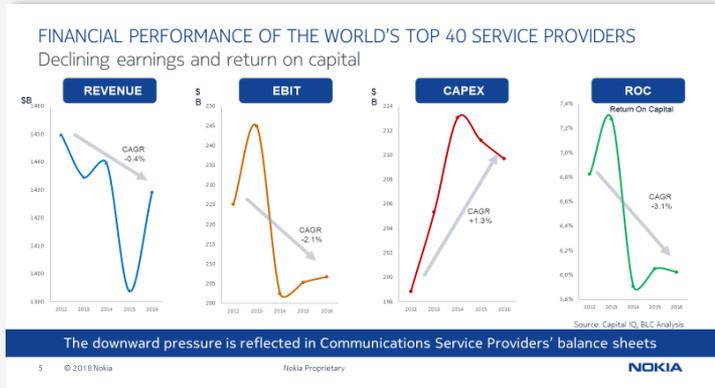


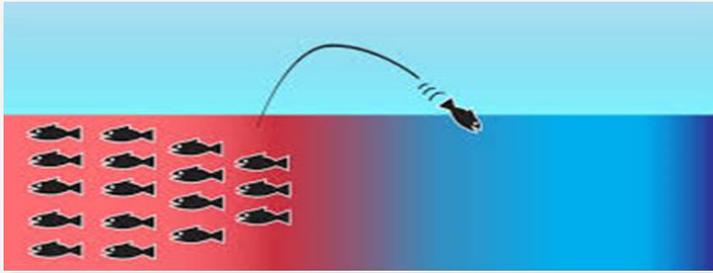


# Key Factors with Impact on CSP's

Balance Sheet



Explore New Market



Today's biggest corporate names use virtualized resources and infrastructure and adapt quickly to customer demand

Competition

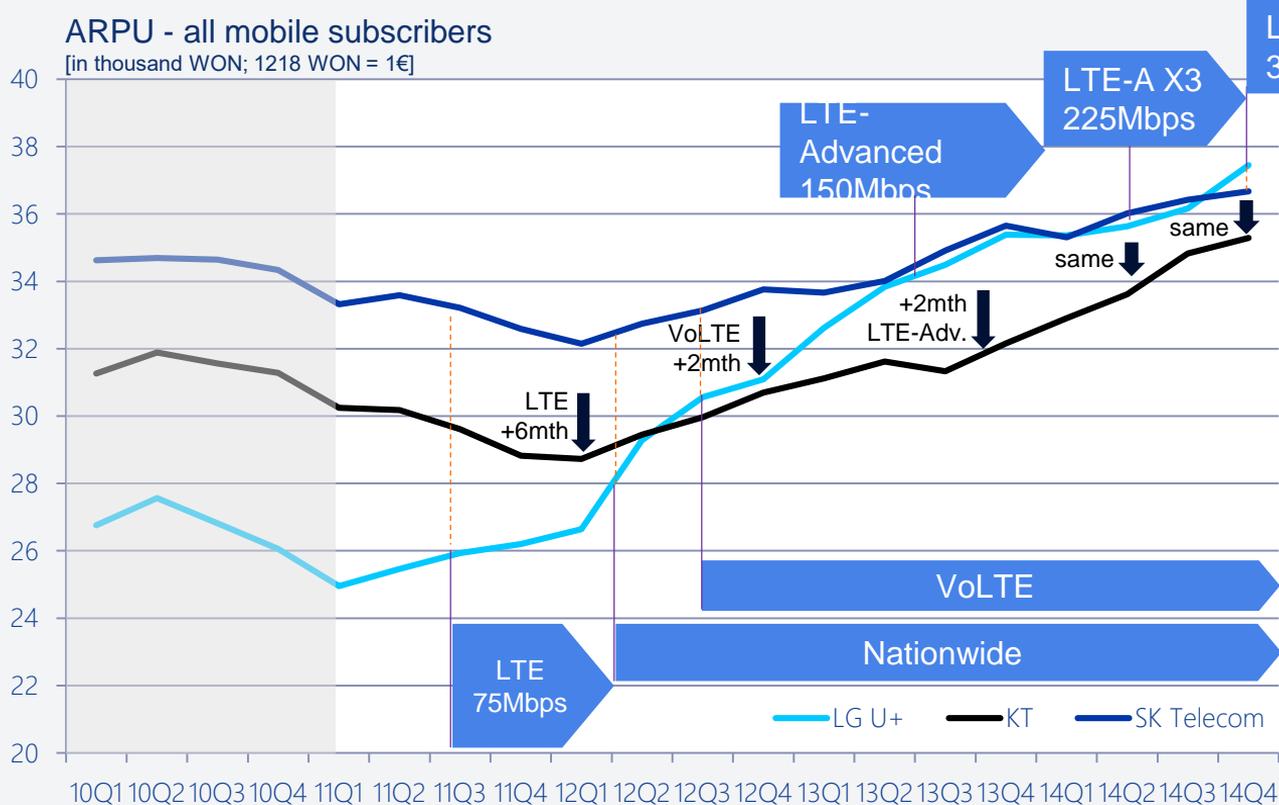


Adoption of new technologies

Economics, Competition, New Markets and New Technologies stressing CSPs

# South Korea – Winning ARPU and TTM strategy

Fast new service adoption provides competitive edge – analogy also to 5G services



Result of 4 years Aggressive LTE rollout

**+ 50%**

Slowest in the speed competition

lowest ARPU\*

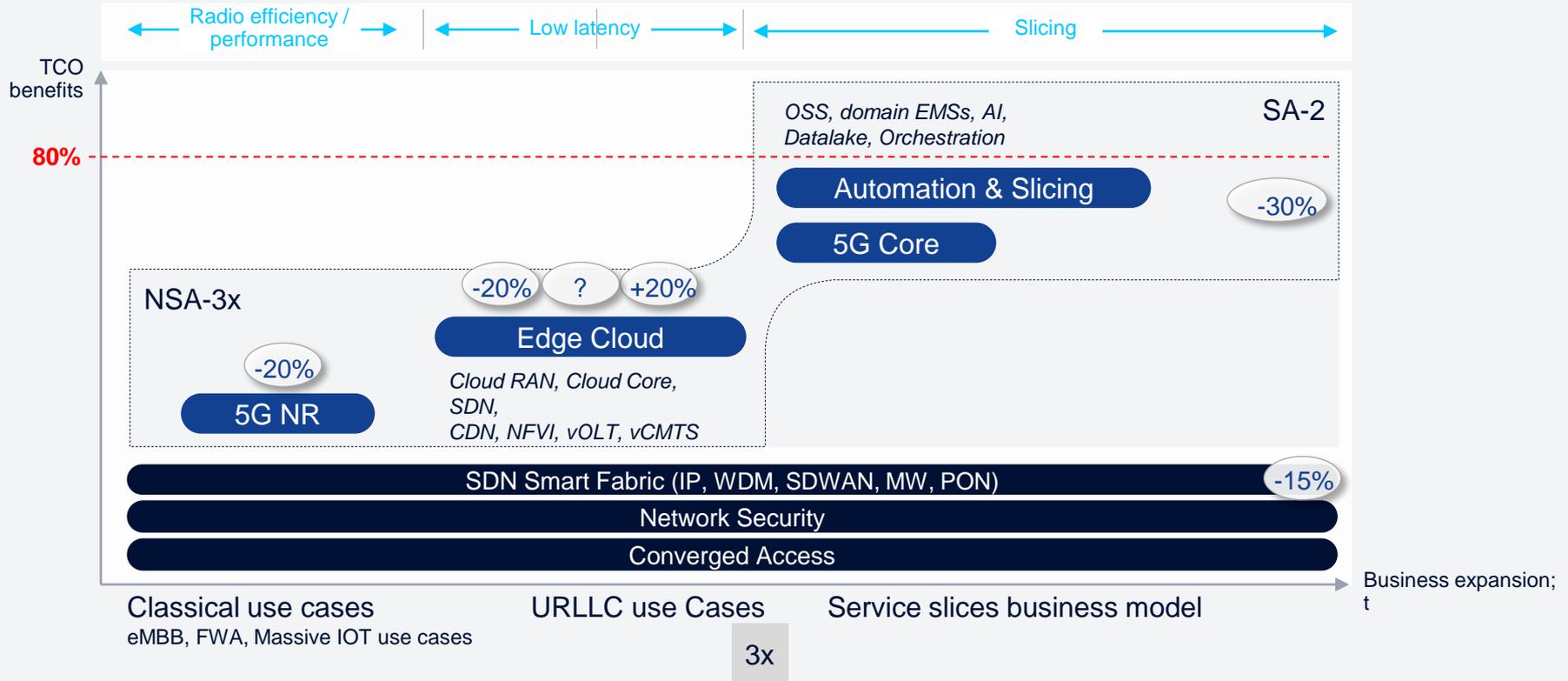
**4.4%**

Source: Annual/quarterly reports  
\* vs. competitor ARPU

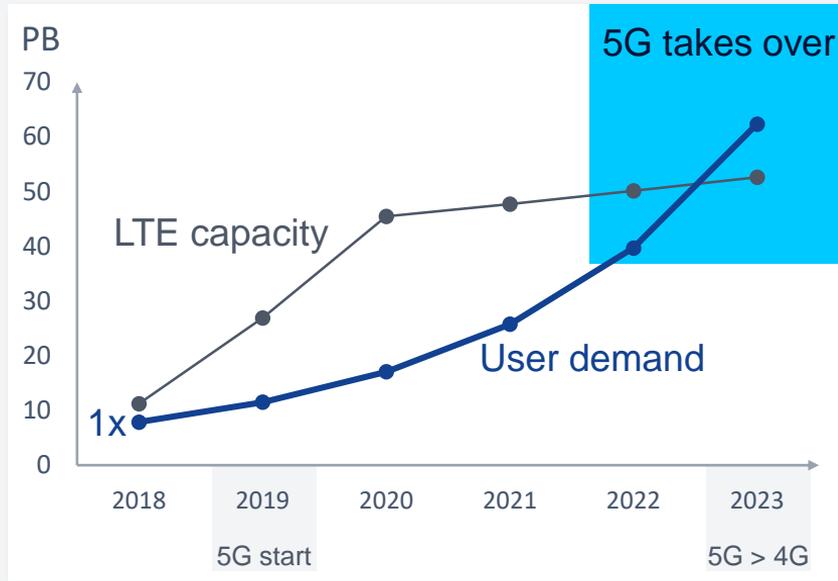
**NOKIA**

# Evolution towards an open, cloud native and dynamic architecture

Driven by use cases and business strategy



# 5G in some markets mandatory to overcome LTE capacity exhaust



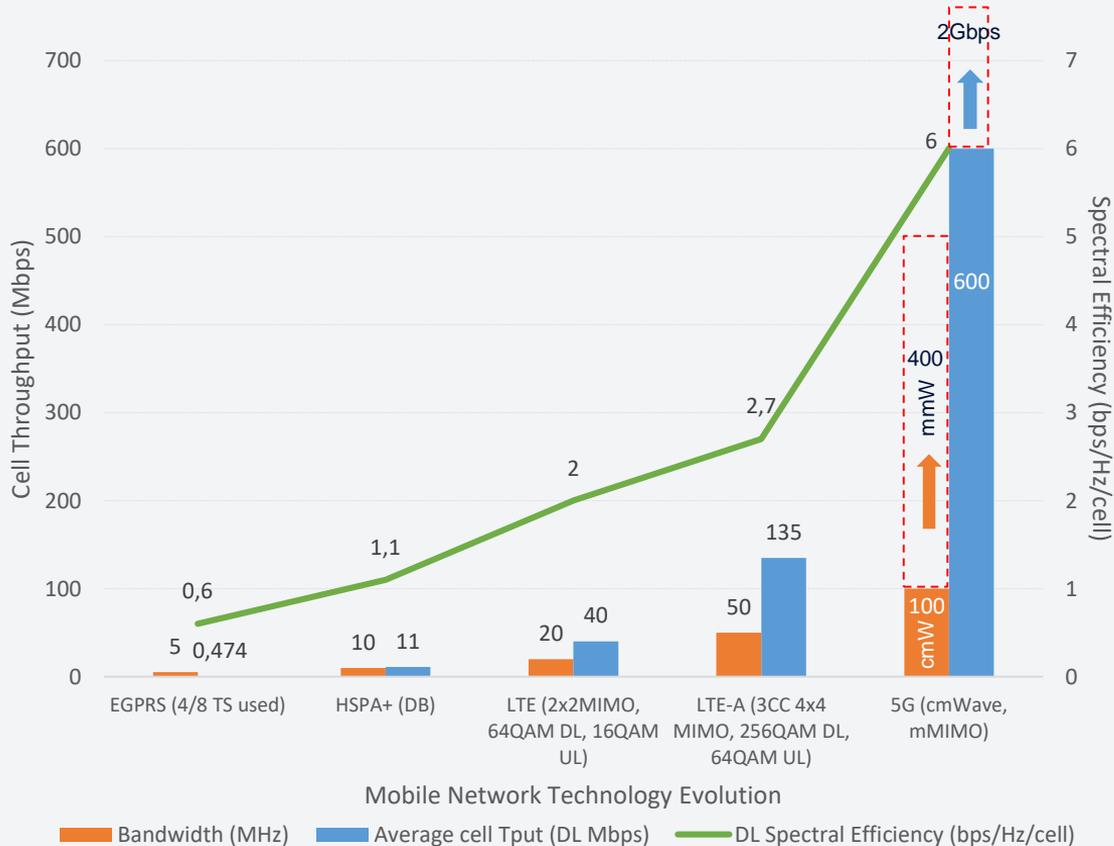
## Impact

- LTE exhaust 2020-2022
- 5G devices dominate 2023
- LTE+5G capacity plan needed

LTE capacity growth with 5G acceleration

Overcoming capacity constraints – expanding spectrum & spectral efficiency

# Spectrum development vs Average Data Rates & Spectral Efficiency

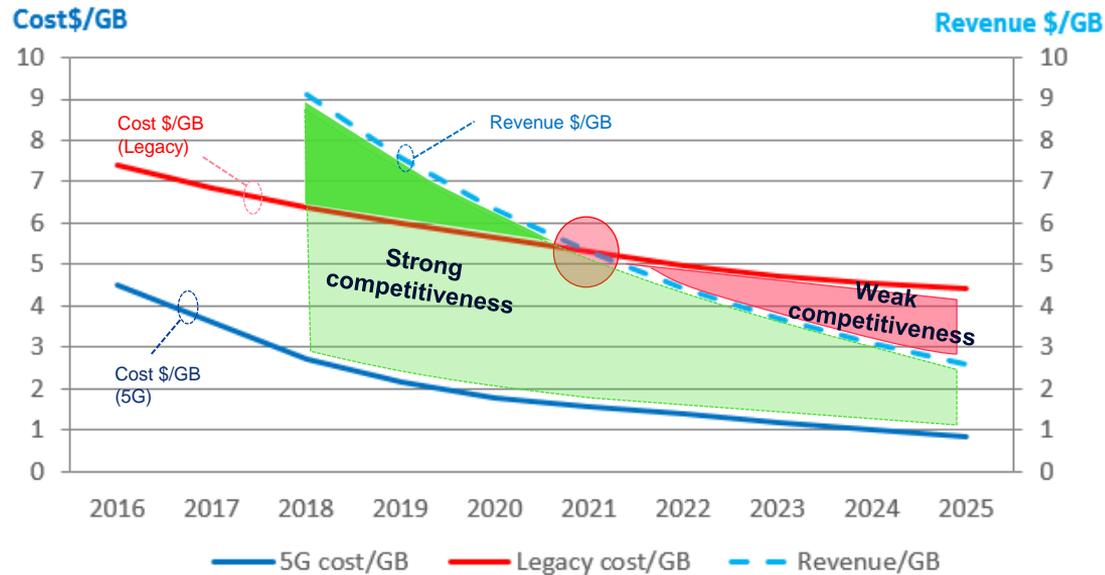


| Technology                                | Frequency (MHz) | Bandwidth (MHz) |
|---|-----------------|-----------------|
| EGPRS (4/8 TS used)                       | 900             | 5               |
|   | 1800            | 10              |
| HSPA+ (DB)                                | 900+2100        | 10              |
|   | 2100            | 10              |
| LTE (2x2MIMO, 64QAM DL, 16QAM UL)         | 2600            | 20              |
|   | 1800            | 10              |
|   | 900             | 10              |
| LTE-A (3CC 4x4 MIMO, 256QAM DL, 64QAM UL) | 900             | 50              |
|   | 1800            |                 |
|   | 2600            |                 |
| 5G (2x2) 256QAM                           | 700-900         | 10              |
| 5G (cmWave, mMIMO)                        | 3500            | 100             |
| 5G (4x4) 256QAM                           | 28000           | 400             |

# Declining ARPU will challenge sustainable business with legacy infrastructure

Leverage lower 5G cost/GB to ensure strong competitiveness

Cost per GB and Service revenue per GB trends in major economies, 2016-2025



Source: Bell Labs Consulting & Tefficient

- Current legacy infrastructure will not provide sustainable business for growing data demand
- Hence the main driver for operators to deploy 5G E2E is to realize the efficiency gains the technology provides over LTE and to keep strong competitive position

# South Korea offer – seemingly lower 5G data plan - 5G will enable operators more cost efficiently support data packages, also when shifting to more unlimited data

## LTE pricing

## 5G pricing



- 4 GB, \$44.05
- 150 GB, \$69.60
- Unlimit., \$88.10

- 8 GB, \$48.50 \*
- 150 GB, \$66.10 \*
- 200 GB, \$83.70 \*
- 300 GB, \$110.20 \*

\* Unlimited to eof 2019

SKT is offering "the same amount of 5G data at lower prices" than it charged for its 4G services.

*SKT statement*



- Unlimited, \$63.00

- 5 GB, \$70.50 \*\*
- 50 GB, \$88.10 \*\*
- 100 GB, \$114.60 \*\*
- 8 GB, \$48.50

\*\* Unlimited

"The 5G Super Plan Basic is 9,000 won (\$8) cheaper than the unlimited data plan for LTE services."

*Park Hyun-jin, KT's 5G marketing chief*



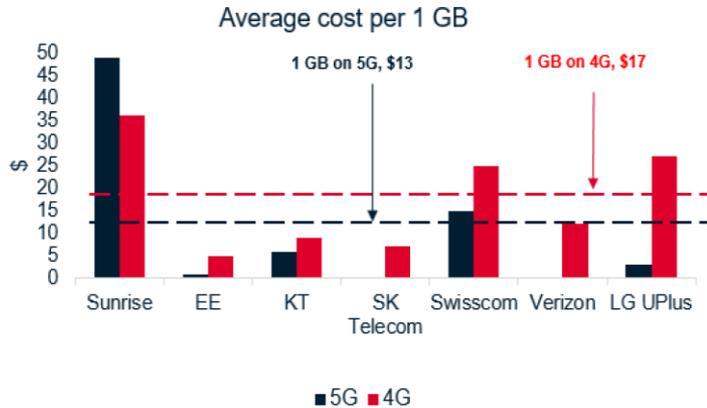
- Unlimited, \$63.00 \*\*\*
- \*\*\* 3 Mbps speed when >2 GB/day

- 150 GB, \$66.10
- 250 GB, \$83.70

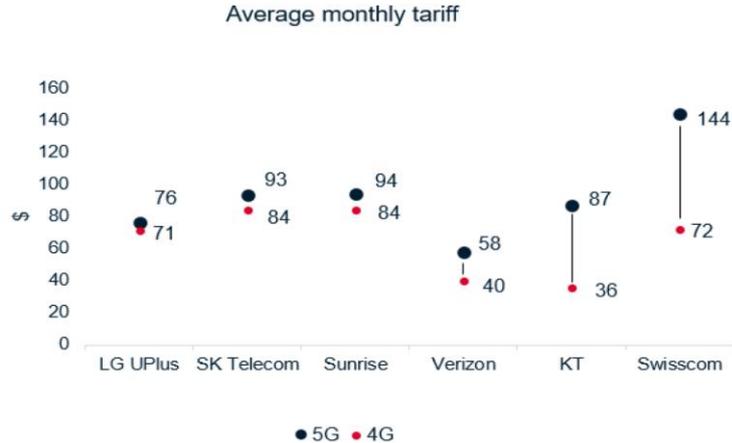
# 5G pricing is still in initial phase

No consensus on pricing in first 5G launches. Offers vary considerably both across and within markets.

## LIMITED PLAN



## UNLIMITED PLAN



**Limited plans:** 5G brings the average price per GB down by almost one quarter compared to 4G, from \$17 to \$13.

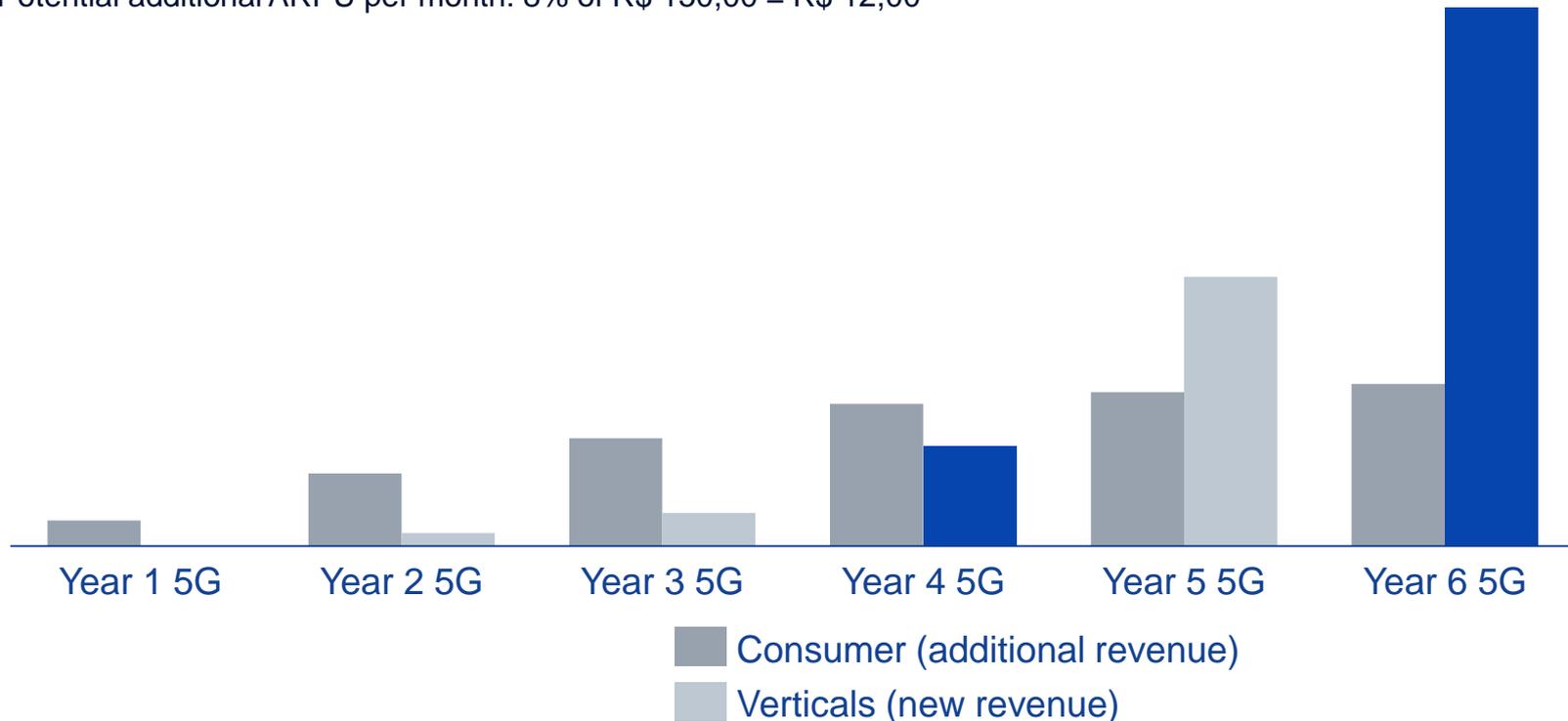
**Unlimited plans:** 5G tariffs are more expensive than 4G. 5G around \$89, versus \$68 for 4G.

# But can we calculate the impact for Brazil ?

Based on Korea: 5G plans presents 8% higher ARPU than 4G

Potential of 4G users to migrate to 5G in early stage (12 months after launch): 1.050 kuser

Potential additional ARPU per month: 8% of R\$ 150,00 = R\$ 12,00



# Preparing your network to handle whatever the world throws at it

## De-risking 5G network evolution - solution requirements

Emerging devices & sensors

### Massive scale access

- Widest range of RAN options
- Highest cell site capacity
- Smallest footprint & power consumption

Centralize RAN CU functions  
→ Leverage pooling gains

Radio sites

### Cross-domain process automation

AI & ML enhanced and closed loop fulfillment & assurance

### Converged edge cloud

- vRAN, MEC and core functions
- Microservice support
- Multi-access including fixed/WiFi

Flexible placement of VNFs, apps & content  
→ Lowest latency and reliability

Edge

### Cloud native core

- 5G upgrade without new VNFs
- CUPS\* from the start
- Mix and match of NSA and SA
- Service based architecture

Central core

## Cross-domain performance optimization & security

Validated use case performance: throughput, latency, reliability

### Programmable and scalable Anyhaul

- Dynamic interaction of cloud and transport networking domains
- Choice of most economical transport technologies for e2e connectivity/use case

