4G EVOLUTION AND 5G SPECTRUM POLICY

Creating a sustainable future for mobile broadband

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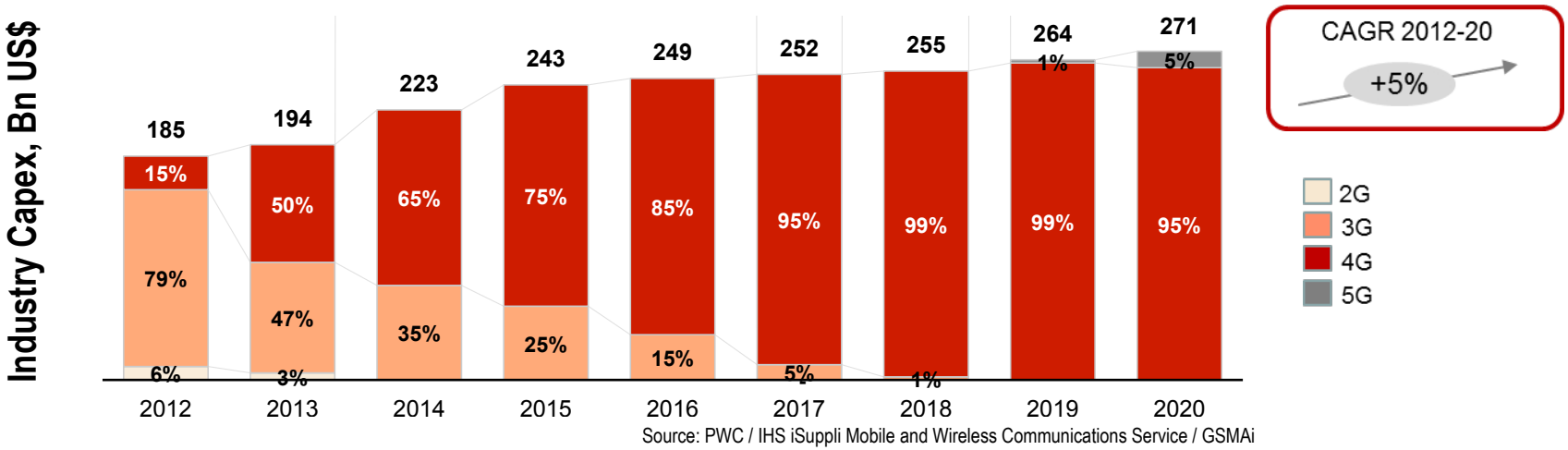
MOBILE CONNECTION & INVESTMENTS

Clear majority of the world's mobile connections are still 2G (i.e. 63%) leaving around a third on 3G (32%) and only 5% on 4G



Source: PWC / IHS iSuppli Mobile and Wireless Communications Service / GSMAi

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HOW TO SUPPORT DATA GROWTH?

THERE ARE 4 MAIN WAYS MOBILE NETWORKS CAN SUPPORT RISING DATA

- **Increasingly spectrum efficient mobile technologies** (e.g. HSPA+, LTE, LTE-A & 5G)
  - Operators actively upgrade technologies but needs to follow standards evolution and device availability for the market

- **Denser networks** (e.g. more cell sites inc. small cells)
  - This drives up CAPEX and OPEX for equipment, backhaul, leasing sites, power etc

- **Wi-Fi offload** (i.e. shifting data on to Wi-Fi networks)
  - Many operators have Wi-Fi hotspots but there are backhaul and management challenges

- **Using more mobile spectrum**
  - Most cost-effective capacity enhancer so keeps network costs and consumer prices down
  - Newer mobile technologies tend to use more spectrum (5G likely to exemplify this trend)

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WHAT IS 5G?

NO FORMAL DEFINITION OR APPROACH AGREED, BUT…

- **Two broad visions/drivers:**

1. **Service level:** Extremely reliable, near universal coverage, high speed mobile broadband that can cost effectively support growing traffic (especially video) and better support low-power IoT.
   Uses 2G, 3G, 4G & potentially others
2. **Generationalist level:** Achieving *much* higher data rates, lower latency and full connectivity. Few applications require these demands (e.g. virtual reality, tactile internet and autonomous/connected cars).
   Exclusively uses Next-generation radio access technology

- **Regularly Identified requirements**

1. **1-10Gbps**
2. **1ms latency**
3. **1000x bandwidth per unit area**
4. **Supports 10-100x more devices**
5. **(Perception of) 99.999% availability**
6. **(Perception of) 100% coverage**
7. **90% energy reduction**
8. **10 year battery life for IOT devices**

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HOW MUCH MORE SPECTRUM DOES MOBILE NEED AT WRC-15?

- **New mobile bands need be identified at WRC-15 or it could be too late**
  - Can take a decade to get new spectrum at a WRC, produce equipment, free bands, award licences and launch
  - Existing spectrum will meet near-term demand, WRC-15 is for demand in 2020-2025 - or later

- **Spectrum discussions need to begin given long timeframe to free spectrum**
  - Agreeing a dedicated WRC-19 agenda item at WRC-15 will be a vital first step
  - Identifying additional (and harmonised) spectrum bands for mobile broadband (IMT) at WRC-15 as an important milestone for the mobile industry

- **Need to appropriately respond to the emerging high level use cases for 5G**
  - Enhanced Mobile Broadband
  - Massive Machine Type Communications
  - Ultra-reliable and Low Latency Communications

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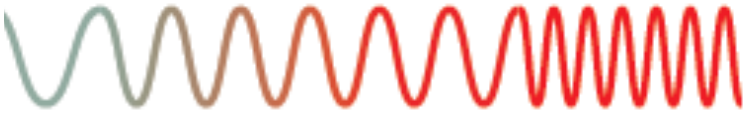
WHAT ARE THE 5G SPECTRUM POLICY CONSIDERATIONS?

- **5G likely to require significant additional capacity spectrum**
  - Spectrum above 6GHz is a good target as very wide bandwidths are more commonly available
  - 1-6GHz (inc. refarmed IMT spectrum) provide capacity but can also cover wider areas and suit macro base station use cases

- **5G will require coverage spectrum to provide nationwide services, not just urban hotspots**
  - Sub-1GHz spectrum is vital for digital inclusion, in-building penetration and also low-power Internet of Things applications

- **Wider range of mobile licensing regimes are possible with 5G**
  - Exclusive licensing: Essential to guarantee QoS and encourage network investment
  - Flexible shared licensing: Higher 5G frequency ranges suit sharing as small coverage areas mean more manageable interference

FREQUENCY RANGES TO BE EXPLORED FOR 5G



SUB 1-GHz | **1-6 GHz** (inc. refarming) | **ABOVE 6 GHz** (inc. mm waves)

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THANK YOU

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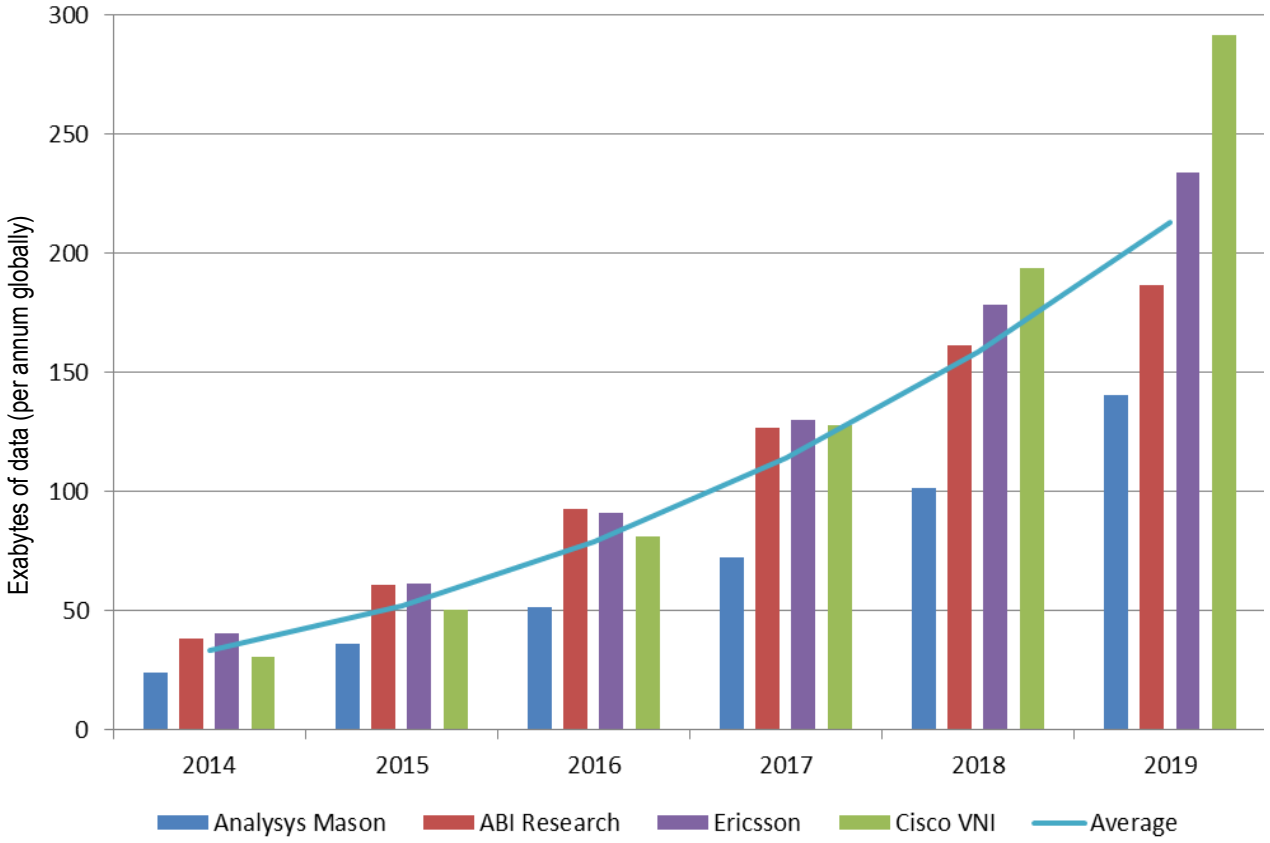
DATA GROWTH EXCEEDING EXPECTATIONS



100X DATA GROWTH IN PART OF 4G'S LIFETIME

TRAFFIC IN 2019 ABOUT 6-10X THAT OF 2014
TRAFFIC IN 2019 ABOUT 100X THAT OF 2010

AS WE'LL SEE THIS IMPACTS SPECTRUM

ITU'S SPECTRUM ESTIMATES BASED ON
ONLY 44-80X DATA GROWTH FROM 2010-2020

ANALYSTS INCREASING THEIR NUMBERS

ANALYSYS MASON & ABI RESEARCH JUST
REVISED 2019 PREDICTIONS UP BY 30%

PREDICTIONS MAY BE UNDERSTATED

WE FOUND SAUDI ARABIAN DATA TRAFFIC WAS 2.6X
HIGHER THAN CISCO'S VNI ESTIMATES

Sources

Analysys Mason, Global Mobile Network Traffic, Oct 2014
ABI Research, Mobile Data Traffic & Usage, Oct 2014
Cisco VNI Mobile Forecast, Jan 2015
Ericsson Mobility Report, Feb 2015

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