

# 5G for people and things

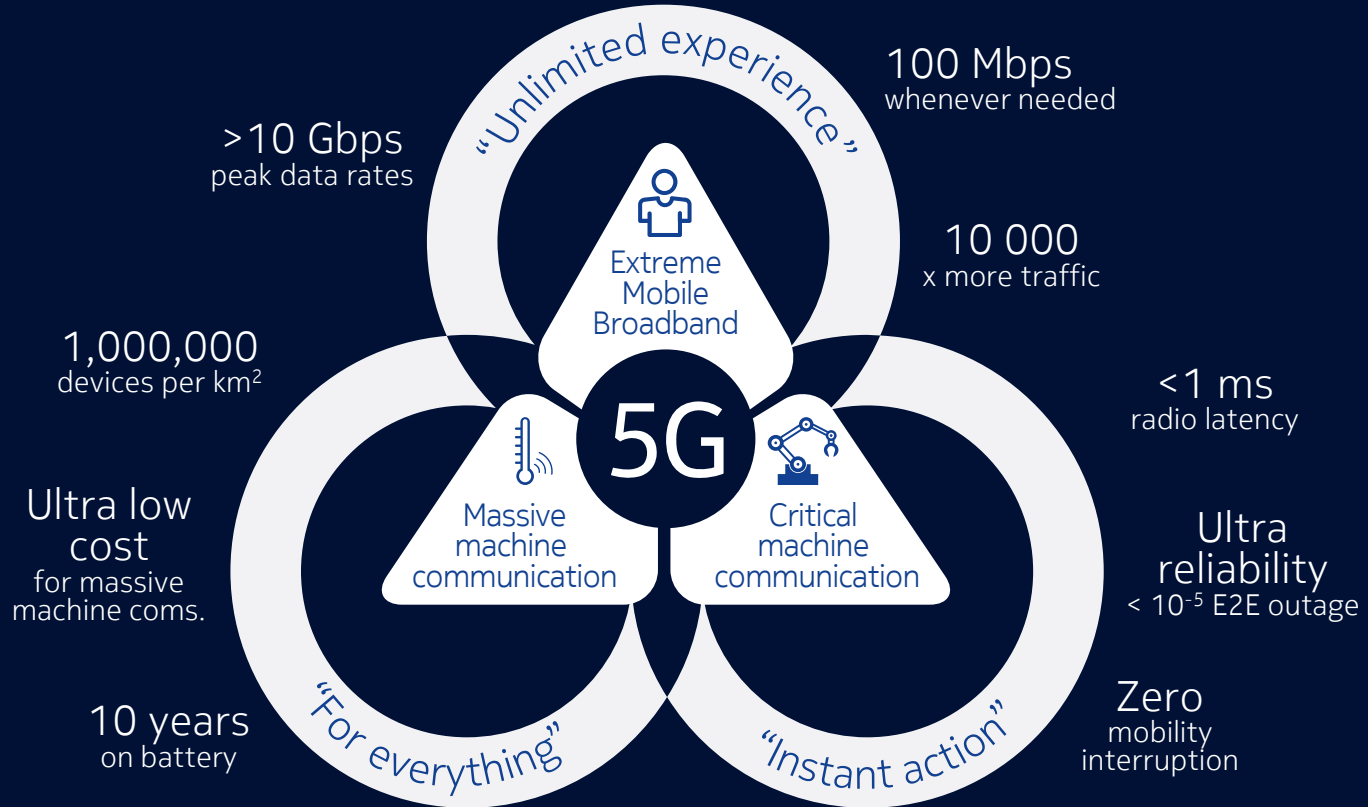
## Spectrum views



NOKIA

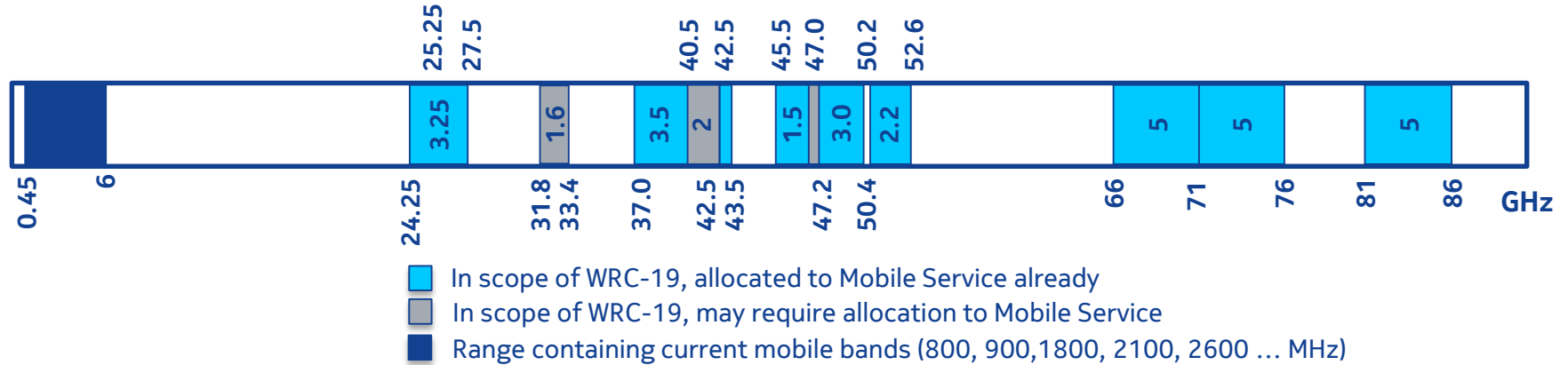
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# 5G will change the world



# Bands under study for WRC-19

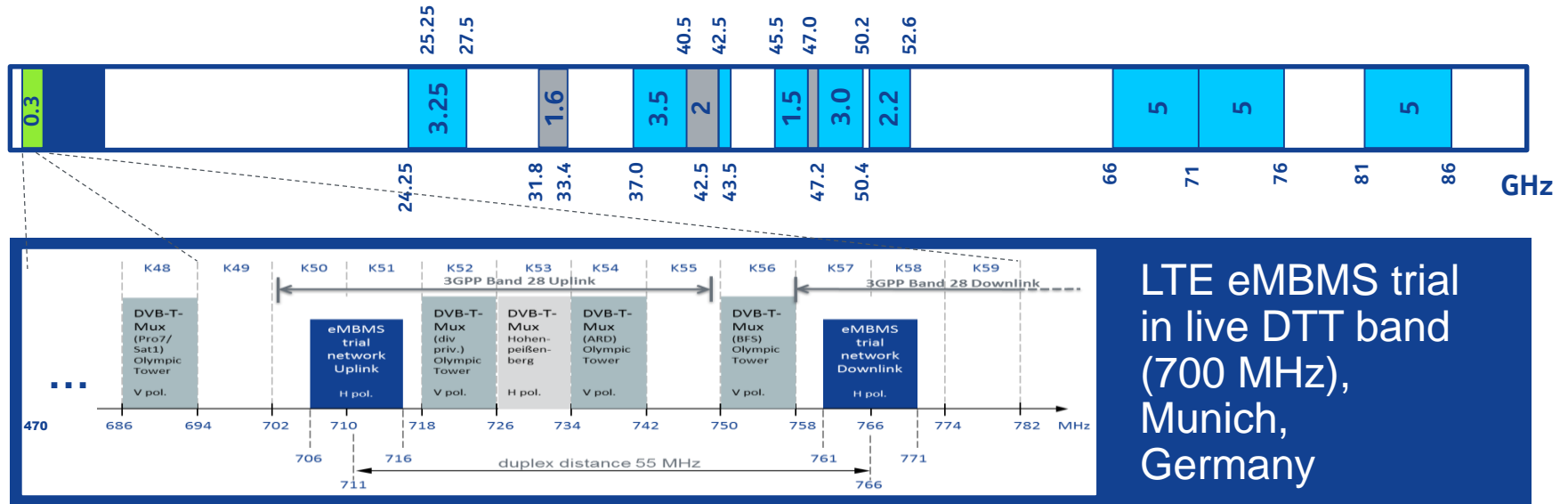
Opportunities at ~25 GHz and above



- Bands between 24.25 GHz and 86 GHz are being studied for **WRC-19** (Agenda Item 1.13)
- New **spectrum needs** for 5G/IMT-2020 and **compatibility** with other services are being analyzed
- **Prioritization of bands**, considering global developments, is required to focus the studies to the most promising bands
- Industry preference for bands as low as possible and as wide as possible

# 5G below 1 GHz for mMTC and URLLC, plus media in Europe

2x 30 MHz in 700 MHz & more opportunities below for mMTC, URLLC and media, resp.



**LTE eMBMS trial in live DTT band (700 MHz), Munich, Germany**

Wide area coverage in sub 1GHz bands for mMTC and URLLC

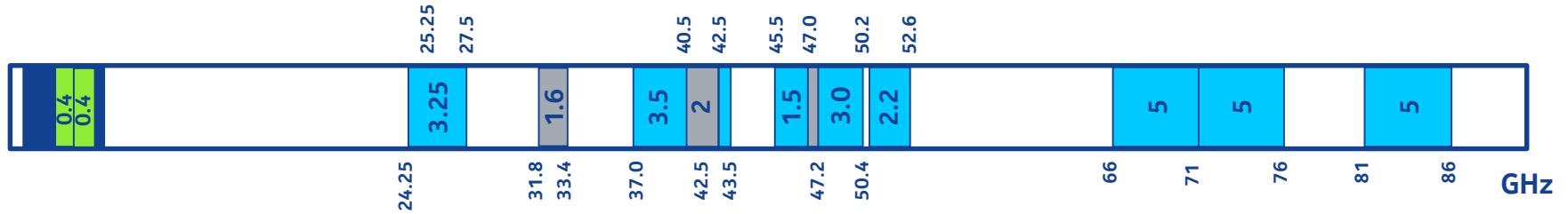
- 700 MHz band becomes available ~2020 in Europe, 600 MHz band may play similar role in US

Wide area DL coverage in EU in co-existence and co-operation with broadcast (win-win)

- Flexibility option in 470-694 MHz based on Supplemental Downlink coexisting with DTT (>2020)

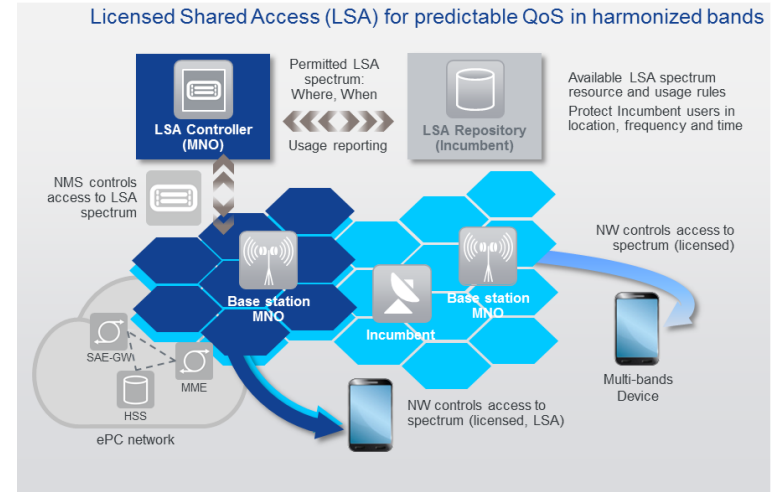
# 5G early eMBB in 3.4 GHz to 4.2 GHz range in Europe

400 + 400 MHz opportunities in C-band



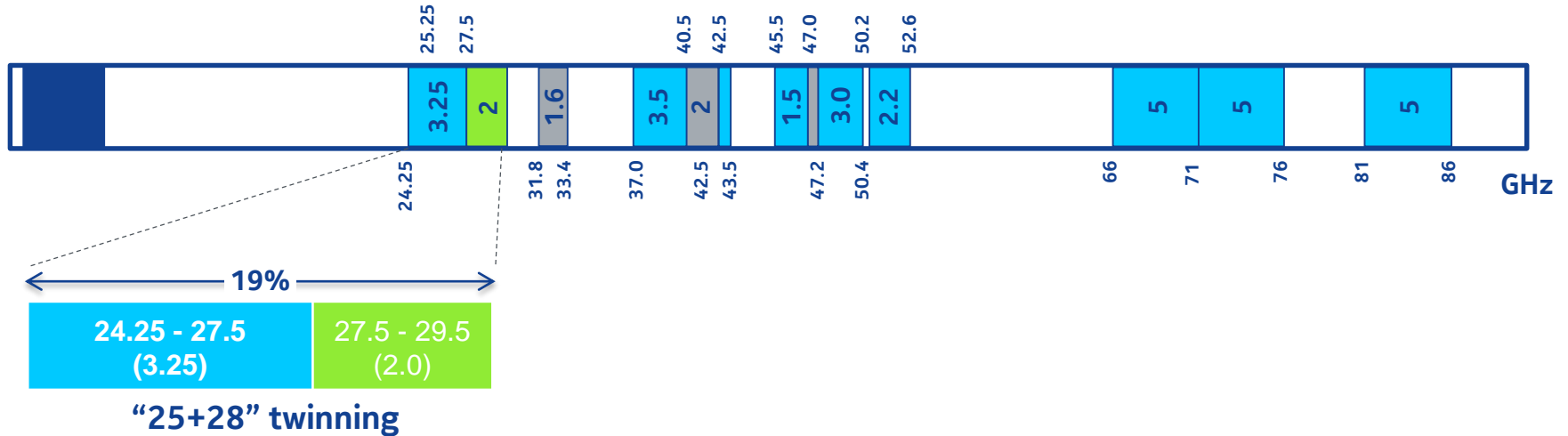
## Urban area coverage in C-bands for early eMBB

- 3.4-3.8 GHz sparsely used in Europe
- Putting proper regulation in place can make 3.4-3.8 GHz available for early 5G eMBB ~2020
- Further extensions possible in 3.8-4.2 GHz range >2020
- Sharing, e.g. based on LSA, may play a role



# First “close-to mm-wave” band for true eMBB in Europe

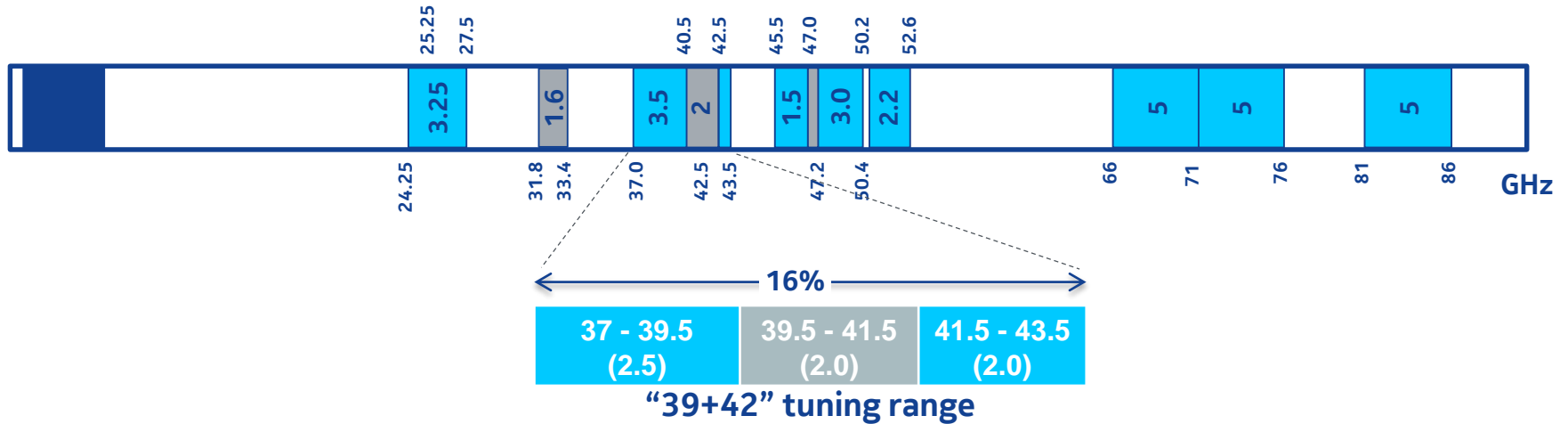
GHz opportunities with economies of scale with 28 GHz band activities in US and Korea



- 28 GHz band (27.5-28.35 GHz) is in FCC ruling on 5G spectrum, Korea targets 26.5-29.5 GHz from 2018 Olympics on
  - 25 GHz band is directly adjacent to the 28GHz band – good possibility for tuning range approach (band twinning)
  - 32 GHz band at 31.8 GHz is adjacent to (\*) passive services with “zero transmission” protection requirements, may require large guard
- Technical preference of mobile industry for 25 GHz band in Europe
- Subject to studies and ongoing consultations at EU commission, RSPG and CEPT PT1, target availability latest 2020

# Next mm-wave band in Europe

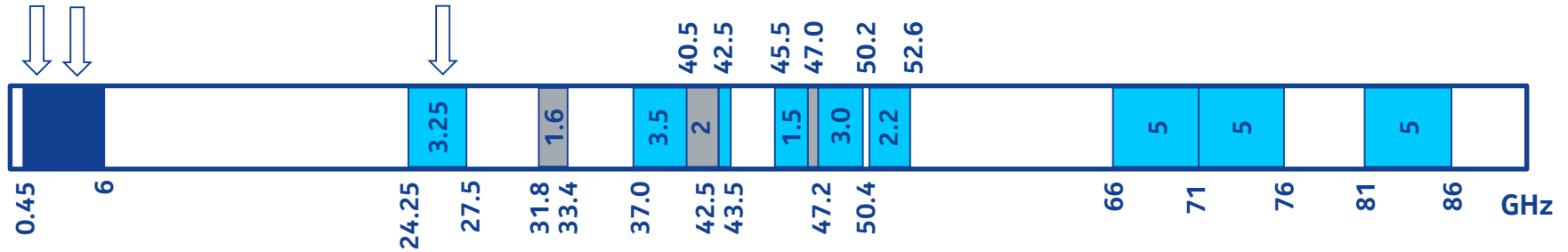
GHz opportunities with economies of scale with 39 GHz band activities in US



- 39 GHz band (38.6-40 GHz) is in FCC ruling on 5G spectrum
- Parts of the range 37.0-43.5 GHz are widely supported by administrations globally and under study
  - WRC-19 will likely agree on 5G spectrum in WRC-19 in that range, probably different chunks in different regions
  - Applicable to a second wave of 5G rollouts

# Summary 5G Pioneer Bands in Europe

700 MHz, 3.4-3.8 GHz, 25 GHz



- 700 MHz band for wide area layers supporting mMTC and URLLC
- 3.4-3.8 GHz for urban macro layer supporting eMBB in the low single digit Gbps range
- 25 GHz for capacity hot spots supporting eMBB in the double digit Gbps range

All 3 bands need to be ready to use, i.e. allocated, technically harmonized, assigned and available to allow for 5G deployments



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