

# Draft BEREC Guidelines on Very High Capacity Networks

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Meeting on the draft BEREC Guidelines on very high capacity networks, 17 March 2020, Brussels

Body of European Regulators  
for Electronic Communications

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The logo for BEREC (Body of European Regulators for Electronic Communications) features the word "BEREC" in a bold, sans-serif font. The letters "B", "E", "R", and "E" are blue, while the "C" is maroon. A blue curved line starts under the "R" and sweeps under the "C".

- Introduction
- Definition of the term ‘very high capacity network’ in the EECC
- Criteria for the definition of ‘very high capacity networks’
- Application of the criteria
- Determination of the performance thresholds

# Introduction

### Introduction

- According to Art 82 EECC\*), ‘*By 21 December 2020, BEREC shall [...] issue guidelines on the criteria that a network is to fulfil in order to be considered a very high capacity network (VHCN), in particular in terms of down- and uplink bandwidth, resilience, error-related parameters, and latency and its variation.[...]*’
- NRAs shall take these Guidelines into utmost account
- The Guidelines shall contribute to the harmonization of the definition of the term ‘VHCN’ in the EU
- VHCN is a new and important concept of the EECC\*)
- One of the general objectives of the EECC (Art. 3(2a)) is ‘*promot[ing] connectivity and access to, and take-up of, VHCNs*’
- The concept of VHCN is used also in other initiatives taken by the EU institutions

\*) European Electronic Communications Code

### Introduction (contd.)

- The term 'VHCN' is relevant for several provisions in the EECC, e.g. for the following
- The conditions under which NRAs shall not impose certain obligations on wholesale-only undertakings depend on access to a VHCN (Art. 61(3)) in connection with Art. 80)
- The geographical surveys of network deployments may include a forecast of the reach of VHCNs (Art. 22(1))
- NRAs may invite undertakings and public authorities to declare their intention to deploy VHCNs in designated areas (Art. 22(3))
- The regulatory treatment of new VHCN elements foresees lighter regulation for VHCNs under certain conditions related to co-investment (Art. 76)
  - This provision (Art. 76), however, only applies to certain types of VHCN
  - The performance thresholds defined in the BEREC Guidelines on VHCNs are not relevant for this provision (Art. 76.)

# Definition of the term 'VHCN' in the EECC

## Definition of the term 'VHCN' in the EEC (1)

- The term 'VHCN' means (Art. 2(2))
  - Either a network with a fibre roll out up to a certain point
  - Or a network which is capable of delivering, under usual peak-time conditions, a similar network performance
    - in terms of downlink and uplink bandwidth, resilience, error-related parameters, latency and its variation
- Rec. (13) further clarifies to which point fibre needs to be rolled out
- In conclusion, VHCNs according to Art. 2(2) are:
  - Any network providing a **fixed-line** connection with fibre roll out at least up to the **multi-dwelling building**;
  - Any network providing a **wireless** connection with fibre roll out up to the **base station**;
  - Any network providing a **fixed-line** connection and which is capable of delivering under usual peak-time conditions a certain network performance (**performance thresholds 1**); and
  - Any network providing a **wireless** connection and which is capable of delivering under usual peak-time conditions a certain network performance (**performance thresholds 2**).

## Definition of the term 'VHCN' in the EECC (2)

- The performance thresholds 1 and 2 need to be determined as follows:
  - **Performance thresholds 1:** The end-user QoS which is achievable under usual peak-time conditions by a network providing a **fixed-line** connection with a fibre roll out up to the **multi-dwelling building**.
  - **Performance thresholds 2:** The end-user QoS which is achievable under usual peak-time conditions by a network providing a **wireless** connection with a fibre roll out up to the **base station**.
- The equivalent performance is considered with regards to the achievable end-user QoS of VHCNs for the following reasons:
  - The EECC (Art. 3(2)a) promotes the rollout of VHCNs to benefit end-users and VHCNs are capable of providing end-user services with a particularly high QoS
  - The term 'VHCN' is defined (Art. 2(2)) as a certain type of network (not a limited part of a network) and, therefore, the performance up to the end-user where the public network ends needs to be considered

# Criteria for the definition of 'VHCNs'

## Criteria for the definition of VHCNs (1)

- In accordance with the EECC and based on data collected from network operators, the Guidelines lay down the following
- Any network which fulfils **one** (or more) of the following 4 criteria is a VHCN
- **Criterion 1:** Any network providing a **fixed-line** connection with a fibre roll out at least up to the **multi-dwelling building**
- **Criterion 2:** Any network providing a **wireless** connection with a fibre roll out up to the **base station**
- **Criterion 3:** Any network providing a **fixed-line** connection which is capable of delivering, under usual peak-time conditions, services to end-users with the following quality of service (**performance thresholds 1**):
  - Downlink data rate  $\geq 1000$  Mbps<sup>\*)</sup>
  - Uplink data rate  $\geq 200$  Mbps<sup>\*)</sup>
  - IP packet error ratio (Y.1540)  $\leq 0.05\%$
  - IP packet loss ratio (Y.1540)  $\leq 0.0025\%$
  - Round-trip IP packet delay (RFC 2681)  $\leq 10$  ms
  - IP packet delay variation (RFC 3393)  $\leq 2$  ms
  - IP service availability (Y.1540)  $\geq 99.9\%$  per year

\*) IP packet payload data rate at the end of the subscriber access line (not including the CPE)

## Criteria for the definition of VHCNs (2)

- **Criterion 4:** Any network providing a **wireless** connection which is capable of delivering, under usual peak-time conditions, services to end-users with the following quality of service (**performance thresholds 2**)
  - Downlink data rate  $\geq 150$  Mbps<sup>\*)</sup>
  - Uplink data rate  $\geq 50$  Mbps<sup>\*)</sup>
  - IP packet error ratio (Y.1540)  $\leq 0.01\%$
  - IP packet loss ratio (Y.1540)  $\leq 0.005\%$
  - Round-trip IP packet delay (RFC 2681)  $\leq 25$  ms
  - IP packet delay variation (RFC 3393)  $\leq 6$  ms
  - IP service availability (Y.1540)  $\geq 99.81\%$  per year
- The performance thresholds of criterion 4 refer to **outdoor** locations only and to the **average** value within the coverage area considered
- The performance thresholds 1 and 2 refer to the following path
  - From the end-user to the first hand-over point in the network where traffic of the end-user services is handed over to other public networks<sup>\*\*)</sup>
- In case of particularly long distances (e.g. several hundred kilometres) the threshold round-trip IP packet delay increases for every 100km by 1 ms

\*) IP packet payload data rate

\*\*\*) In case of round-trip parameters back to the end-user

## Criteria for the definition of VHCNs (3)

- VHCN does not represent a unified concept
  - ‘Fixed VHCNs’ meet criterion 1 or criterion 3 (or both)
  - ‘Wireless VHCNs’ meet criterion 2 or criterion 4 (or both)
- A ‘Wireless VHCN’ may also meet the QoS thresholds of criterion 3 (e.g. in case of FWA) and then it may be considered equivalent to a ‘Fixed VHCN’
- Since for a network it is sufficient to meet one criterion to qualify as VHCN
  - A network which qualifies as a VHCN according to criterion 1 does not necessarily fulfil criterion 3
  - A network which qualifies as a VHCN according to criterion 2 does not necessarily fulfil criterion 4
- The Guidelines provide criteria for the consideration of a network as a VHCN, where this is relevant for the application of the EECC
- They should not be interpreted as a view on the appropriateness of such consideration as a criterion for any other policy instrument, including public funding

# Application of the criteria

## Criterion 1

- Any network providing a **fixed-line** connection qualifies as VHCN if fibre is rolled out at least up to the **multi-dwelling building** (criterion 1)
- It does not need to fulfil further criteria
- Criterion 1 is fulfilled in case of FTTB and FTTH
- Criterion 1 is not fulfilled e.g. in case of a fibre roll out up to a node to which multiple single-family houses are connected even only a few
- BEREC is of the view, that in case fibre is rolled out up to the **multi-dwelling building** it is desirable that technologies which are deployed inside the building correspond to the performance potential of FTTB

### Criterion 2

- Any network providing a **wireless** connection qualifies as VHCN if fibre is rolled out at least up to the **base station** (criterion 2)
- It does not need to fulfil further criteria
- Criterion 2 is fulfilled e.g. in case of
  - Mobile networks with a fibre roll out up to the base station
  - Public WLAN (WiFi) networks with a fibre roll out up to the access point
- BEREC is of the view, that in case fibre is rolled out up to the **base station** it is desirable that wireless access technologies which are deployed correspond to the performance potential of fibre to the base station

### Criterion 3 / 4

- The network needs to be **capable** of meeting during peak-time the performance thresholds of criterion 3 / 4
- It is not necessary that
  - The network **actually offers** a service which meet the performance thresholds
  - **All services** provided by the network have to meet the performance thresholds
- The area covered by the network needs to be divided in appropriate sub-areas e.g.
  - In case of criterion 3, multi-dwelling building, group of single-family houses, area of an access node
  - In case of criterion 4, coverage area of a base station or group of base stations
- For each sub-area, it needs to be determined whether the performance thresholds are met
- If this is the case, then the part of the network that covers this sub-area qualifies as a VHCN

### Criterion 3 / 4 (contd.)

- A sub-area meets the performance thresholds if, under usual peak-time conditions, the end-users in this sub-area will **typically** / on **average** at **outdoor locations** experience at least the QoS of the performance thresholds
- For example:
  - In case of **criterion 3**, measurements made with an internet speed test<sup>\*)</sup> in the sub-area during peak-time **typically** measure at least **1,000 / 200 Mbps**
  - In case of **criterion 4**, measurements made with a **drive test**<sup>\*)</sup> in the sub-area during peak-time measure on **average** at least **150 / 50 Mbps**
- Criteria 3 and 4 refer to '**any** network which provides a fixed-line / wireless connection' and therefore apply **technologically neutral**
  - In case of **criterion 3**, e.g. to usual **copper** twisted pair with **DSL** technology, **coax** cable with **DOCSIS** technology, twisted pair cable of **category 5 or higher** with **Ethernet** technology
  - In case of **criterion 4**, e.g. mobile networks, public WLAN (WiFi) networks, satellite networks

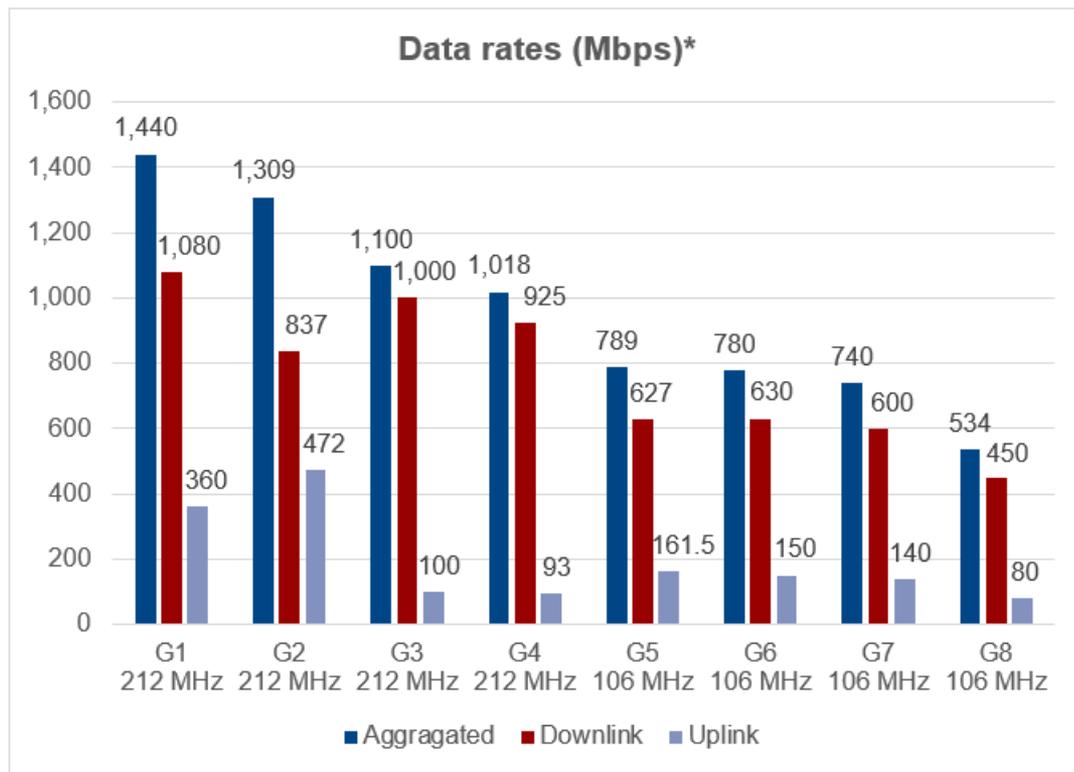
<sup>\*)</sup> Without tariff and CPE limitations

# Determination of the performance thresholds

## Determination of the performance thresholds (1)

- The performance thresholds of criterion 3 and criterion 4 have been determined based on data collected from network operators
  - In total, operators filled in 204 questionnaires, data of 106 questionnaires have been taken into account
- The performance thresholds of **criterion 3** are based on the achievable end-user QoS in fixed networks with **fibre roll out up to the multi-dwelling building** and the **best technology** on the in-building network infrastructure
  - **G.fast (212 MHz)** on the in-building **copper twisted pair**
  - **DOCSIS 3.1** on the in-building **coax network**
- The performance thresholds of **criterion 4** are based on the achievable end-user QoS in mobile networks with **fibre roll out up to the base station** and the **best LTE Advanced (4G) technology** in terms of aggregated spectrum, MIMO order, modulation etc.
  - In order to take 5G into account as much as possible, the data rate thresholds have been determined based on the **90% percentile** (not median)
  - The Guidelines foresee that BEREC intends to update criterion 4 as soon as 5G has reached mature deployment and significant penetration and not later than 2023

## Performance thresholds of criterion 3 (fixed-line connection)



- Data rates are higher in case of **212 MHz** profile
- Median of the typically achievable **aggregated data rate** during peak-time of G.fast 212 MHz is **1,200 Mbps**

\*) Of the IP packet payload

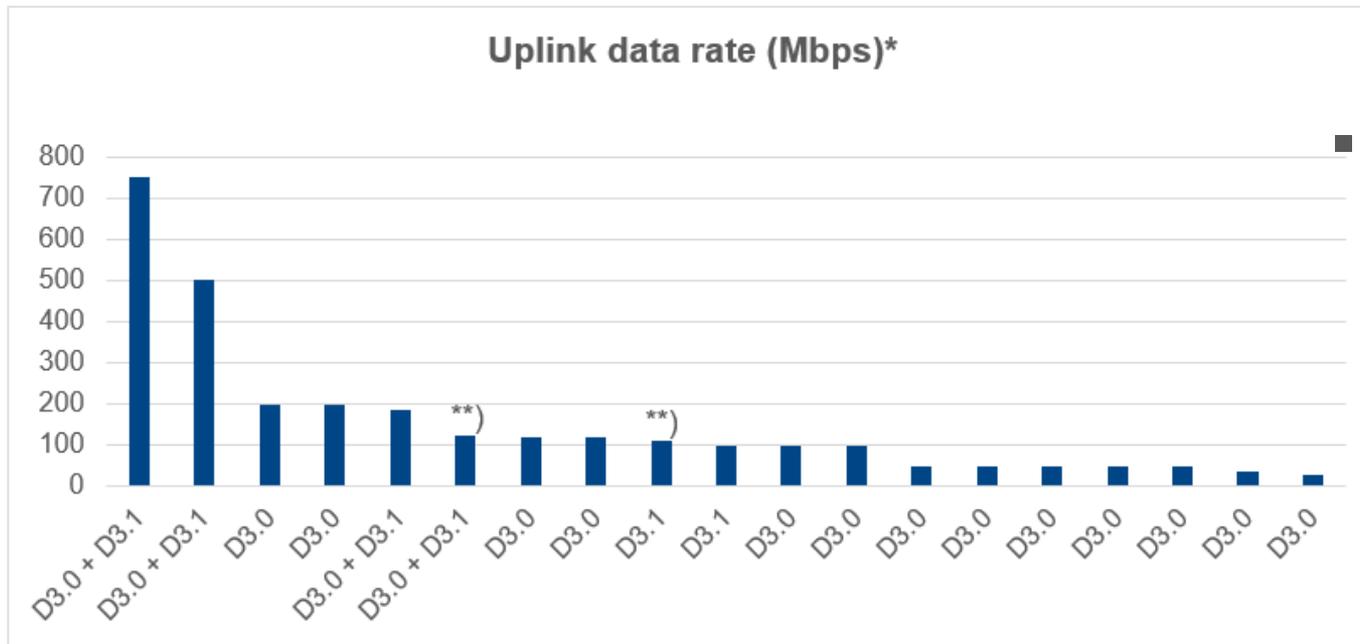
Note: The start frequency of both profiles, 212 MHz and 106 MHz, is 2.2 MHz (except operator G3 17.8 MHz)

Source: BEREC

**Figure 1: Typically achievable data rates during peak-time in fixed networks based on fibre to the multi-dwelling building with G.fast deployment on the in-building twisted pair**



## Performance thresholds of criterion 3 (fixed-line connection)



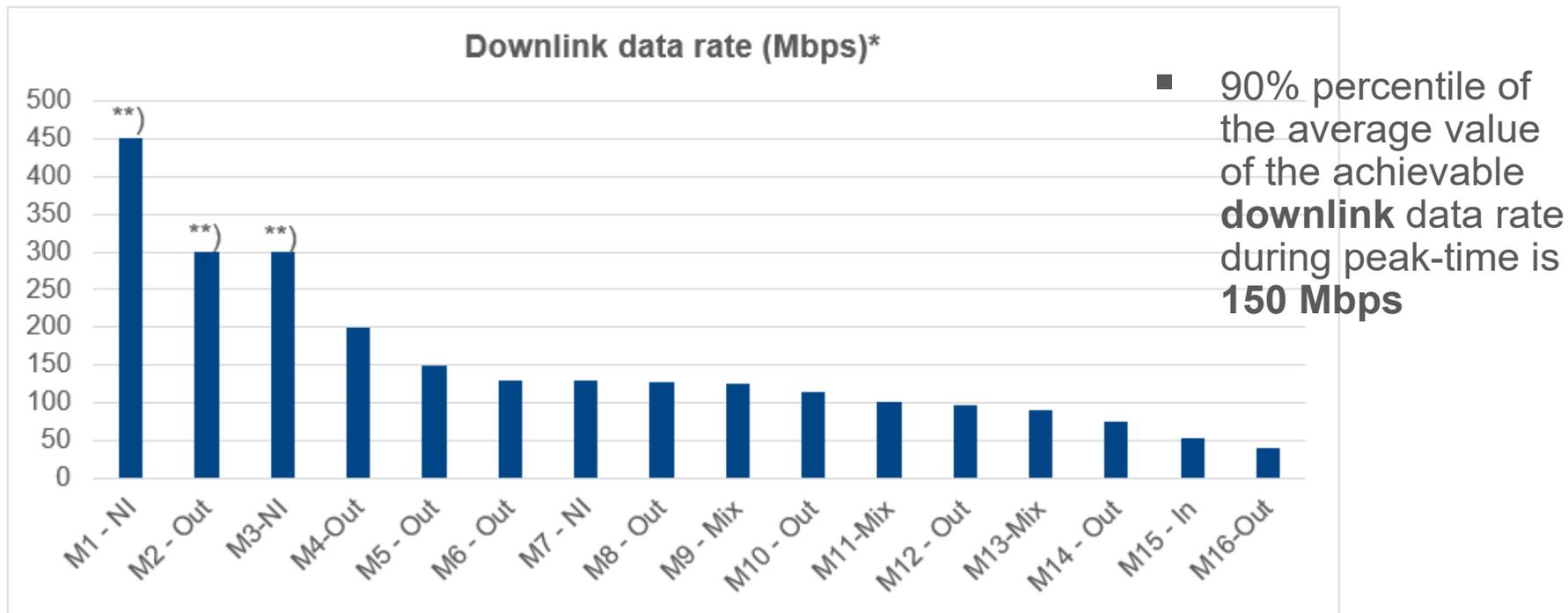
Median of the typically achievable **uplink** data rate during peak-time of **DOCSIS 3.1** is **160 Mbps**

\*) Of the IP packet payload, \*\*) range (see Table 4)

Source: BEREC

**Figure 3: Typically achievable uplink data rate during peak-time in HFC networks with fibre rolled out up to the multi-dwelling building and DOCSIS on the in-building coax network**

## Performance thresholds of criterion 4 (wireless connection)



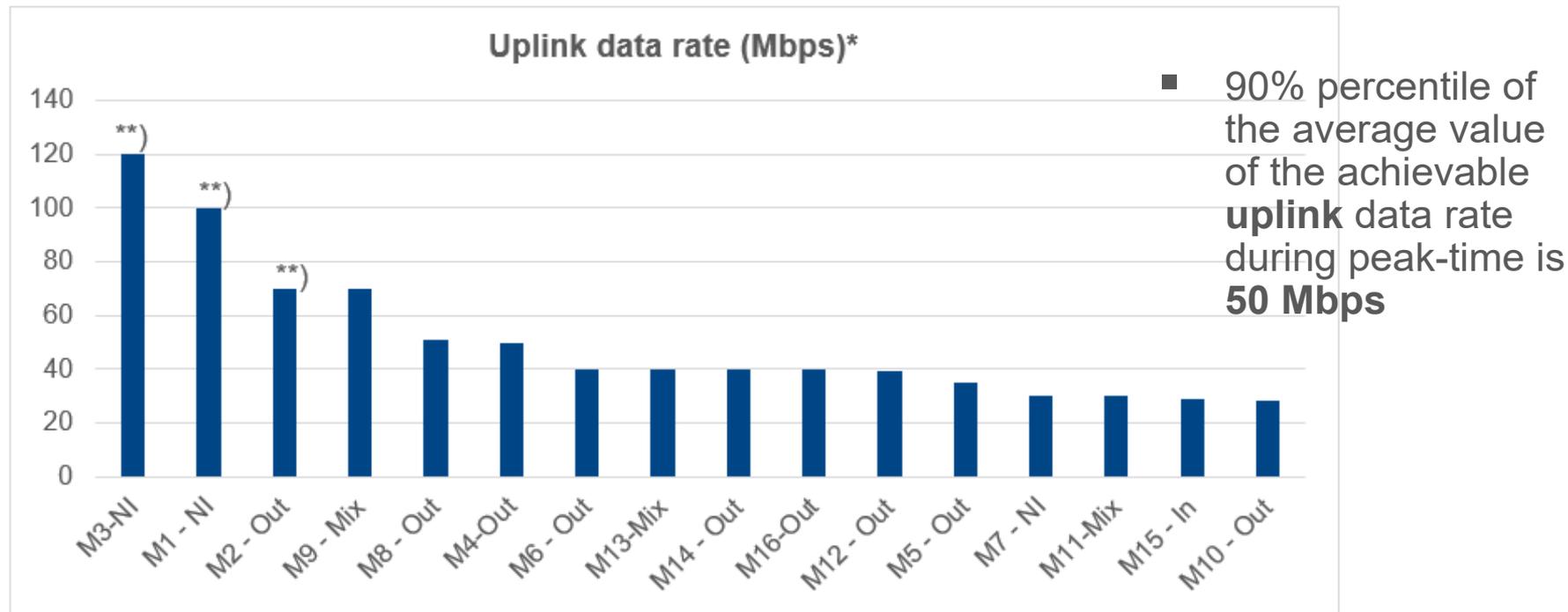
\*) Of the IP packet payload, \*\*) Data considered to be implausible (see paragraphs 184 to 187)

Out ... outdoor only, Mix ... mix of outdoor and indoor, In ... indoor only, NI ... no information

Source: BEREC

**Figure 7: Average value of the achievable downlink data rate during peak-time in a mobile network with fibre roll-out up to the base station and the best LTE Advanced technology used in this network**

## Performance thresholds of criterion 4 (wireless connection)

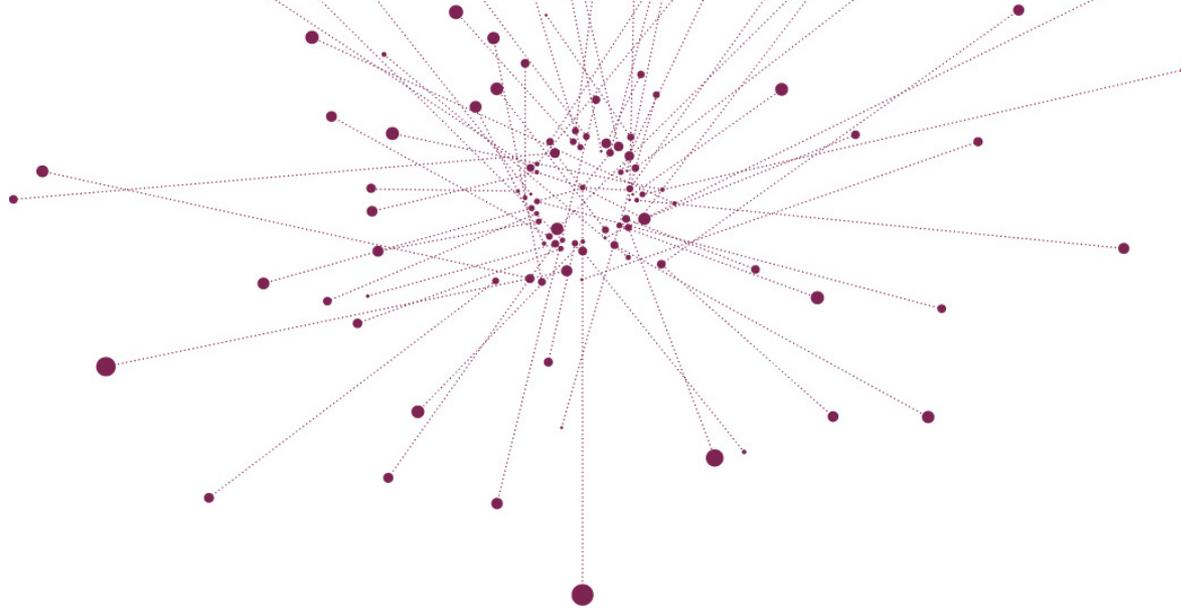


\*) Of the IP packet payload, \*\*) Data considered to be implausible (see paragraphs 184 to 187 and 191)

Out ... outdoor only, Mix ... mix of outdoor and indoor, In ... indoor only, NI ... no information

Source: BEREC

**Figure 9: Average value of the achievable uplink data rate during peak-time in a mobile network with fibre roll-out up to the base station and the best LTE Advanced technology used in this network**



Thank you!

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