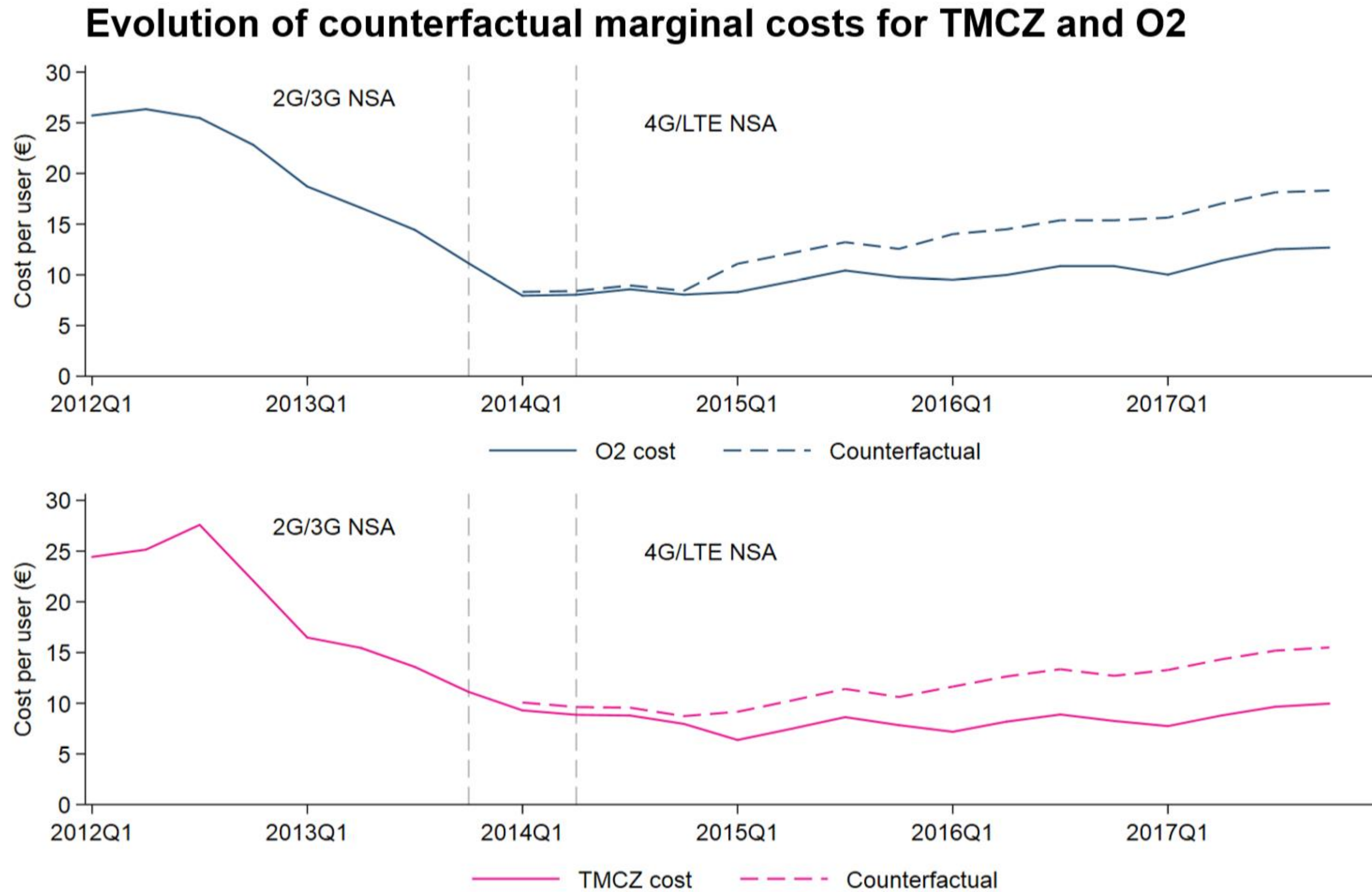
Operator	NSA	Diversion ratio		
		TMCZ	O2	Vodafone
O2	Before	58.57	-	35.00
TMCZ		-	58.67	34.91
Vodafone		47.29	47.51	
O2	After	60.63	-	34.25
TMCZ		-	59.65	35.11
Vodafone		48.91	46.96	

Cost estimates



Simulation

- Marginal cost of access absent of NSA



Simulation results

TABLE 11

Average quarterly change (absolute and in percentages) in price, network quality and consumer surplus in the counterfactual scenario

	Scenario I		Scenario II		Scenario III	
	Abs.	%	Abs.	%	Abs.	%
Price (€)	+2.1	+6.7	+4.3	+13.5	+4.4	+13.9
Quality (Mbits/s)			-0.9	-4.2	-5.2	-24.2
Consumer surplus (Mn €)	-37.5	-2.0	-69.5	-3.7	-111.1	-5.9

5. Concluding remarks

Main lessons

- Even in a market with 3 MNOs (almost symmetric), the NSA between 2 operators is enhancing the consumer welfare
- This result should comfort regulatory authorities to encourage NSAs among telecom operators for the deployment of the 5G technology

Thank you