

UiO : Universitetet i Oslo

**Inside Telecom høstkonferansen / Gulltasten,
20Nov2018, Oslo**

**Seamless integration between mobile- and home
network?**



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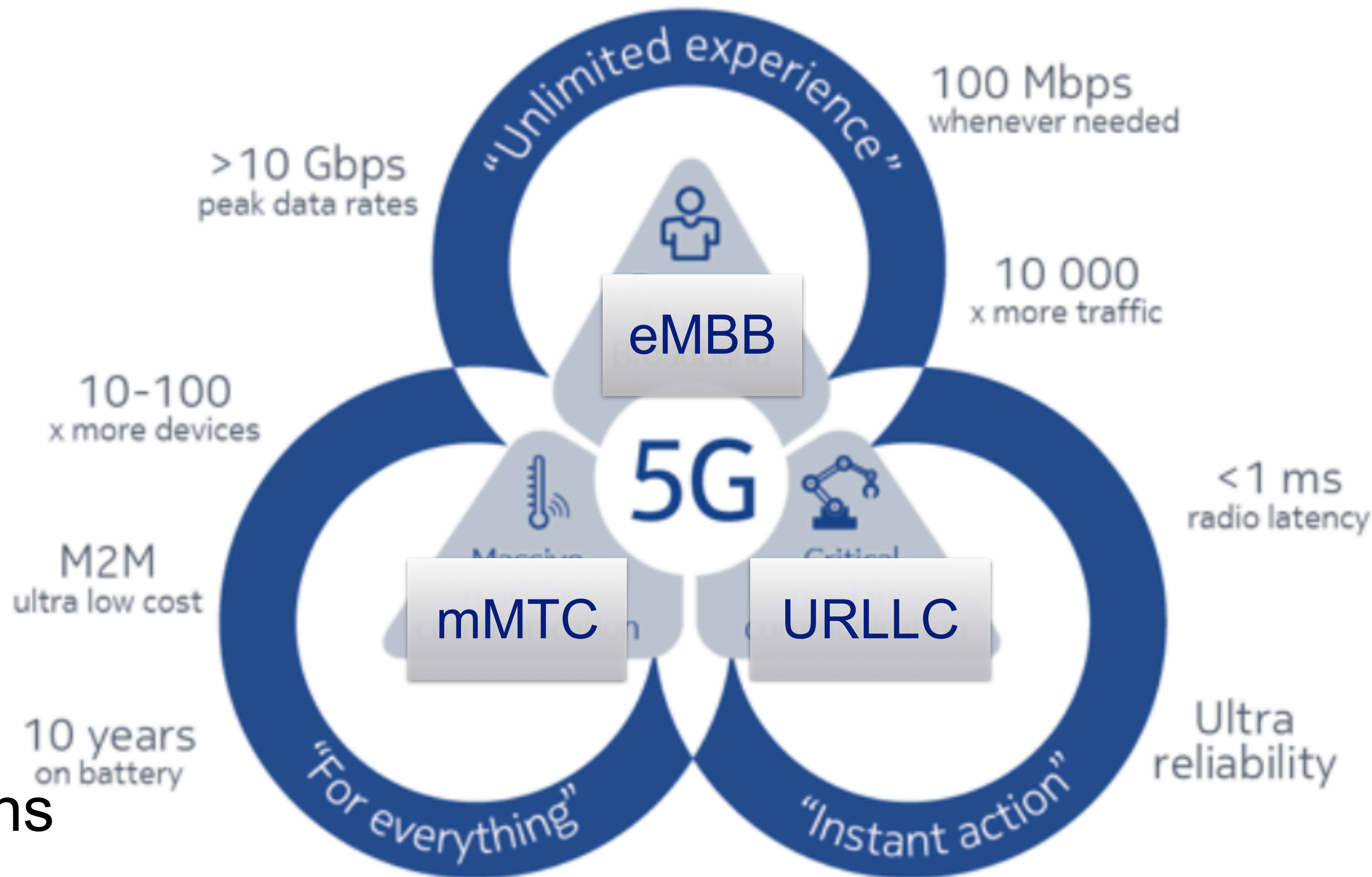
Outlook

- 5G Networks - and integrated access to the home
 - ➔ Industry (secured wireless, Industry 4.0)
 - ➔ Consumer (IoT, Entertainment)
 - ➔ Individuals and Societies (...)
- The indoor challenge & Security, Privacy, Trust
 - ➔ The mobile dilemma
- Novel applications
 - ➔ Application specific routing
- Addressing the Digital Divide
 - ➔ Societal Gap



5G expectations

- Extreme mobile broadband (eMBB)
 - ➔ 10 Gb/s peak
 - ➔ 100 Mb/s whenever needed
- Massive Machine Communications (mMTC)
 - ➔ 10-100 x more devices
 - ➔ M2M ultra low cost
 - ➔ 10 years on battery
- Critical machine communications (URLLC)
 - ➔ <1 ms radio latency
 - ➔ Ultra reliability



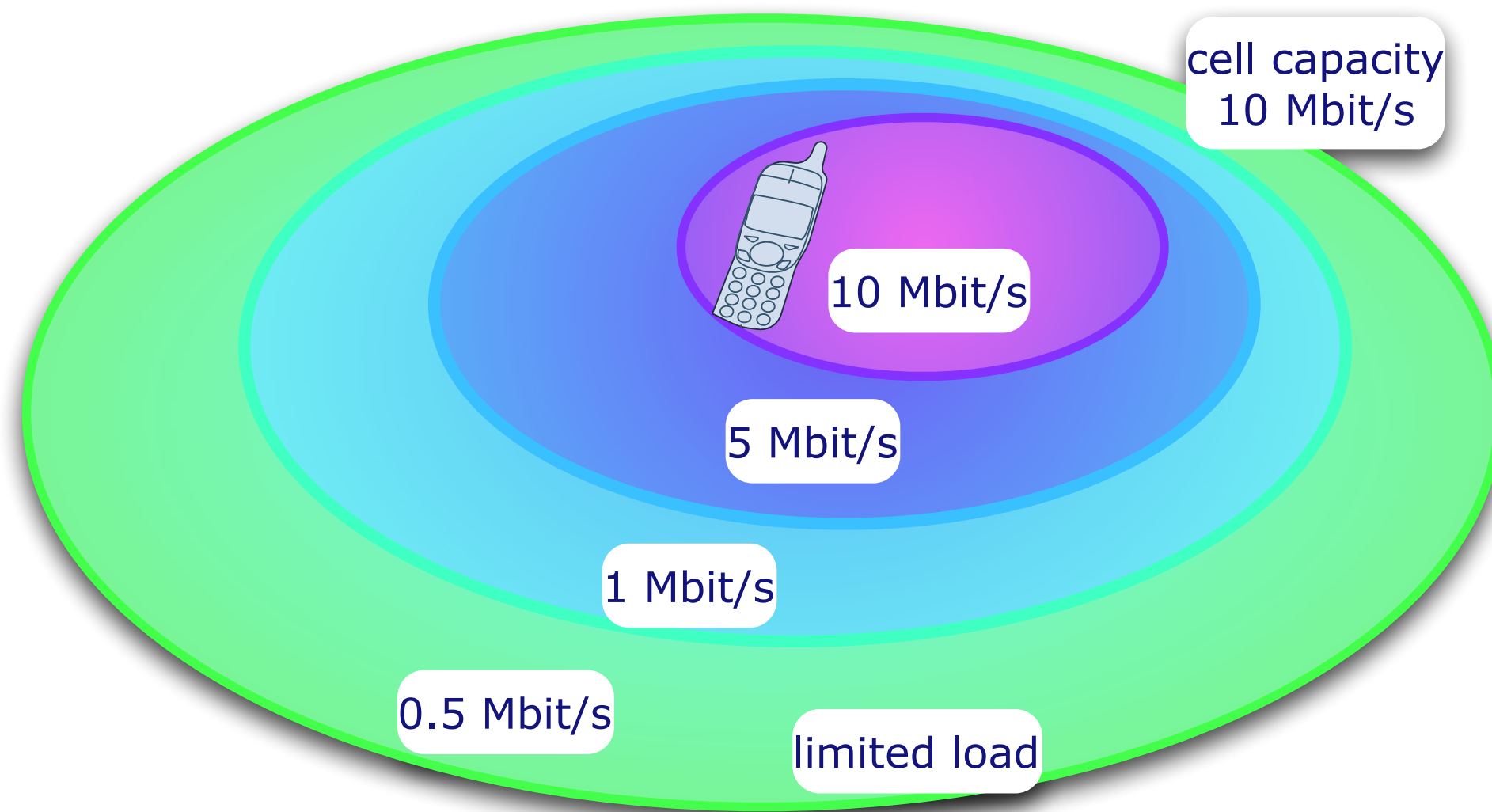
[source: Nokia <https://networks.nokia.com/5g/get-ready>]



5G access: radio and business dilemma

- The radio dilemma

- outdoor to indoor

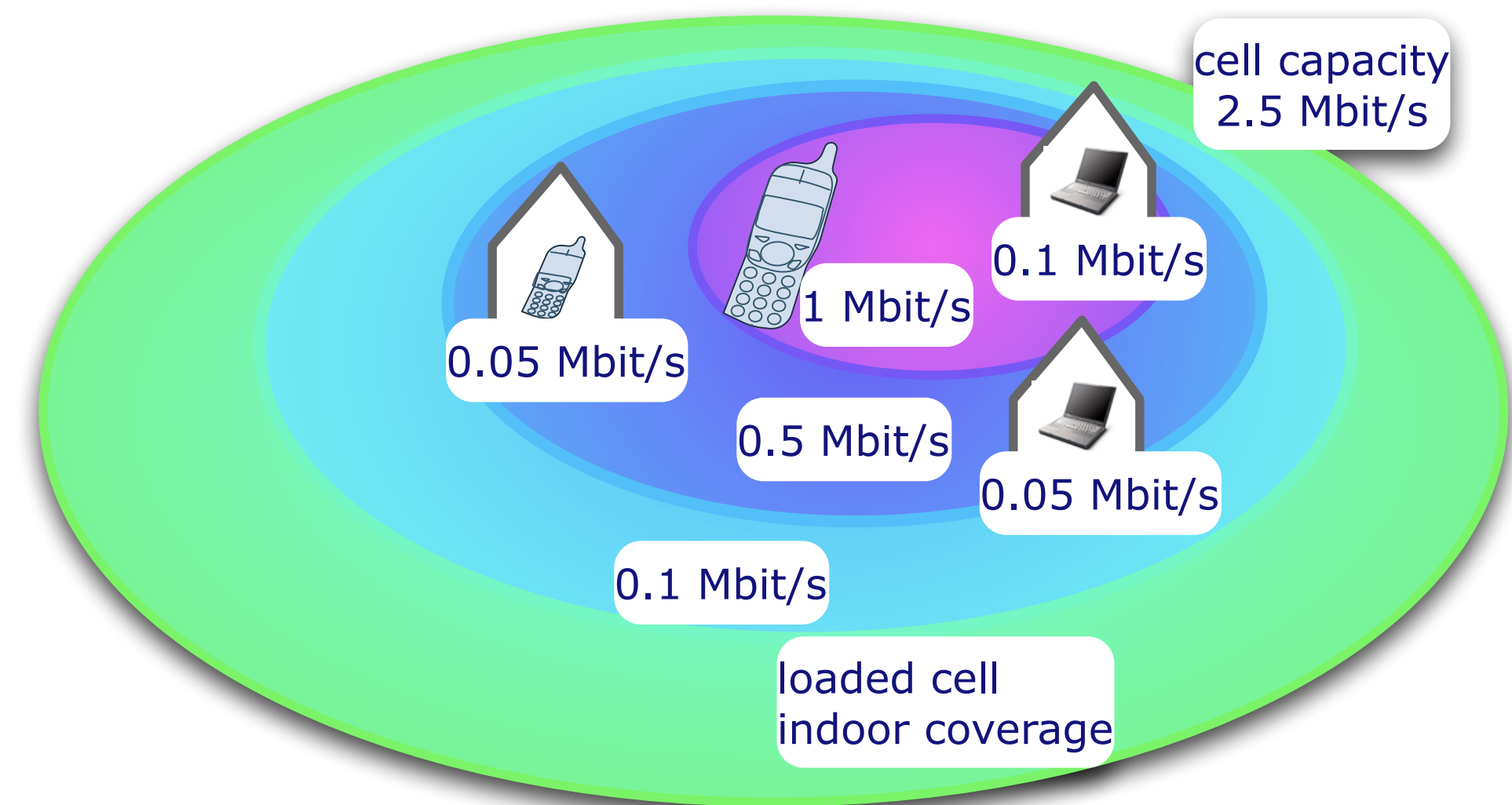


“coverage cell”

- The business dilemma

- 5G access is expensive (range)

- changing access means losing revenue



“70-80% indoor usage”

[Original drawings: Jørgen Grinnes, Telenor, **2010**]



Business perspective of home cells (femto cells)

- Calculations

- ➔ ~60% cost reduction when 10-60% home access
- ➔ flat optimum with 20-40% home access

- Interference

- ➔ re-use of 2.6 GHz

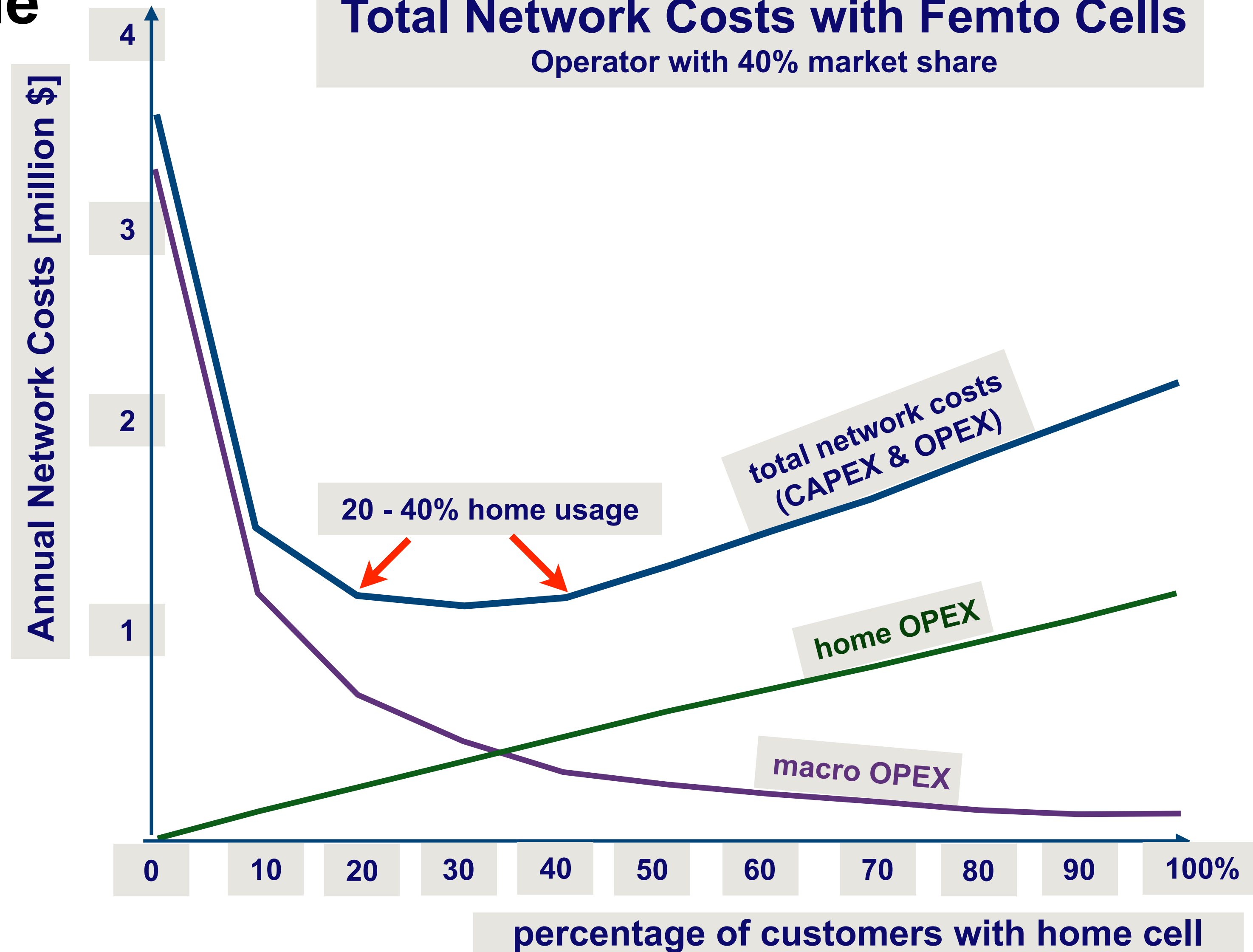
- Design error

- ➔ each operator own femto



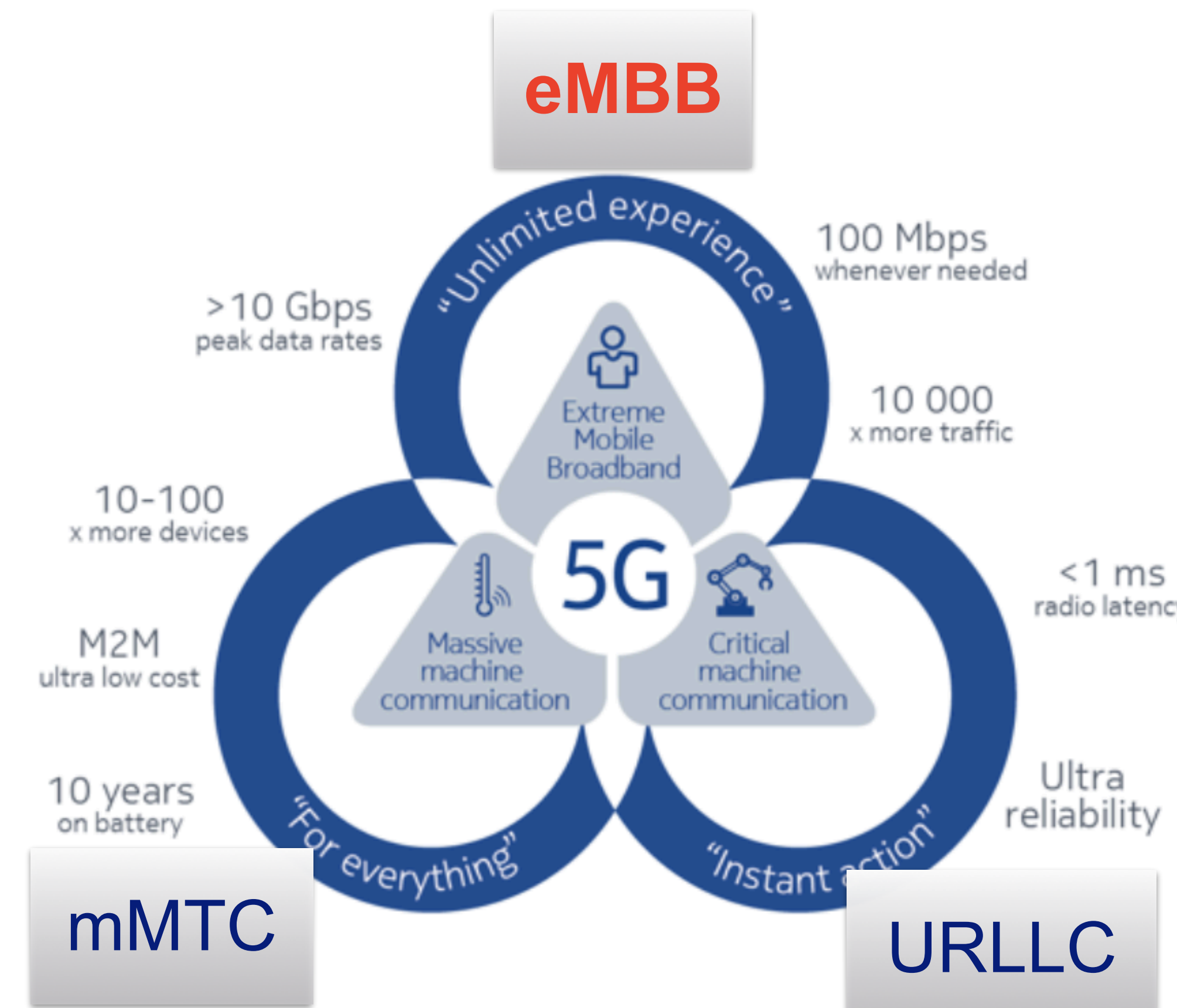
Total Network Costs with Femto Cells

Operator with 40% market share



5G - eMBB analysis and conclusions

- Extreme mobile broadband (eMBB)
 - needs 10-60% of traffic to be taken by indoor
 - Return on investment



[source: Nokia <https://networks.nokia.com/5g/get-ready>]



5G Networks for Industry

- Core demand
- Edge intelligence
 - ➔ Edge/fog computing
- End-to-end QoS and isolation
 - ➔ network slicing
 - ➔ heterogeneity(?)

1

5G may be disruptive for the manufacturing industry

2

Edge computing for shifting intelligence to the network

3

Network slicing for providing end-to-end QoS & isolation

4

Many industrial requirements not fully addressed yet

5

Close interaction of the whole ecosystem needed

6

Industry 4.0 may become THE killer application for 5G 😊

[Source: Andreas Mueller, Bosch, 2018]



largest security project in EU

58 partners from 12 countries

80 M€ budget
35 M€ EU&national

Secured Connected Trustable Things (SCOTT)

SECURITY



PRIVACY

TRUSTABILITY



USABILITY



SAFETY

Automotive

Home

Rail

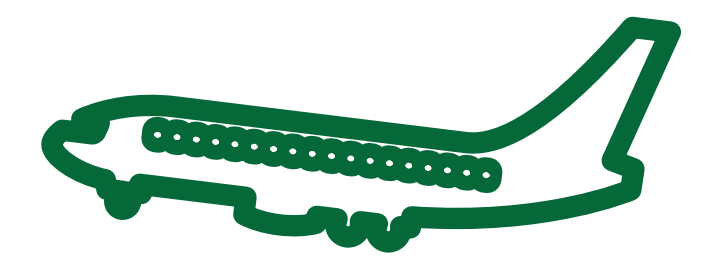
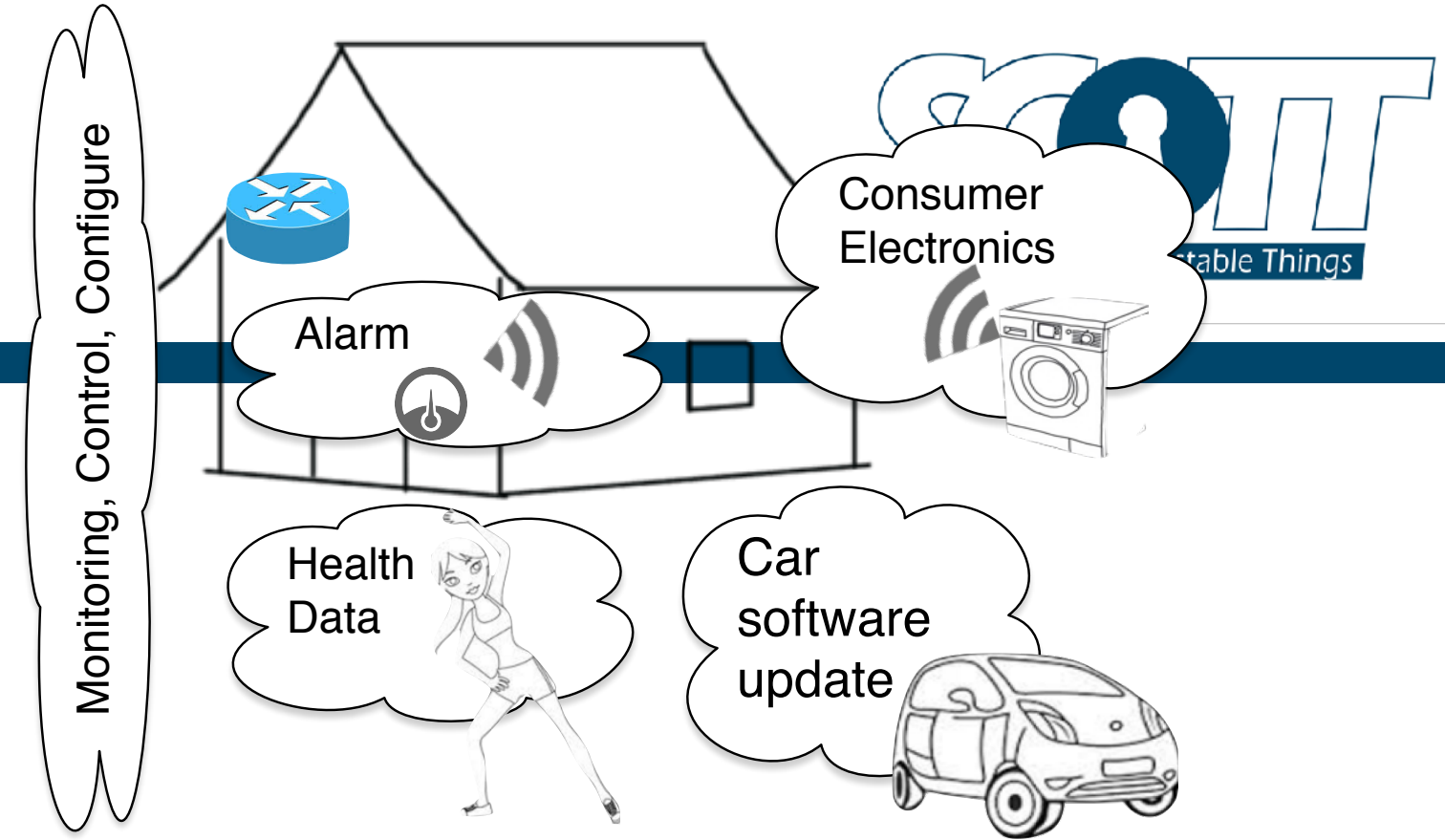
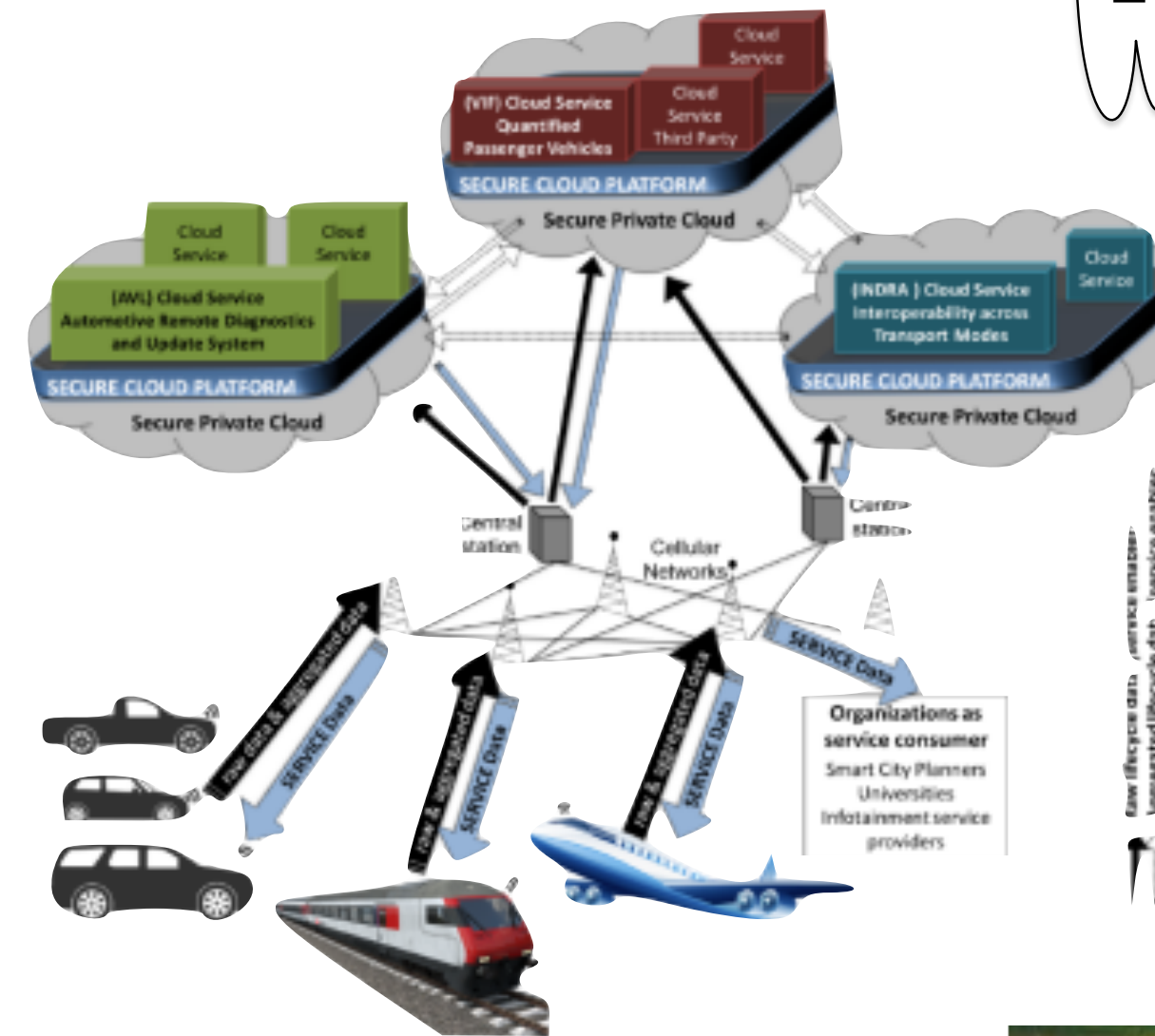
5G

Avionics

- 15 industry-driven Use Cases (TRL 6-7)
- 40 Technology Building Blocks
- 25 Demonstrators
- 5 Domains: Automotive, Aeronautics, Home/Building, Rail, Healthcare, - truly "cross-disciplinary"
- 2017 – 2020 (started in May 2017)

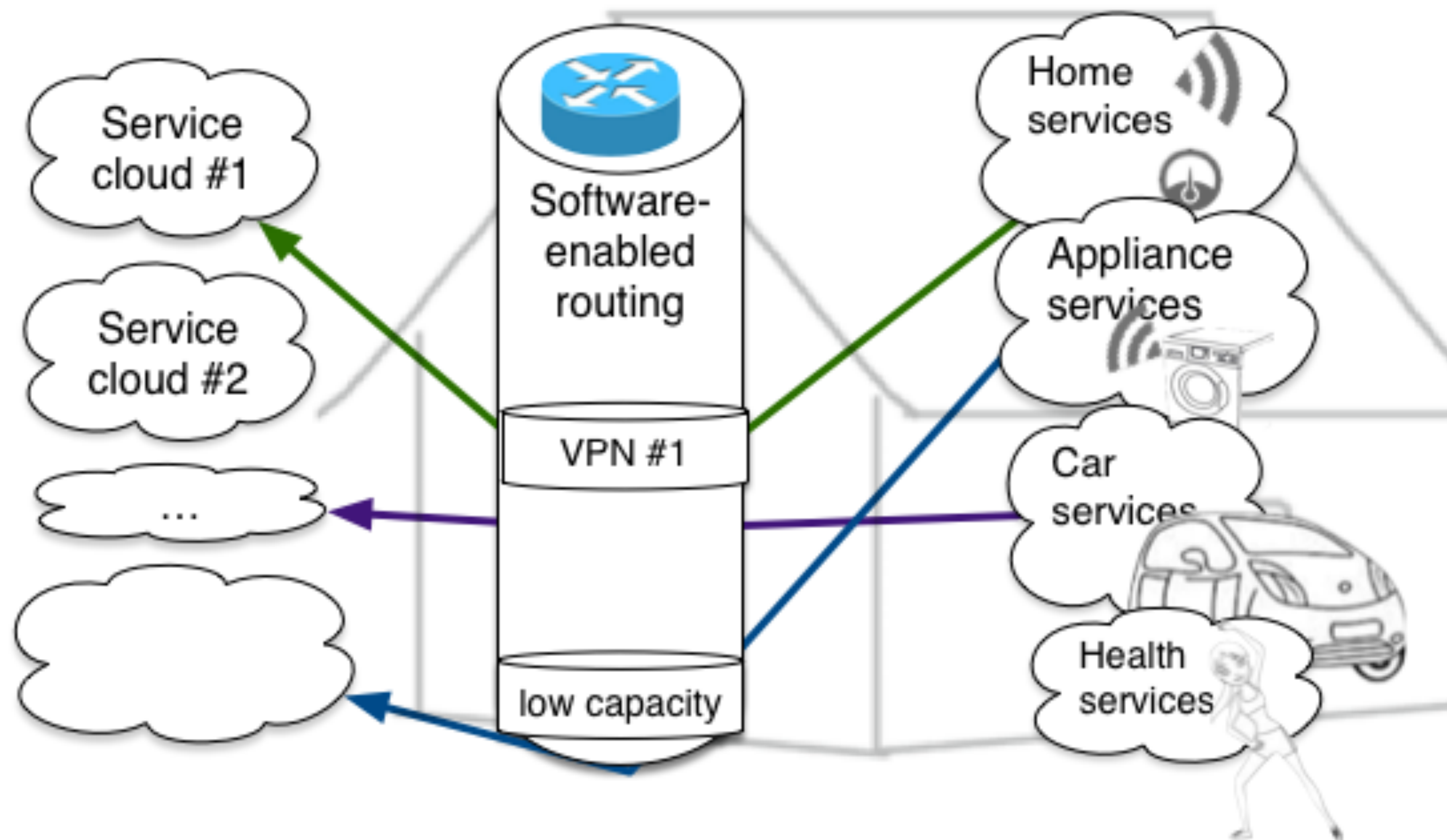
High-level vision for each domain

- Home/Infrastructures: **Cost-efficient monitoring** and **management** for trusted services
- Mobile: **Configurable** networks providing **reliable** services
- Automotive: Security architecture for **accident-free** transport
- Rail: Highly flexible train **composition**
- Aeronautics: **Security-Safety**



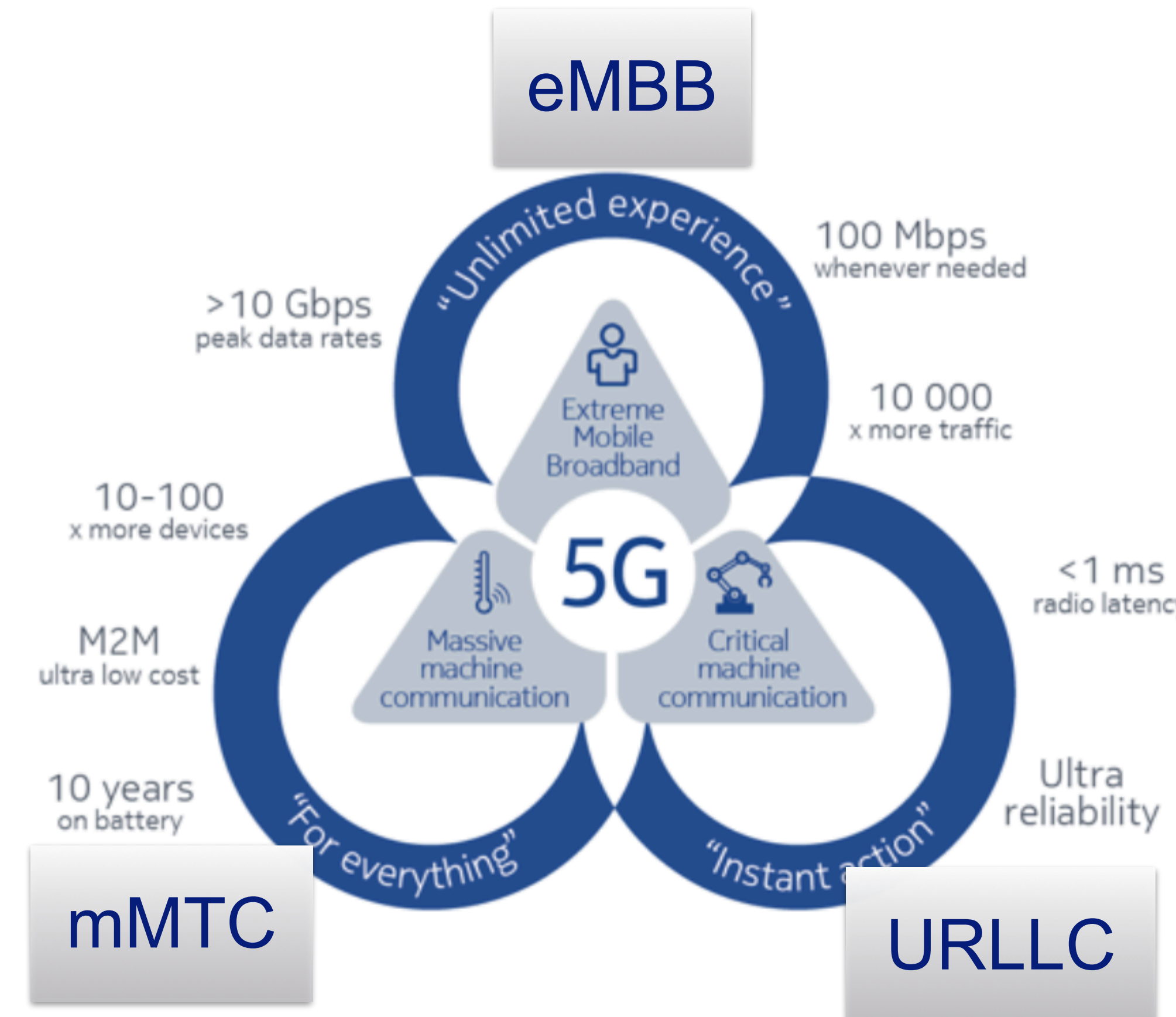
Future Services - home domain requirements

- **Future Service** demands
 - Energy, health, security
 - *require*
- **Cost-efficient monitoring and management** for trusted services
 - Wireless management
 - **Security** monitoring
 - Service harmonisation (**5G@home**)



5G - analysis and conclusions

- Extreme mobile broadband (**eMBB**)
 - needs **10-60% of traffic** to be taken **by indoor**
 - Return on investment
- Massive Machine Communications (**mMTC**)
 - **eSIM as authenticator**
 - co-existence: Wifi/ZigBee/BLE and NB-IoT
- Critical machine communications (**URLLC**)
 - **own networks/network slices**



[source: Nokia <https://networks.nokia.com/5g/get-ready>]

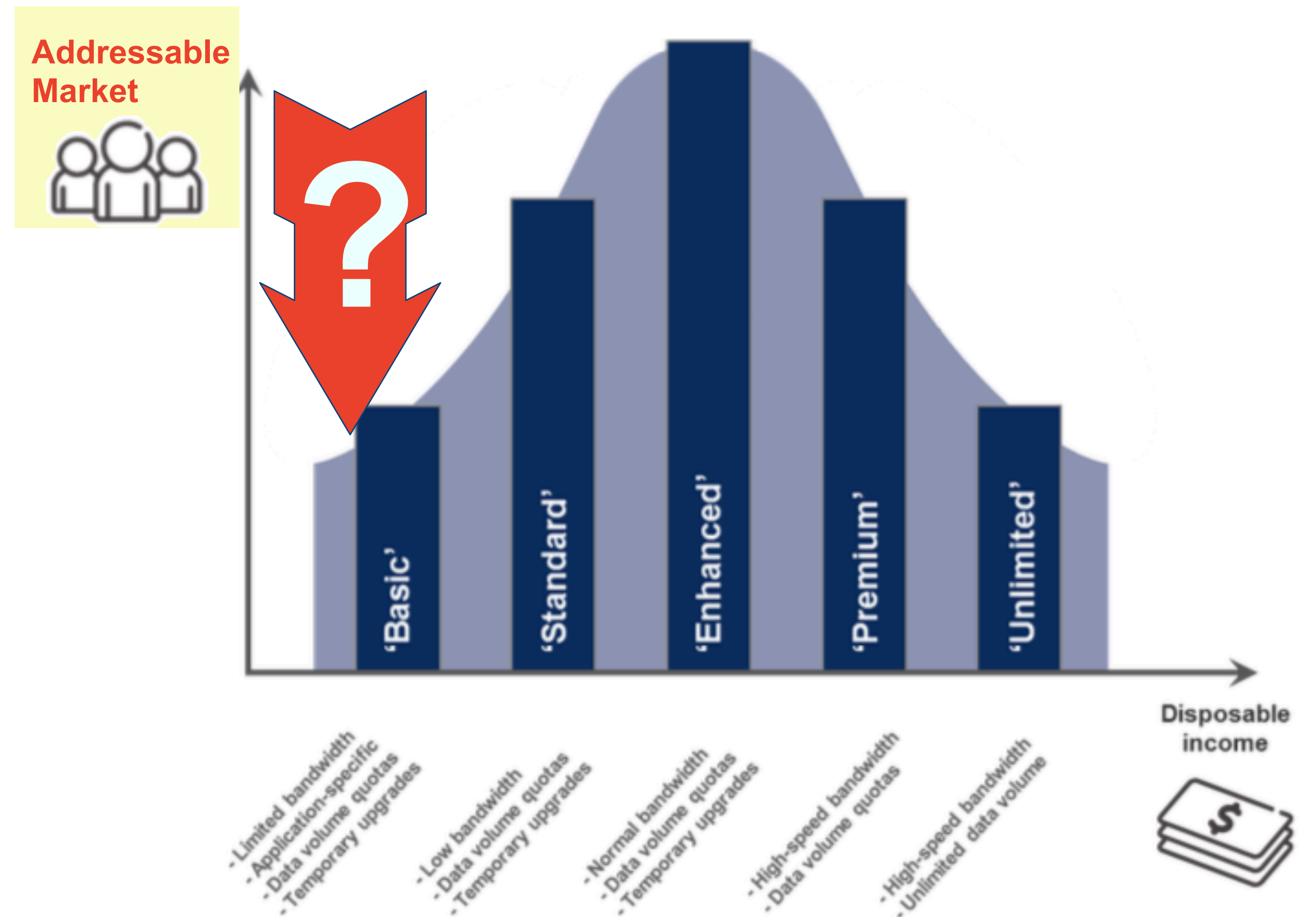


5G business & digital inclusion

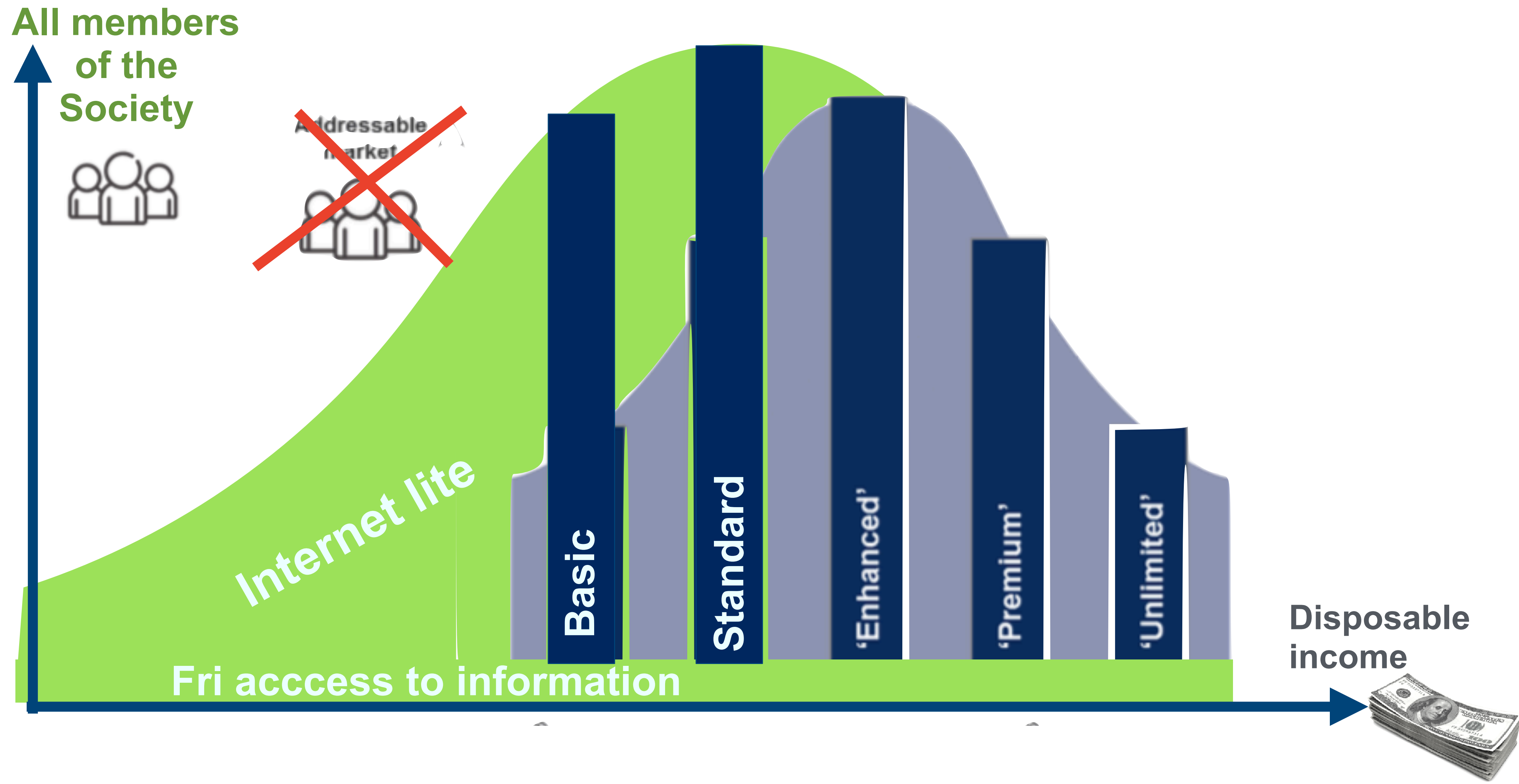
- 5G for digital inclusion?
 - ➔ cost of network, services
 - ➔ IoT, digitisation, automation
 - ➔ “the divide is bigger than ever”



[Source: Service Innovation through Smart Networks, Ericsson, 2018]



6G (#5GforAll) for digital inclusion



[Adapted from: Service Innovation through Smart Networks, Ericsson, 2018]

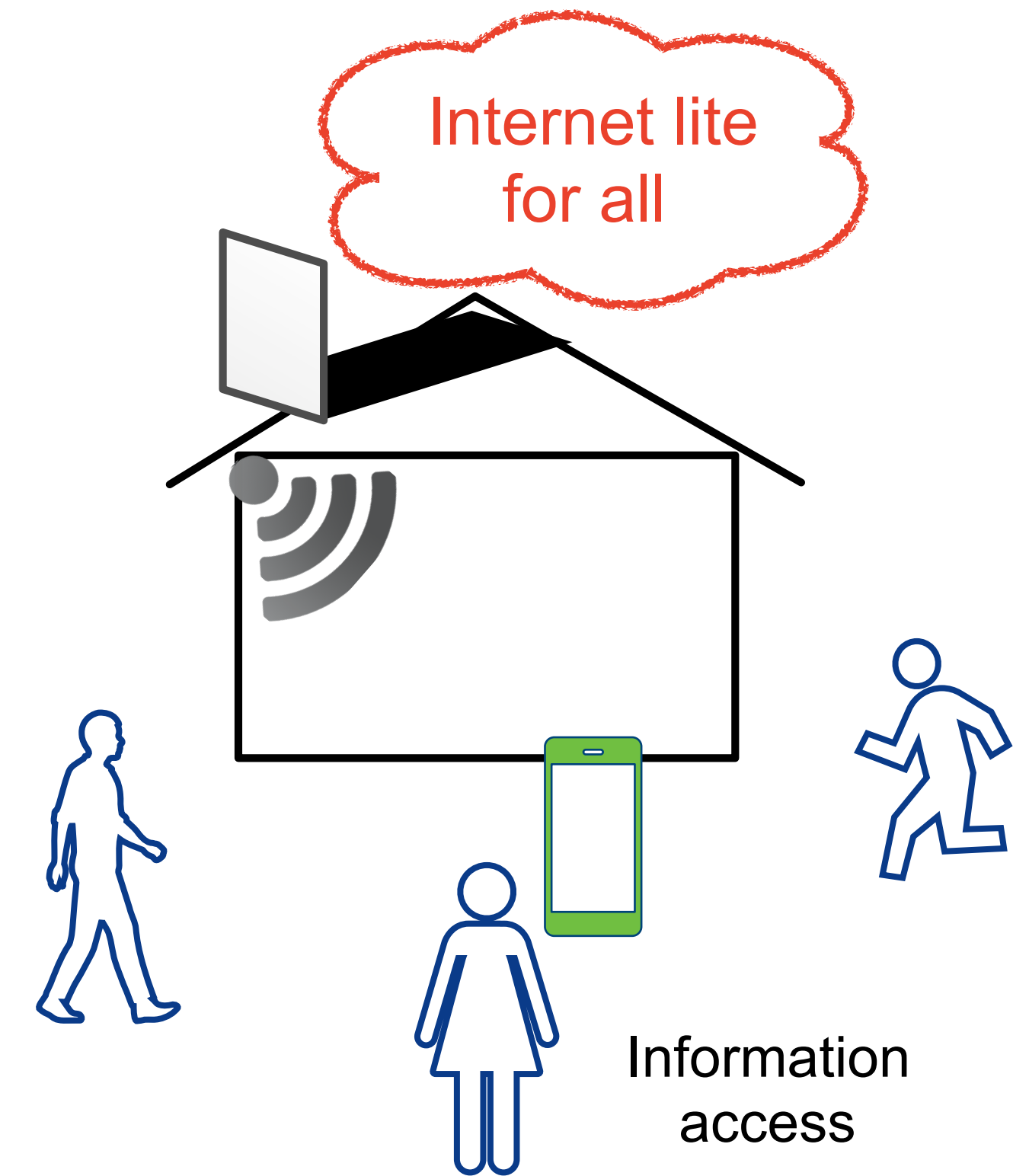
Home Domain for Digital Inclusion

- The digital Divide

- 10x increase in Mobile Broadband (2013-2019) [1]
 - Netflix, YouTube, Hulu
- 26% of NO-subscribers don't have MB [2]
- 8% (400.000) in Norway not connected to the Internet [3]

- Home access for digital inclusion

- "Internet lite for all"
 - Free access to information everywhere
 - Premium access to broadband



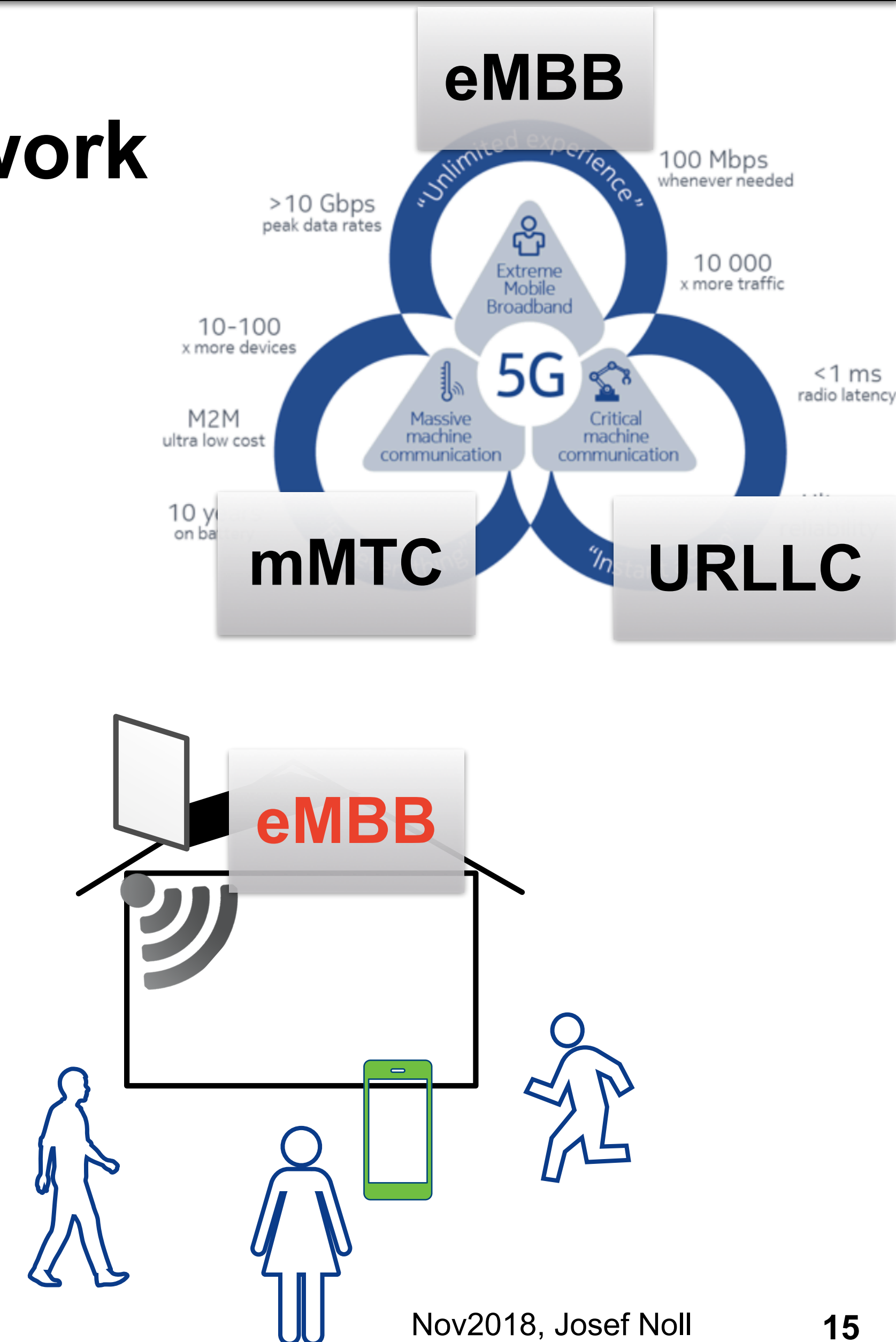
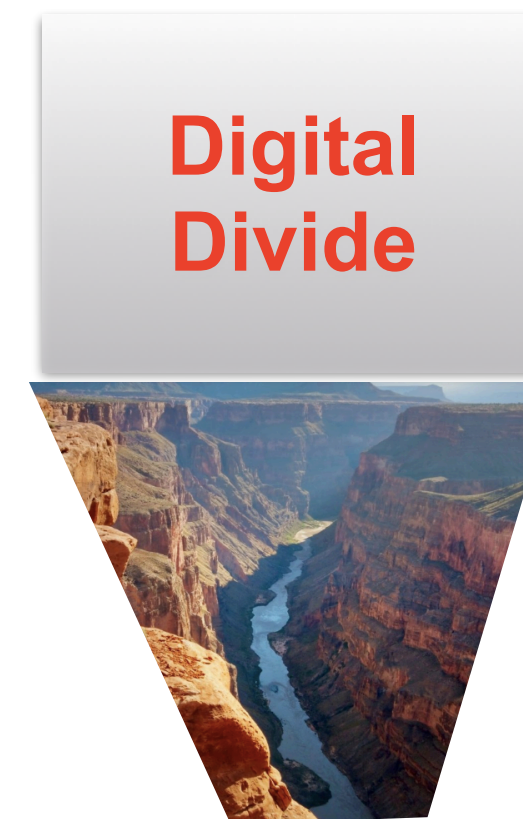
[1] Service Innovation through Smart Networks, Ericsson, 2018

[2] Det norske ekomarkedet 2017, NKOM.no, 2018

[3] "Sauebonden som aldri...", aftenposten.no, 7Okt2018

Conclusions: Seamless Integration of Mobile and Home Network

- Extreme mobile broadband (**eMBB**)
 - needs **10-60% of traffic** to be taken **by indoor**
- Massive Machine Communications (**mMTC**)
 - **eSIM as authenticator**
 - co-existence: Wifi/ZigBee/BLE and NB-Io
- Critical machine communications (**URLLC**)
 - **own networks/network slices** **Internet lite** for **all**
- Digital Inclusion through Home Networks
 - **Internet lite for all** - the freemium model for access



Basis for an inclusive and innovative society