

5G

Syd Djurs Kommune

28/8-2019

PETER NØDBAK

NØDBAK

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NØDBAK

- Indehaver, Senior Rådgiver NØDBAK
- Civilingeniør, 18 år i Telebranchen
- Tidligere:
 - **Udviklingsdirektør, Telenor**
 - Netværksdirektør
 - Chef for Core network,
 - Chef for Transport network
 - Netværksarkitekt, mv.
-
- PhD Vejleder, AAU
- Censor ved Ingeniøruddannelsen
- Medlem af regeringens 5G arbejdsgruppe
- Wireless IOT Group

Indhold

- Om
- Generelt om udviklingen
- Behov for kommunikation
- Udviklingen af mobilnettet
- Krav til mobilnettet I dag – og I morgen
- Kravene til 5G
- Hvordan bygges 5G
- Opsamling





NMT, 2G, 3G, 4G og nu....5G

2005



2013



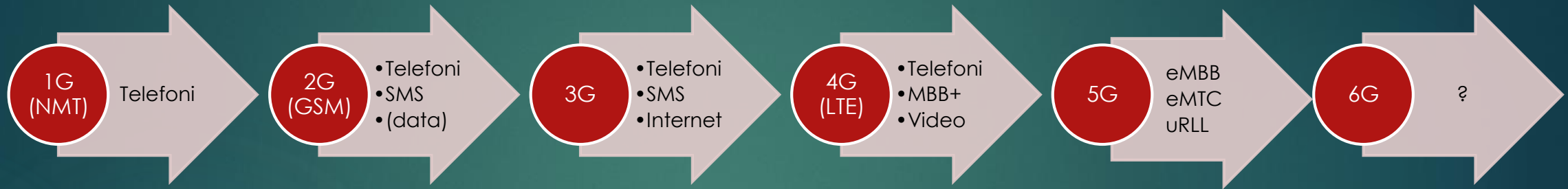
Teknologi skaber adfærd
Adfærd skaber teknologi



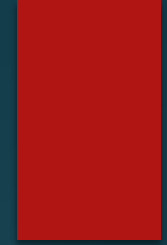
DON'T BLAME TECHNOLOGY!



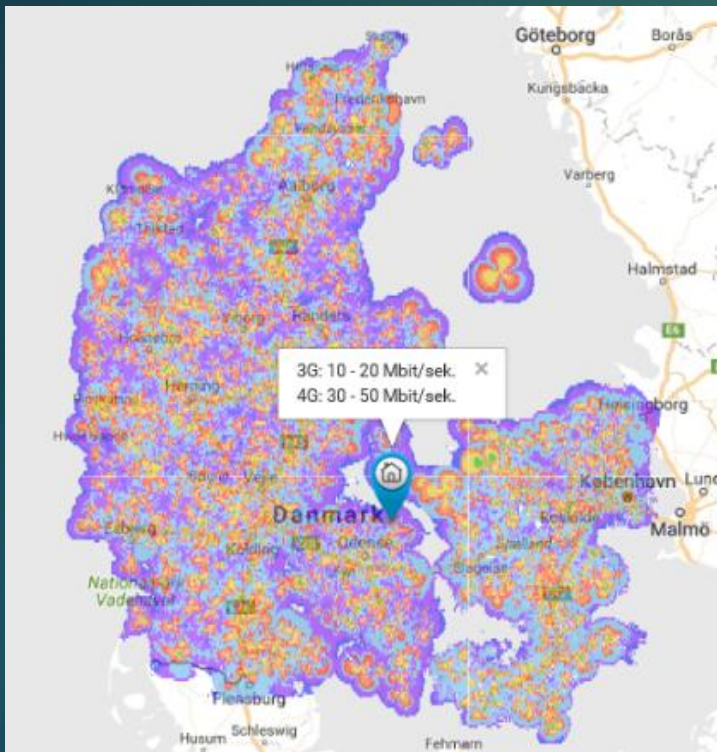
Mobilnettets udvikling



?



Forventninger til mobilnettet



Nye forventninger til mobilnettet

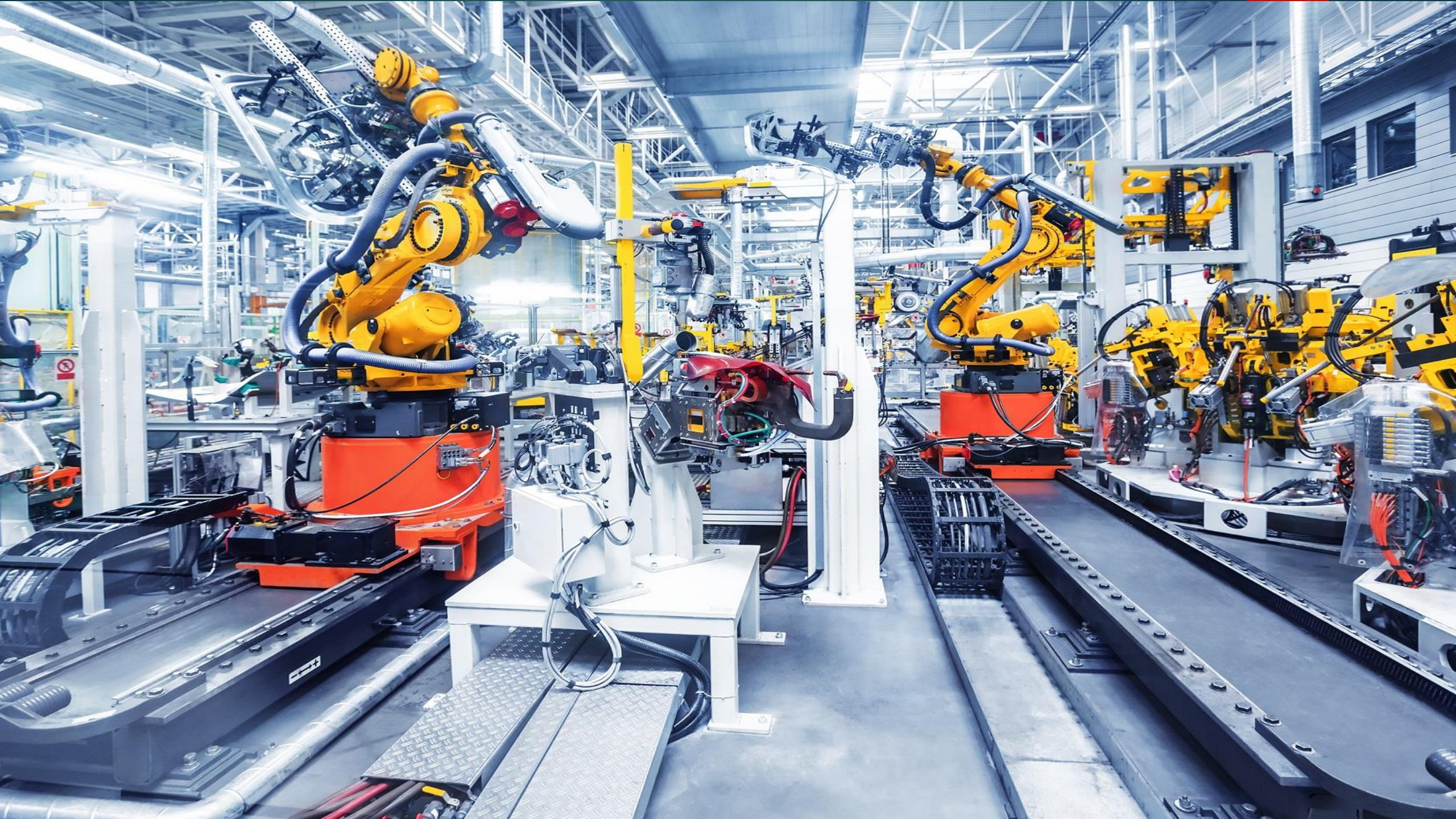




Garbage objects detected: 0











Hvad er 5G



Fiber-like speeds

Multi-Gbps peak rates for both download (consumption) and upload (sharing)



Uniform experience

Reliable performance, e.g. 100+ Mbps, even in challenging environments or at the cell edge



Lower latency

As low as 1ms for interactive content, as well as reduced buffering requirements and lag



Lower cost-per-bit

Significantly lower than today's networks to efficiently support cost-effective data plans

10x
experienced
throughput

10x
decrease in
end-to-end
latency

10x
connection
density

3x
spectrum
efficiency

100x
traffic
capacity

100x
network
efficiency

Design mål

Enhanced Mobile Brodband (eMBB)

- High data rate
- Wide spectrum range
- Wide are of application



Data
Rate

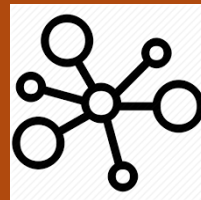
5G

Number
Of devices

Latency/
Reliability

Massive Machine Type Communication (mMTC)

- Scalable connectivity
- Wide area coverage
- Deep indoor penetration

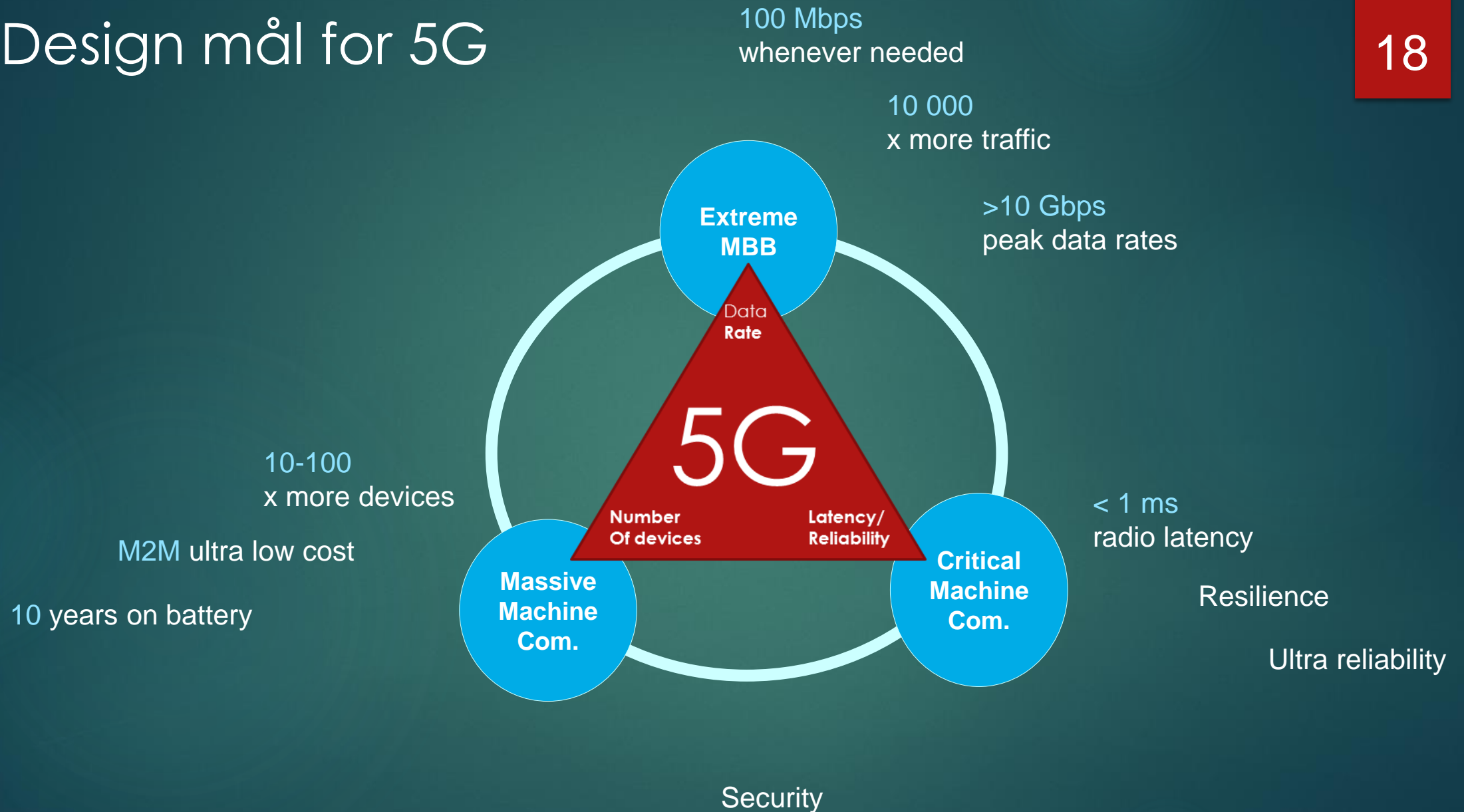


Ultra Reliable Low-Latency Communication (URLLC)

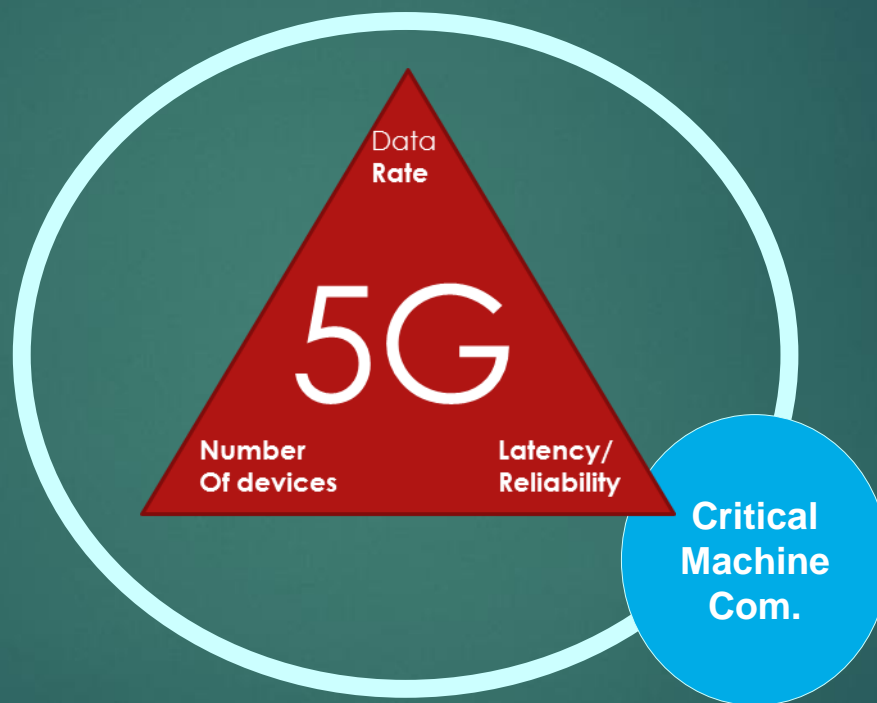
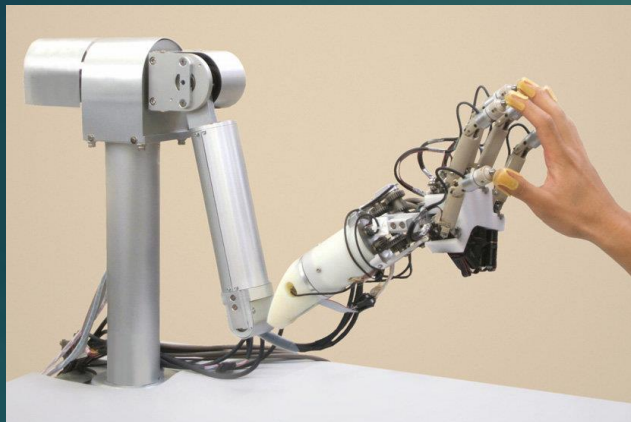
- Ultra-reliable for mission critical applications
- Low latency for real time applications
- Suitable for industrial control



Design mål for 5G



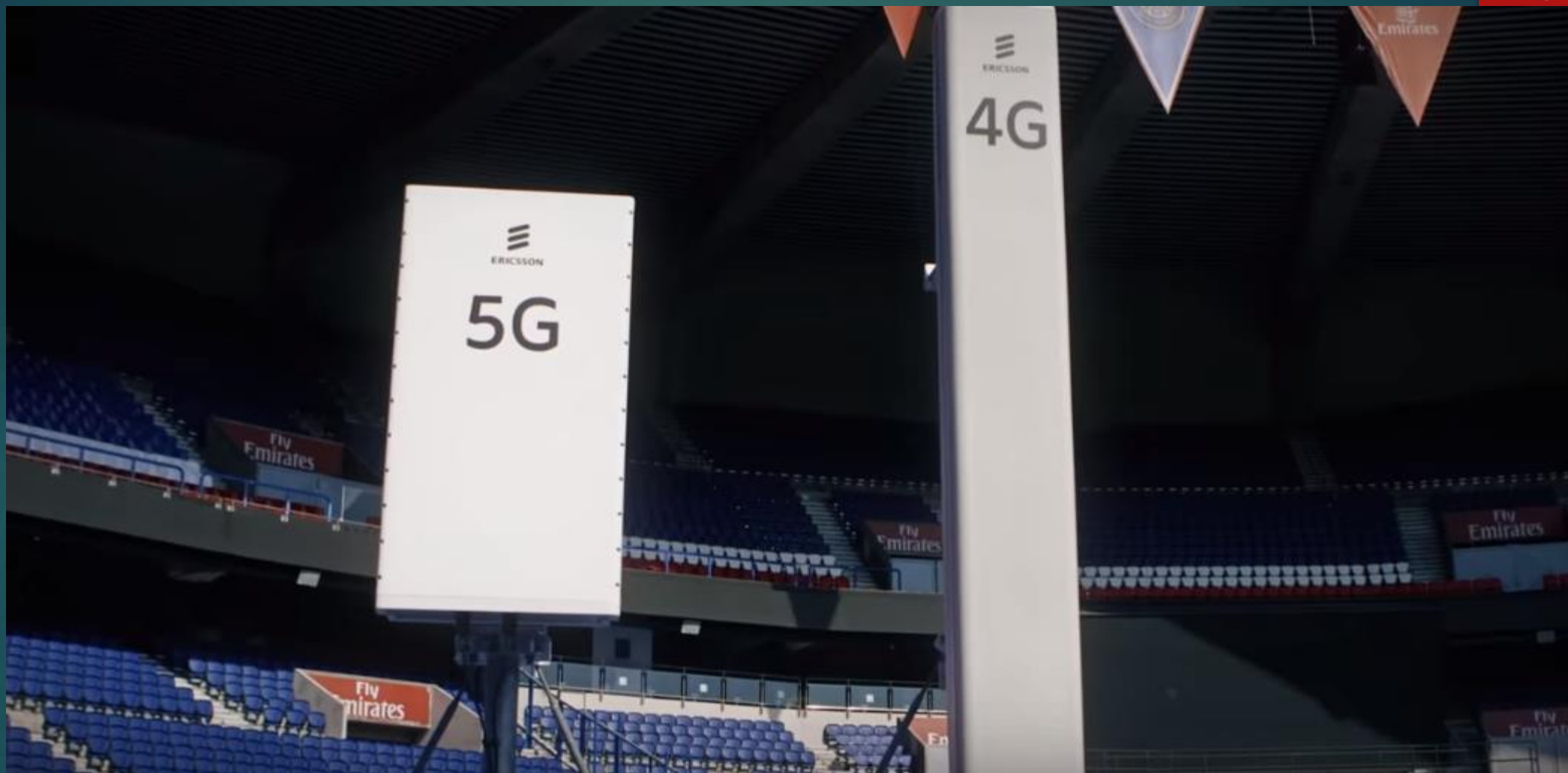
Meget lav forsinkelse og super høj pålidelighed



< 1 ms
radio latency

Resilience

Ultra reliability



<https://youtu.be/KoRkxtZJzEI>

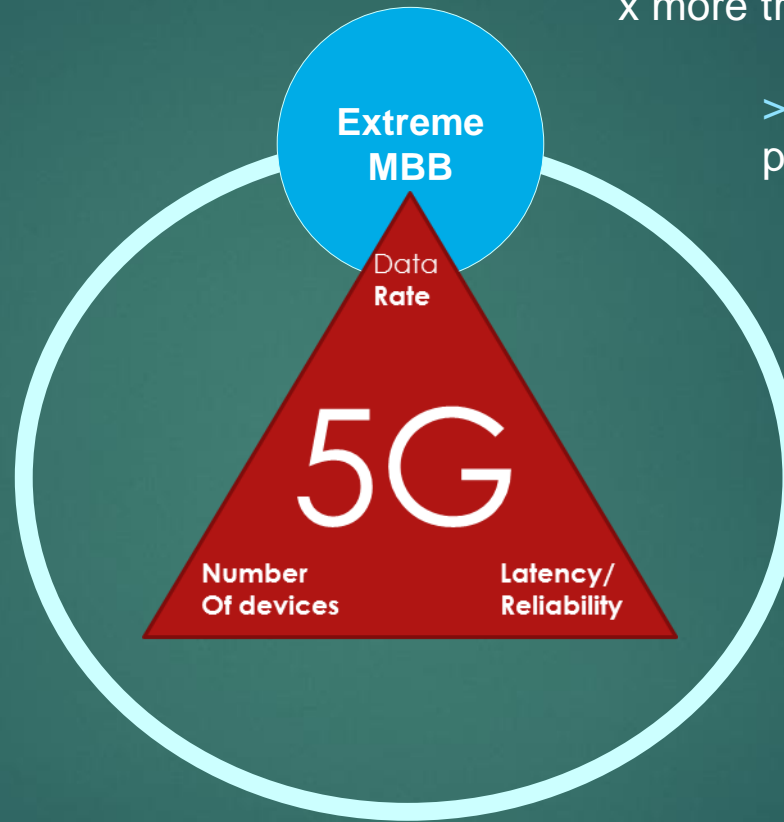
Ekstrem høj båndbredde

100 Mbps
whenever needed

21

10 000
x more traffic

>10 Gbps
peak data rates



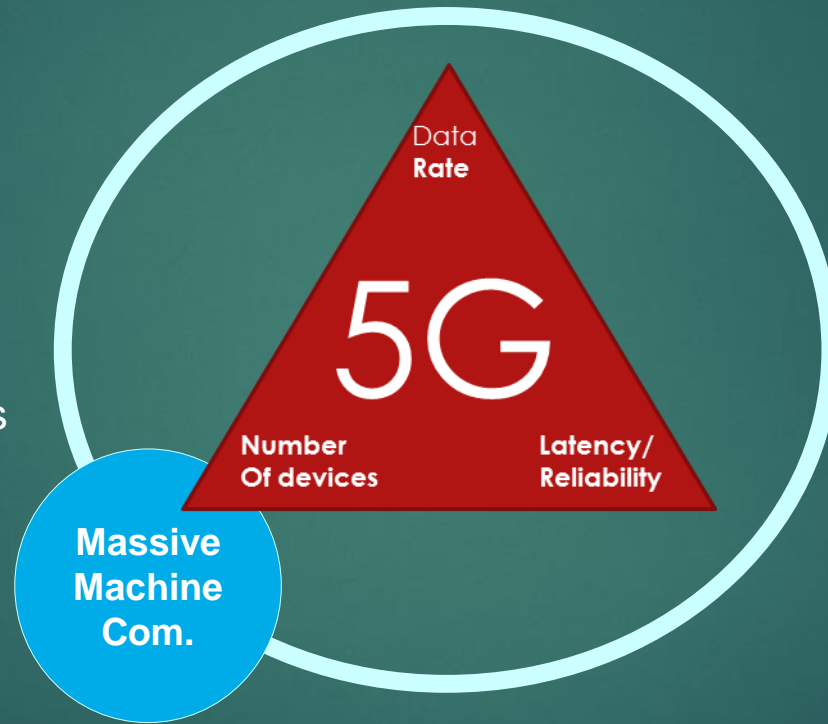
Markant flere enheder koblet på og mere data



10-100
x more devices

M2M ultra low cost

10 years on battery



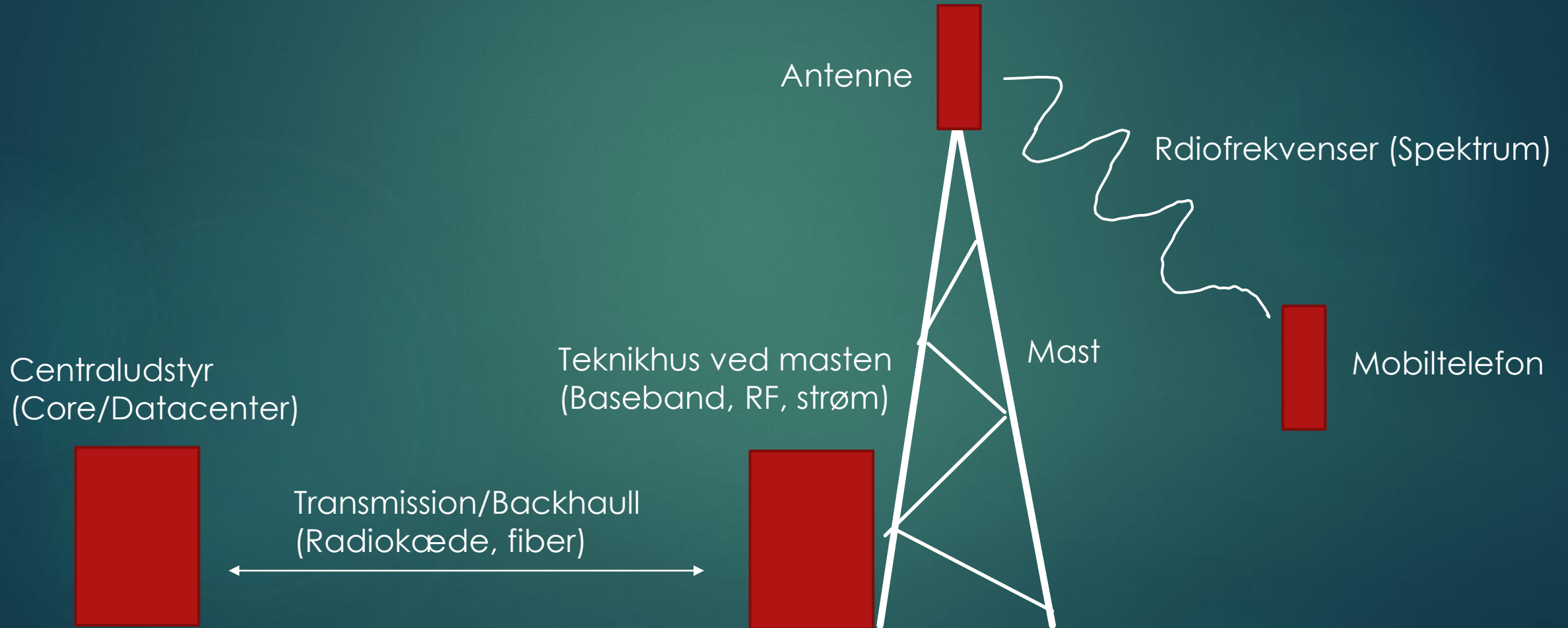
KONE



Hvad er 5G – hvordan bygges det

- ▶ Frekvenser
- ▶ Master
- ▶ Udstyr
- ▶ Kernenetværk (sky)

Mobilnet - referencemodel

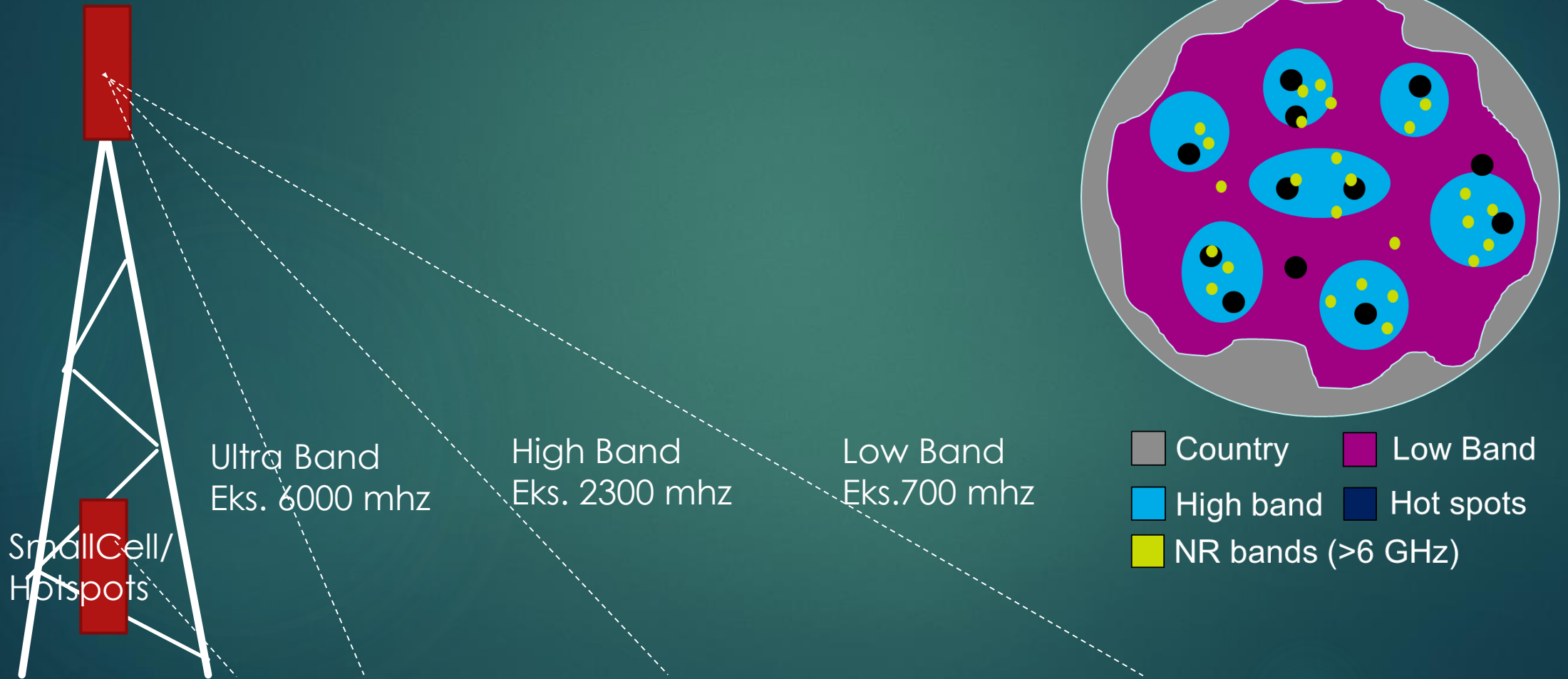


Radiofrekvenser

- ▶ Frekvenser til 5G
 - ▶ 700, 800, 900, 2100, 2300, 2400, 2600, 3500
 - ▶ Nye bånd (både højere og lavere)
- ▶ Lave frekvenser:
 - ▶ Lang rækkevidde
 - ▶ Høj indtrængning
- ▶ Høje frekvenser:
 - ▶ Kortere relativ rækkevidde
 - ▶ Dårlig indtrængning
 - ▶ Højere kapacitet
- ▶ Skal købes/lejes af Staten
- ▶ Uddeles i blokke a 5 Mhz
- ▶ Teknologifhængige



Lidt om dækning





Masterne

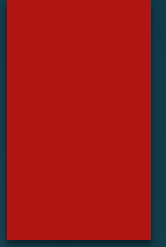
- ▶ Nye antenner
- ▶ Nyt udstyr ved/i masten
 - ▶ RF/baseband (ny modulation, kodning mv.)
 - ▶ MIMO, Beamforming
 - ▶ Edge computing
- ▶ Masteplacering
 - ▶ Genbrug af ca 3500 master
 - ▶ Byg af nye master
- ▶ Nye typer af master
 - ▶ Microceller
 - ▶ Nanoceller
 - ▶ Smallcells
 - ▶ Cloud RAN

Data i skyen

- ▶ Skyen flytter til masten
 - ▶ Intelligent udstyr i/ved masten
- ▶ Hybrid cloud
 - ▶ Opbygning af nyt datacenter
- ▶ Sikkerhed



Opsummering/Diskussion





TAK

The logo for NØDBAK is displayed in a white rectangular box. It features the word "NØDBAK" in a bold, black, sans-serif font. The letter "Ø" is stylized with a diagonal line through it. A vertical line is positioned between the "Ø" and the "D".

NØDBAK

Digitalisering – Nye Teknologier – Digital Transformation

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