Understanding the demand growth for digital connectivity

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How much bandwidth will consumers demand over the next decade?

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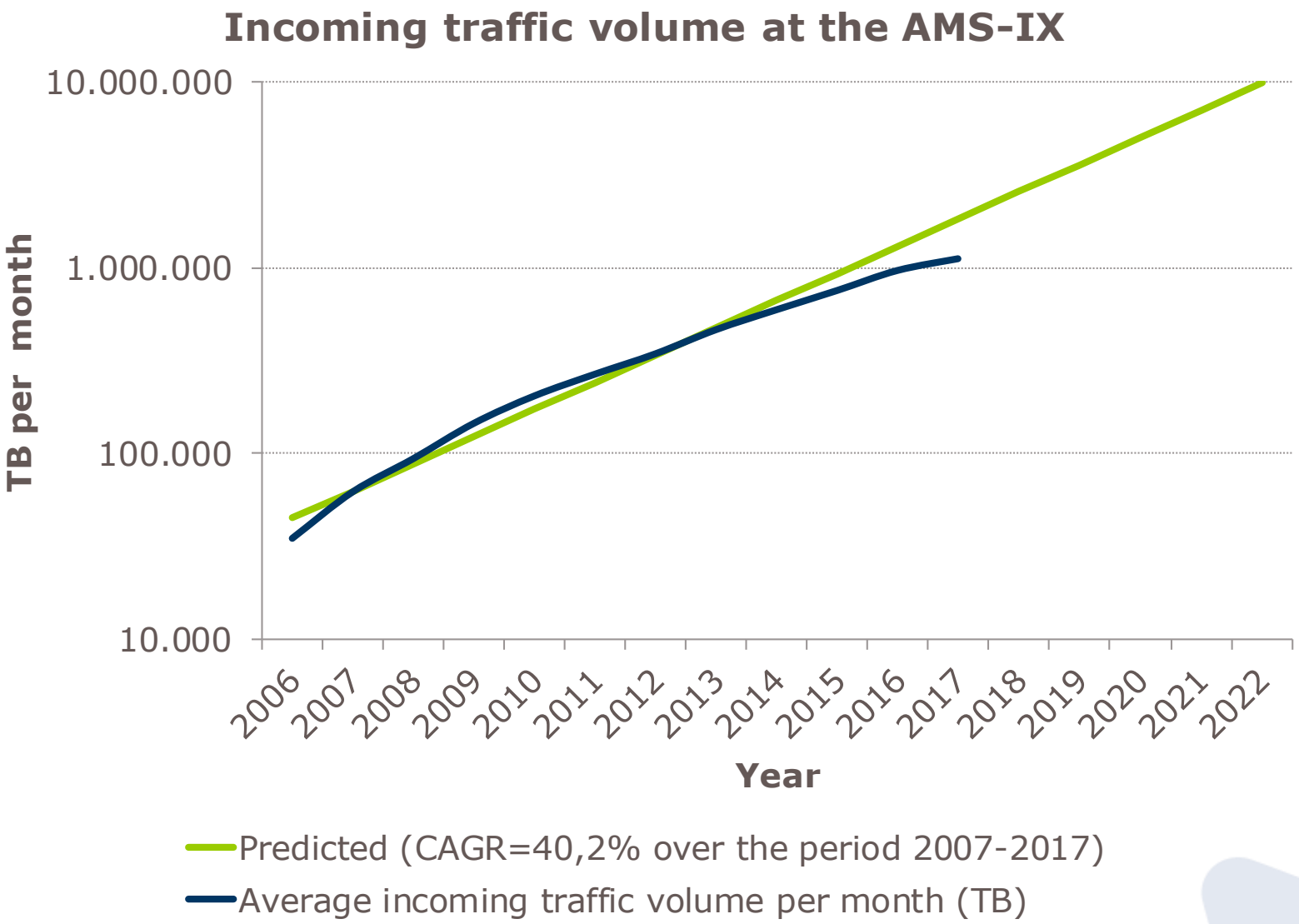

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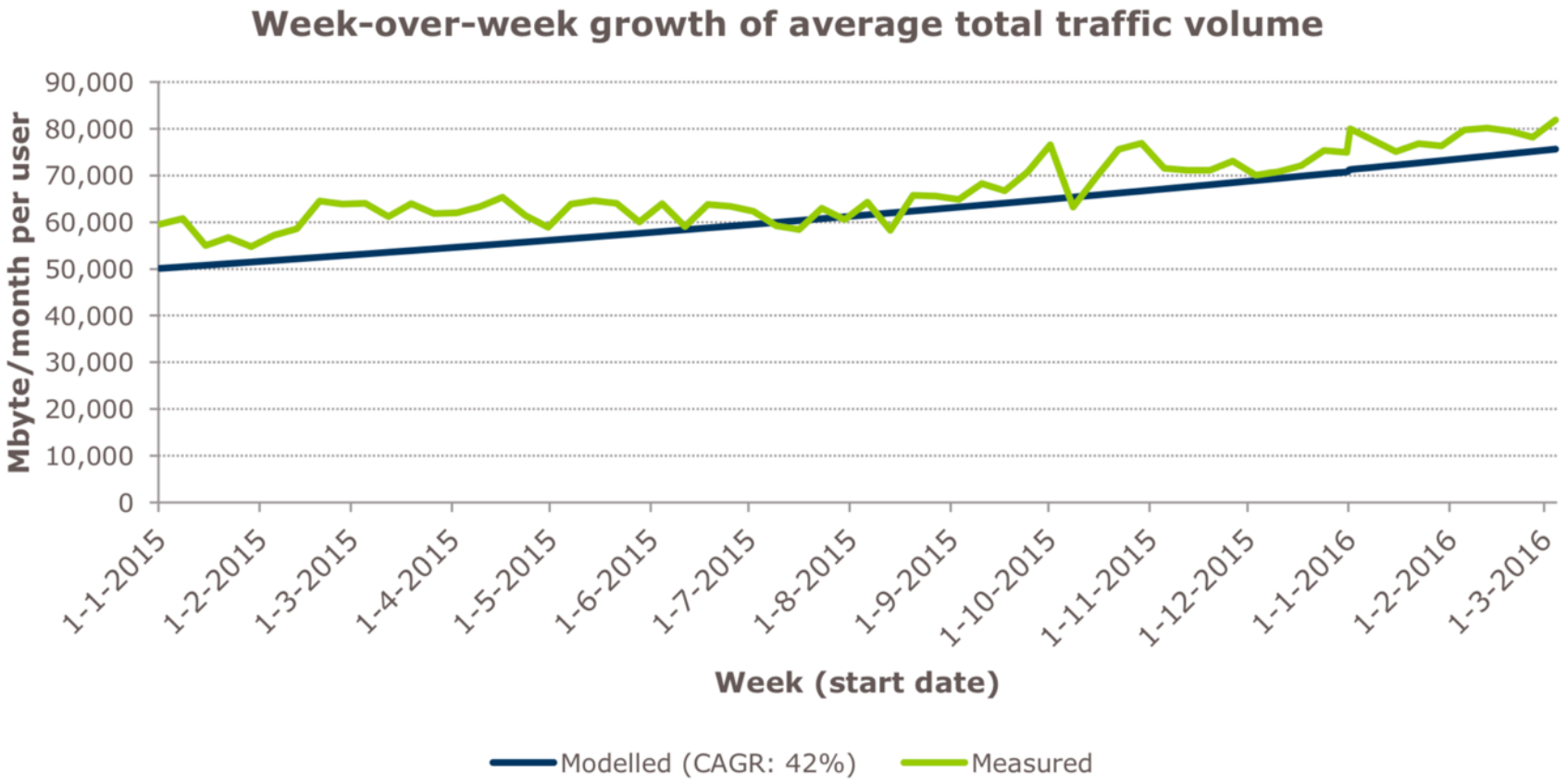
Table 2. Average total monthly volume of traffic per household, according to various sources.

Source	Period	Location	Total traffic volume (Mbyte/month)
Sandvine	2013 H1	Western Europe	13,400
Sandvine	2013 H2	Western Europe	17,400
ISP A	2013-11	The Netherlands	7,466
ISP B	2013-11	The Netherlands	2,655
Cisco VNI	2014	Western Europe	38,800
ISP A	2015-Q1	The Netherlands	55,955
ISP A	2016 Q1	The Netherlands	77,924
ISP B	2016-Q1	The Netherlands	76,986
ISP B	2016-Q2	The Netherlands	75,315
Cisco VNI 2015	2015 (predicted)	Western Europe	46,661
Cisco VNI 2015	2016 (predicted)	Western Europe	56,115
Cisco VNI 2015	2017 (predicted)	Western Europe	67,484
Cisco VNI 2015	2018 (predicted)	Western Europe	81,157
Cisco VNI 2018	2016	Western Europe	27,000
Cisco VNI 2018	2021 (predicted)	Western Europe	78,000



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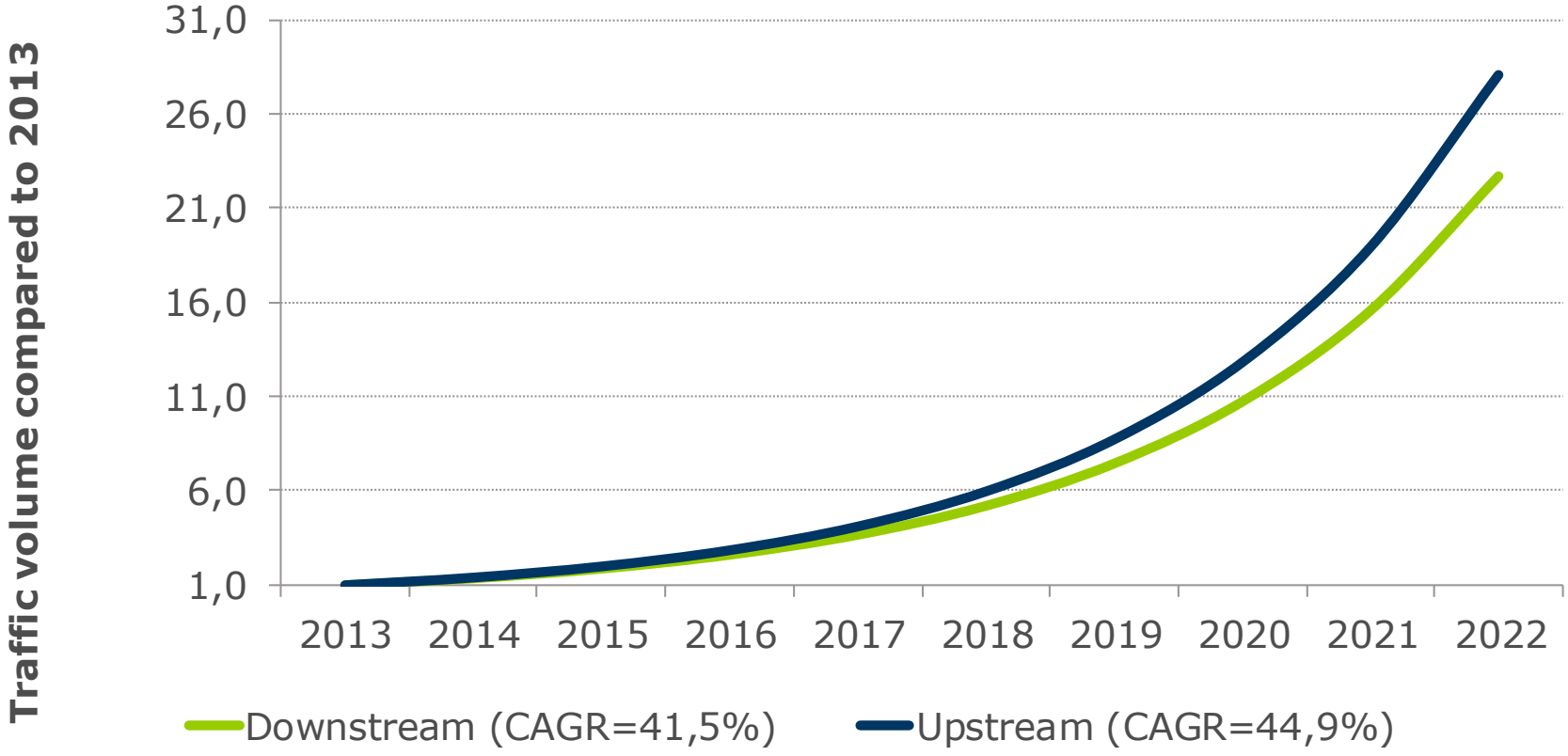
Forecasted growth of aggregate traffic volume



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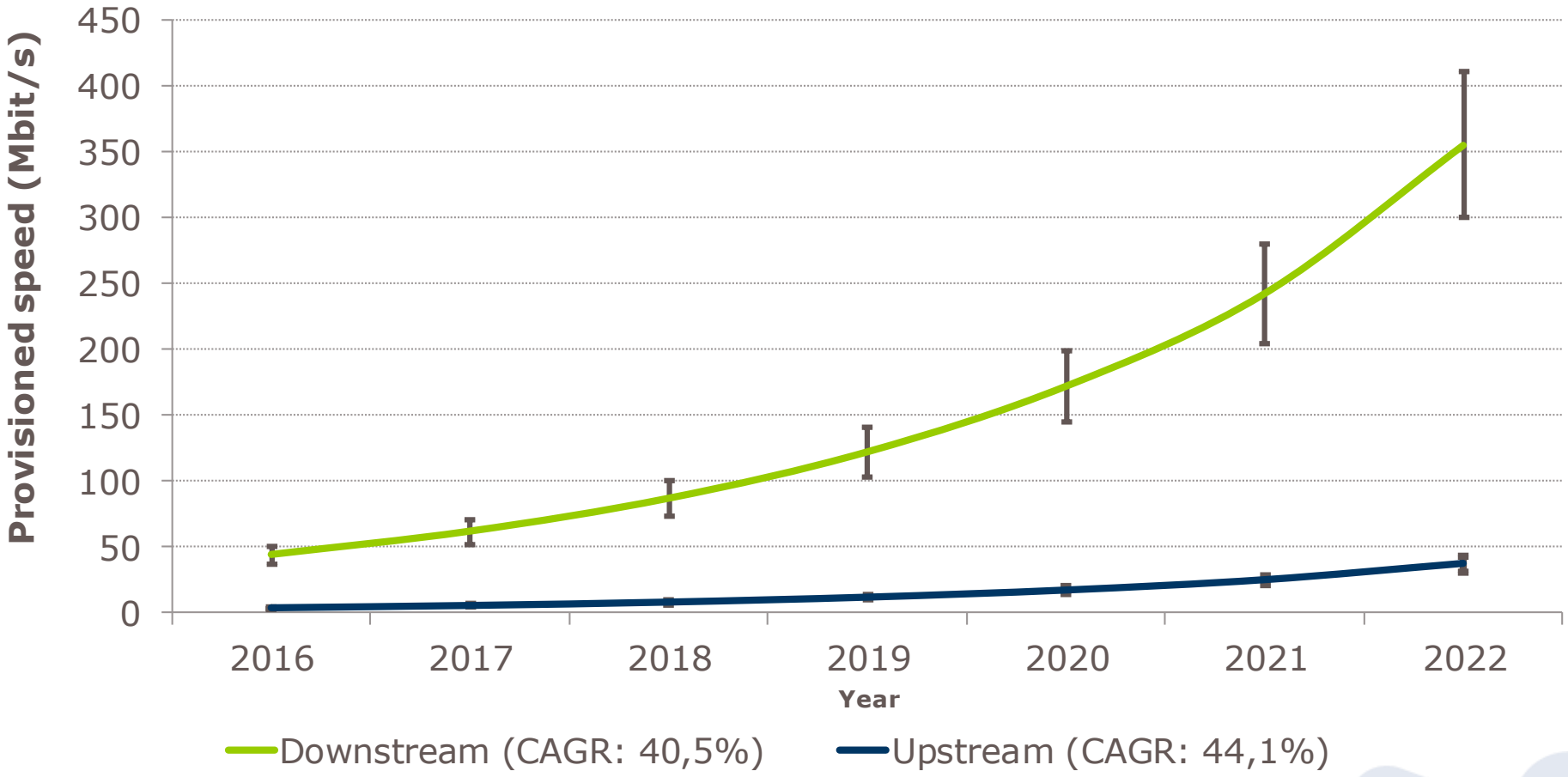
Forecasted development of the average sufficient provisioned speed



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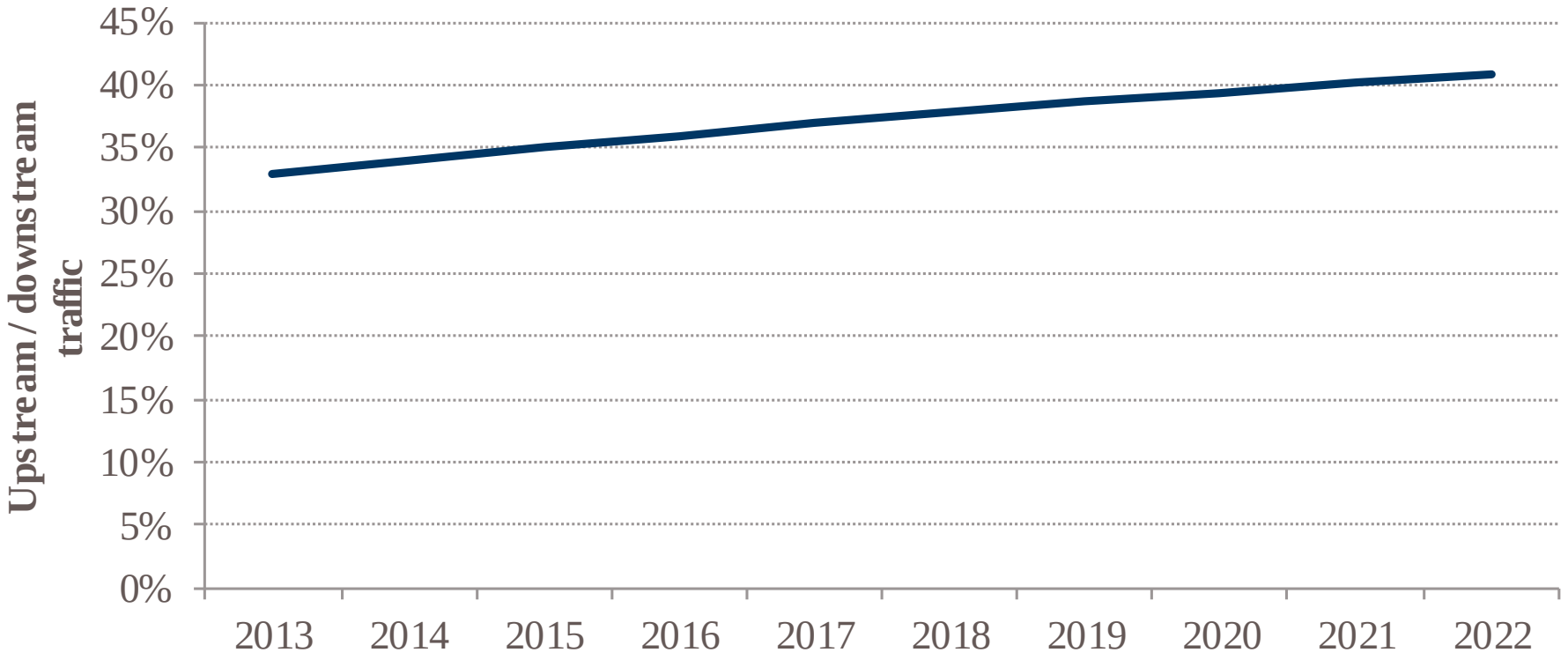
Up vs. down



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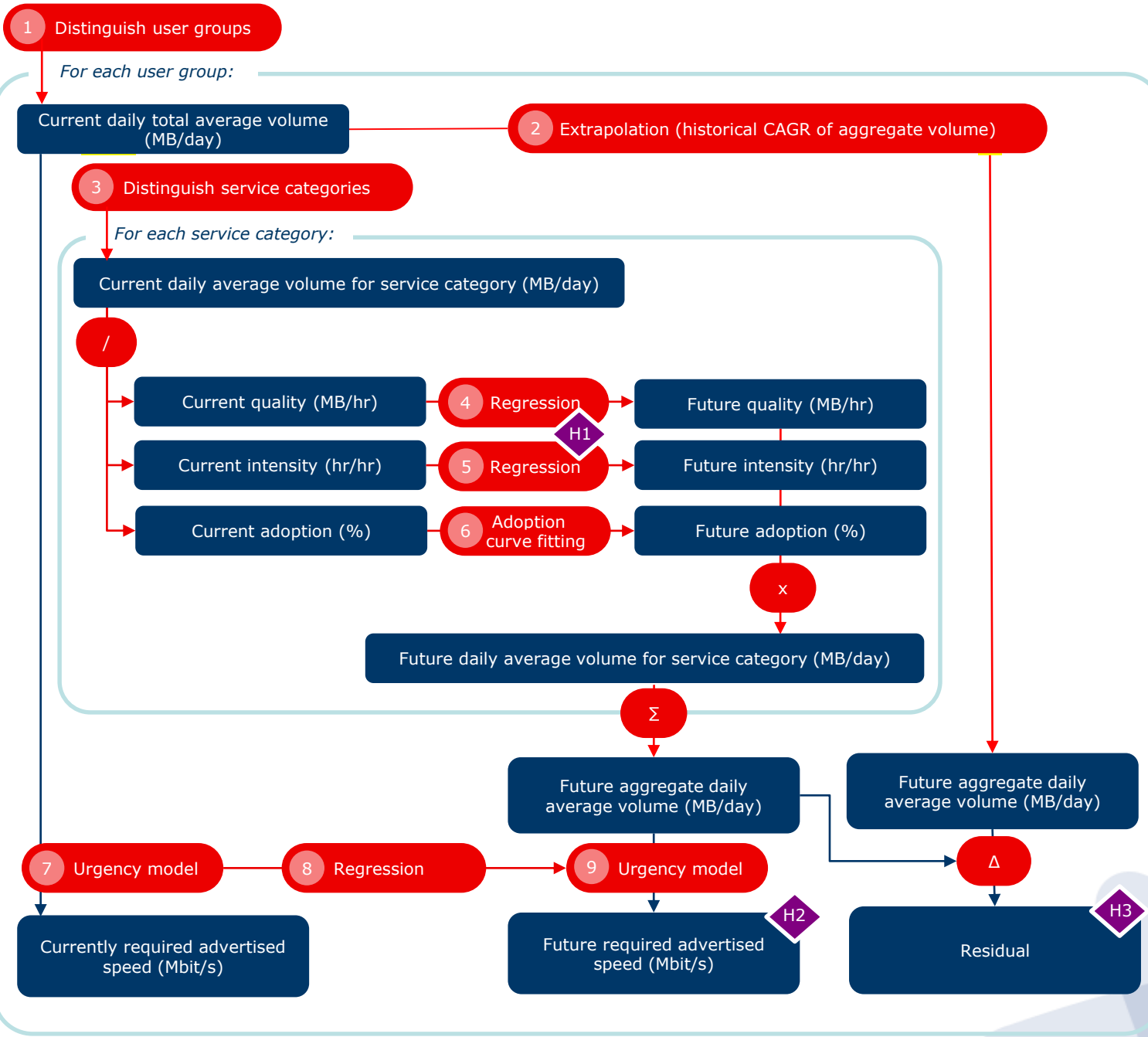
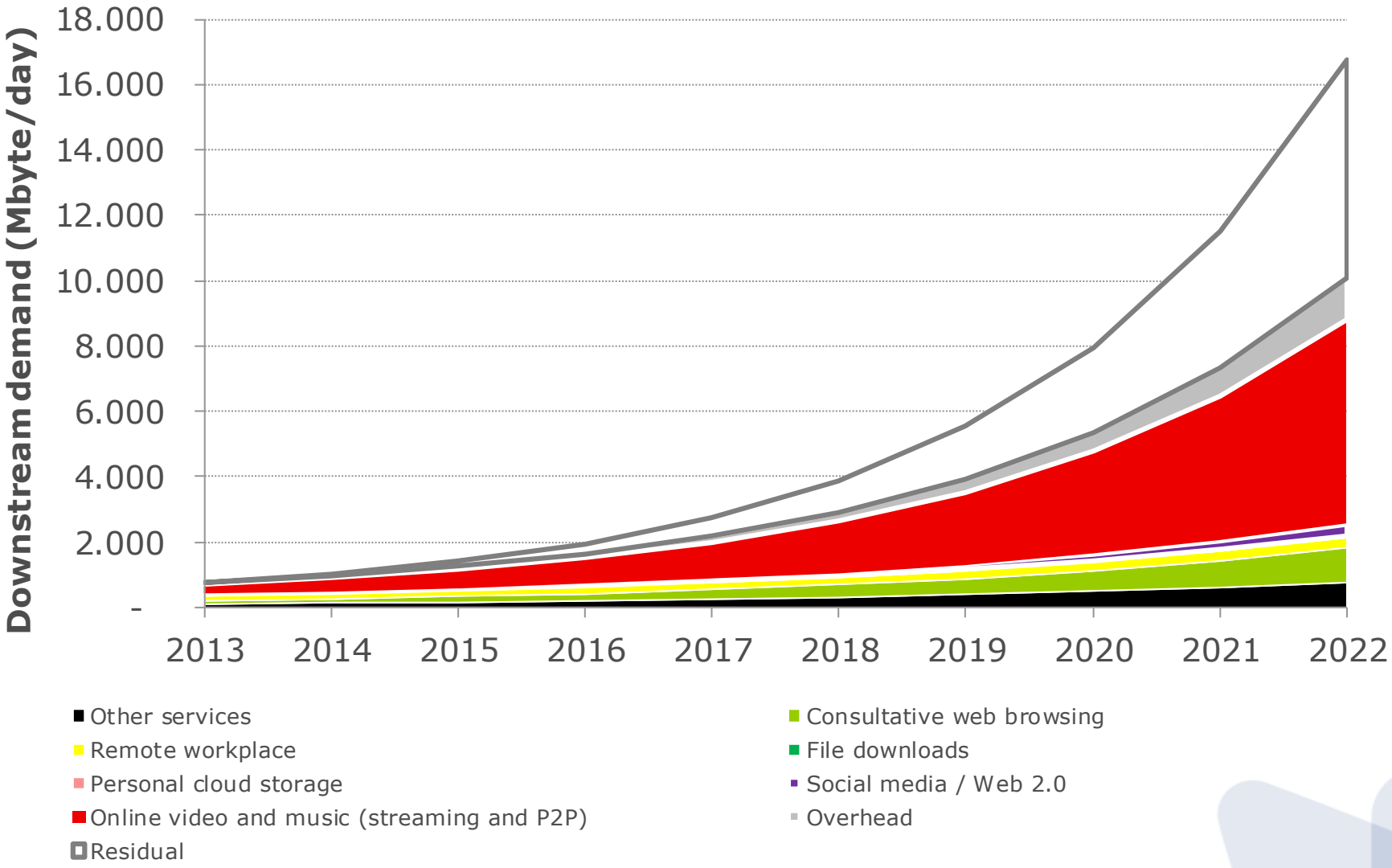
What is generating this demand at the consumer side?


1 Distinguish user groups
For each user group:
Current daily total average volume (MB/day)
2 Extrapolation (historical CAGR of aggregate volume)
3 Distinguish service categories
For each service category:
Current daily average volume for service category (MB/day)
/
Current quality (MB/hr)
4 Regression
Future quality (MB/hr)
H1
Current intensity (hr/hr)
5 Regression
Future intensity (hr/hr)
Current adoption (%)
6 Adoption curve fitting
Future adoption (%)
x
Future daily average volume for service category (MB/day)
Σ
Future aggregate daily average volume (MB/day)
Future aggregate daily average volume (MB/day)
Δ
7 Urgency model
8 Regression
9 Urgency model
H2
H3
Currently required advertised speed (Mbit/s)
Future required advertised speed (Mbit/s)
Residual

Forecasted downstream traffic demand by service category



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Questions, questions, questions…

- Will bandwidth supply growth continue exponentially?
- Will bandwidth demand growth continue exponentially?
- Will we be able to fill ‘the residual’?
- Will fixed household connections lose relevancy in an increasingly wireless world?

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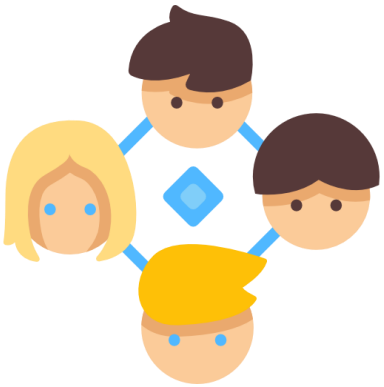
Volume demand per service =



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Adoption Intensity Quality

"n/N people watch X hours of Netflix per day at full-HD resolution"

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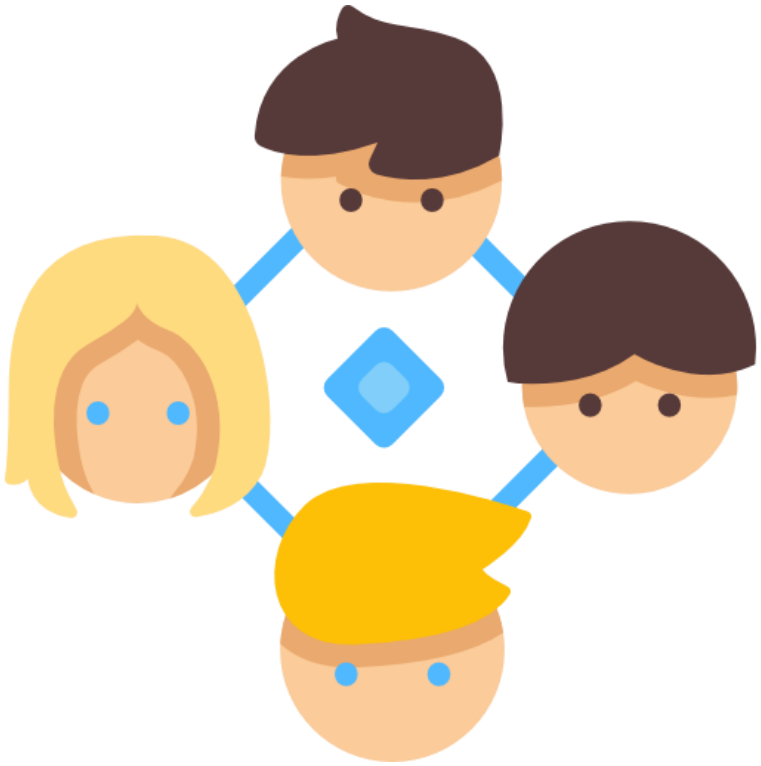

The differences between user groups are huge

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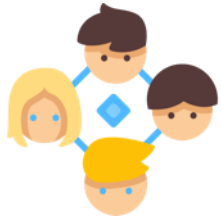
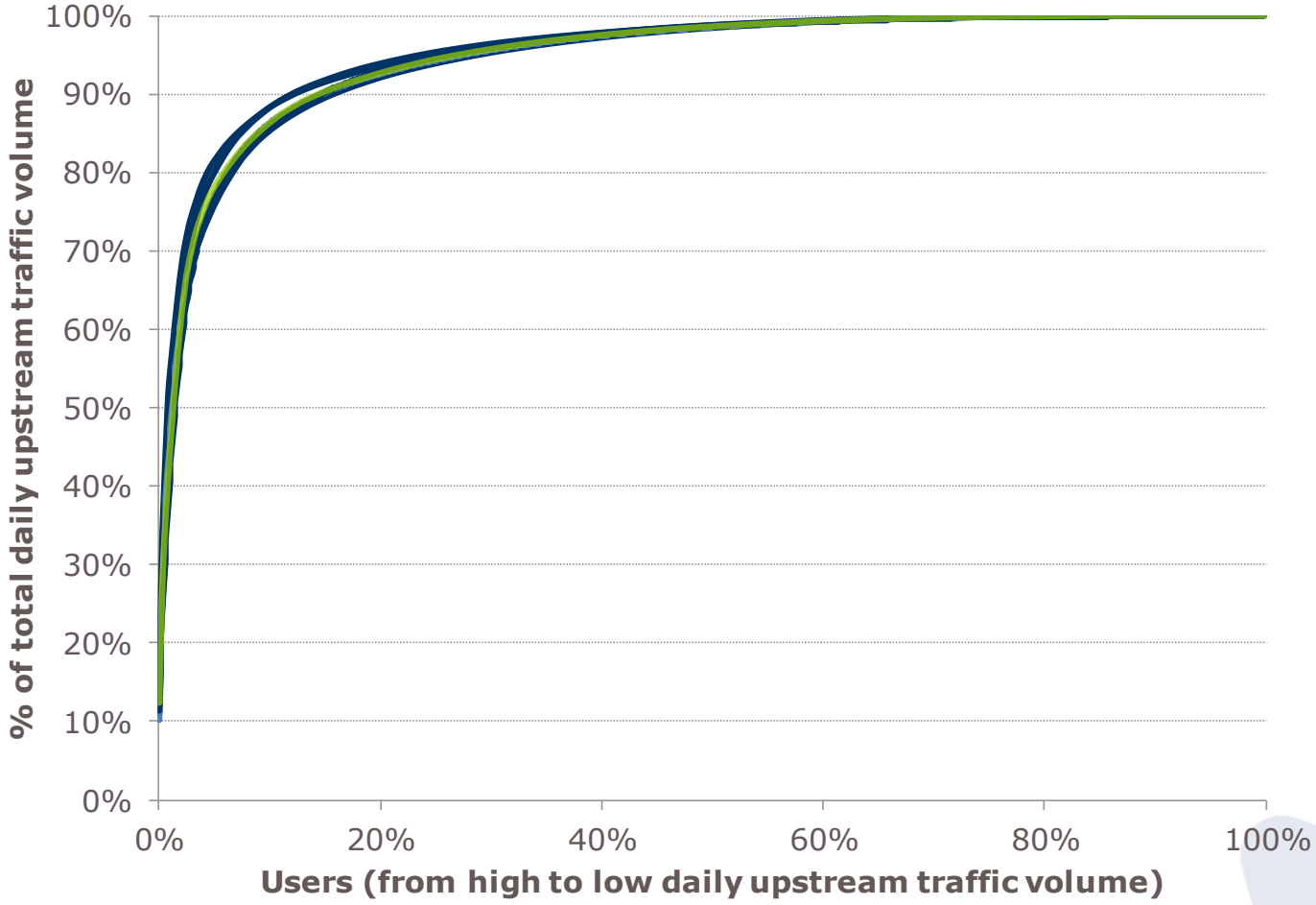
There are huge differences between user groups





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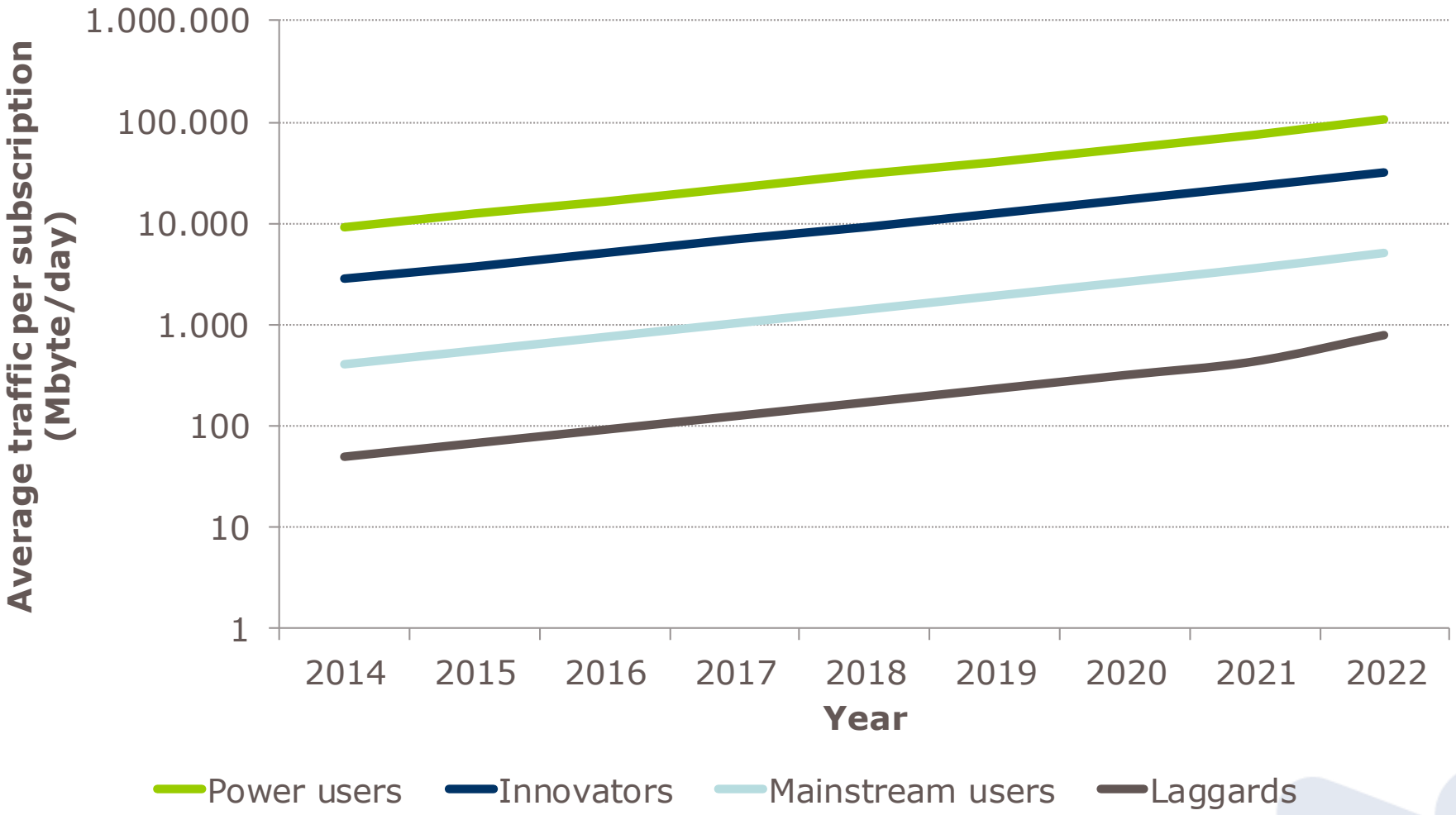
Estimated downstream demand growth per user group



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Broadband demand is driven by technological trade-offs.

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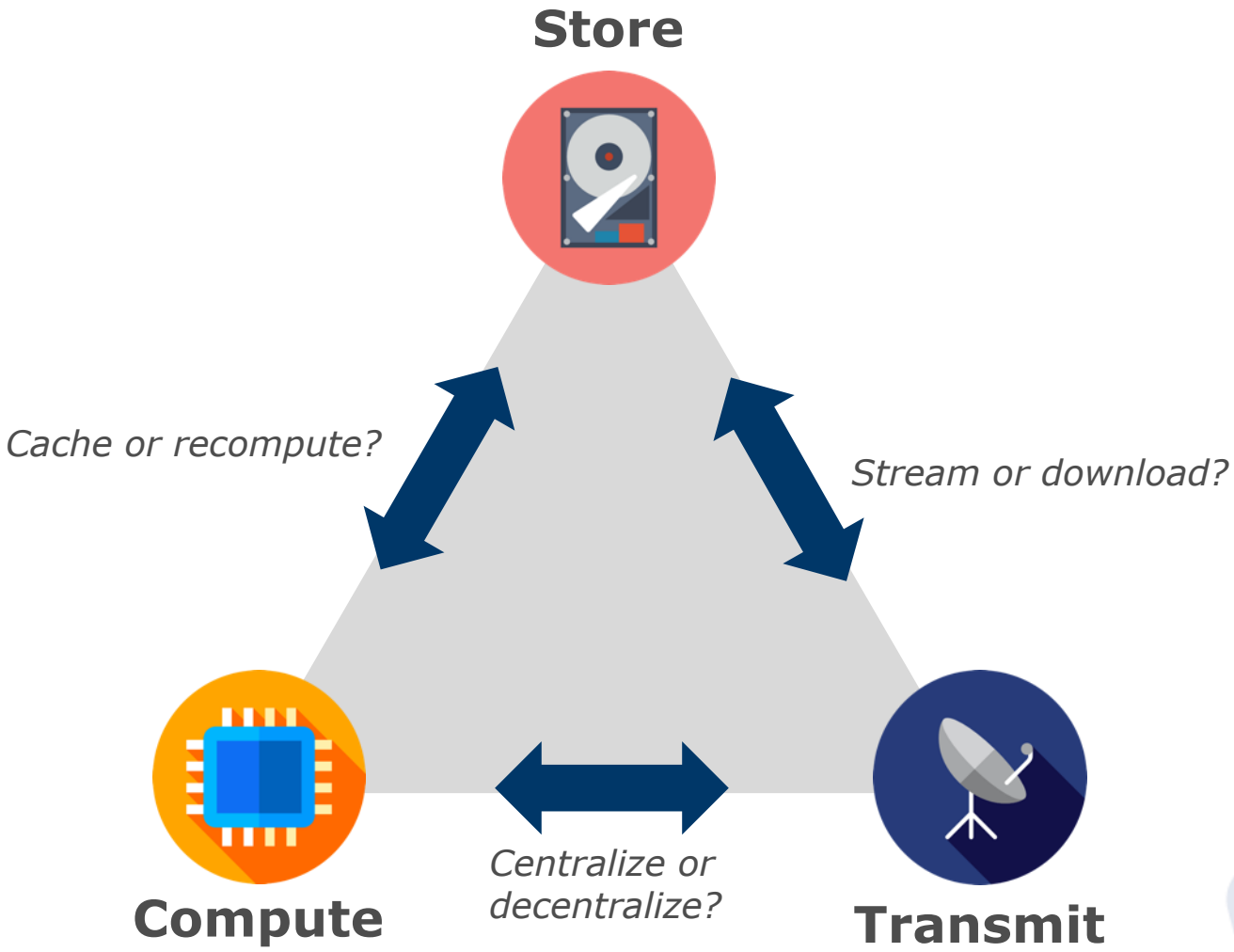
Fundamental trade-off in ICT



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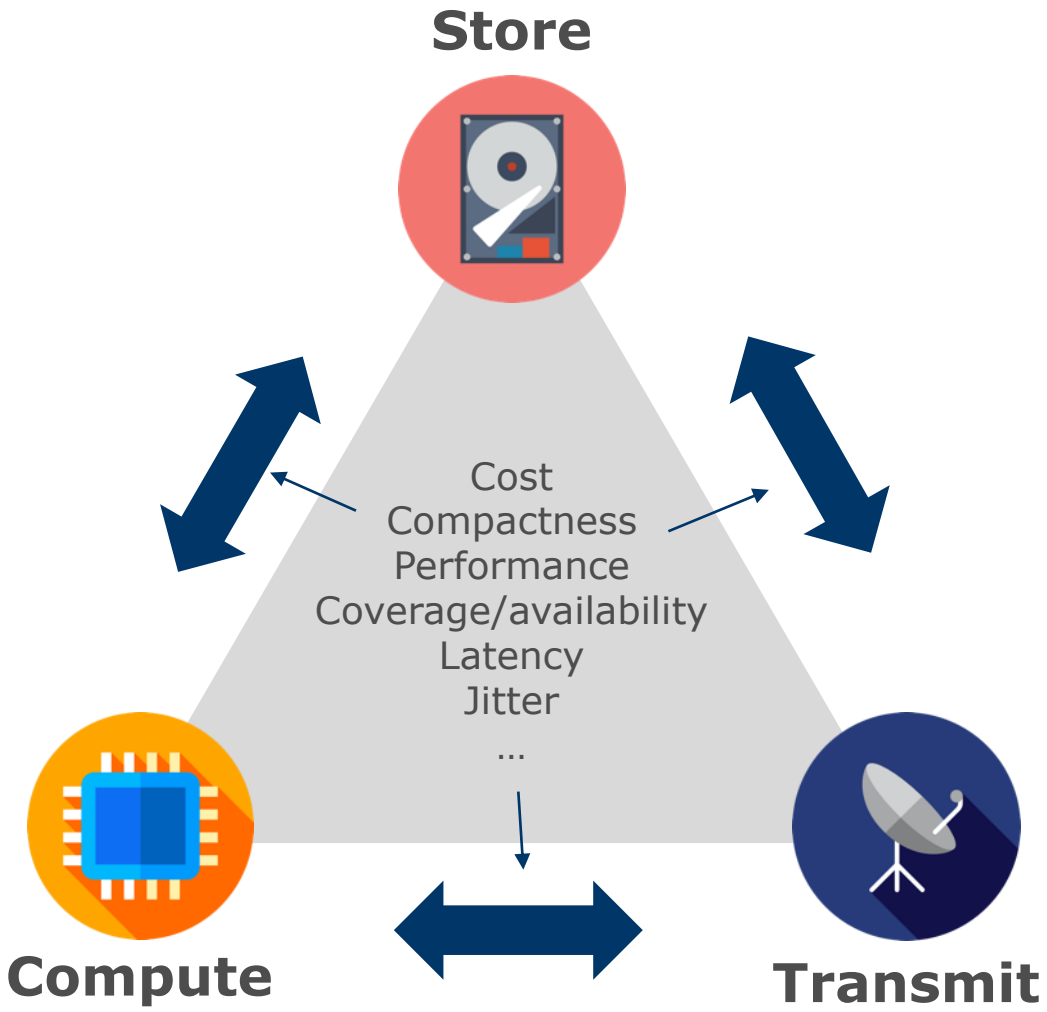
Fundamental trade-off in ICT



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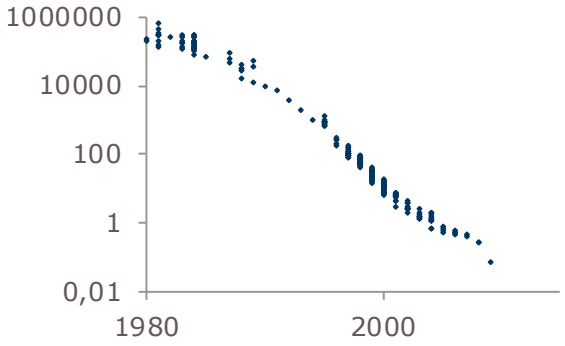
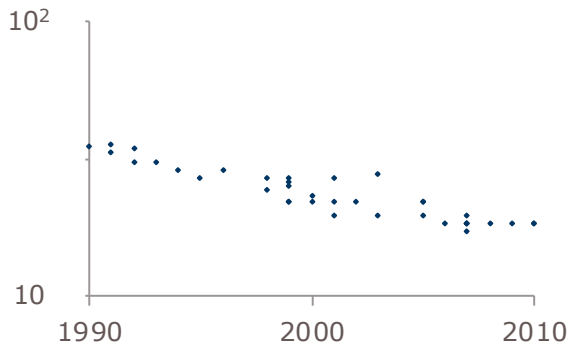
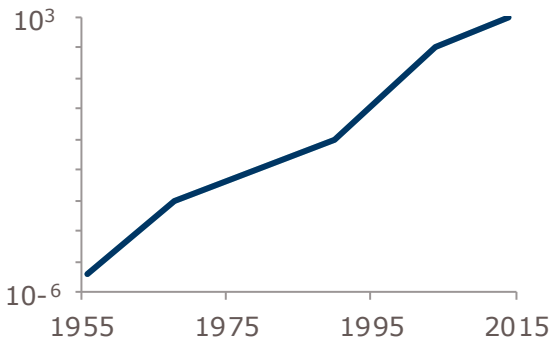
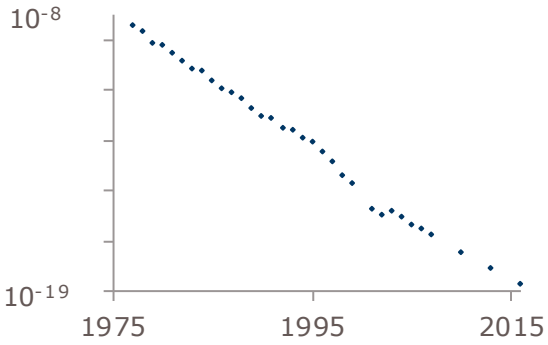
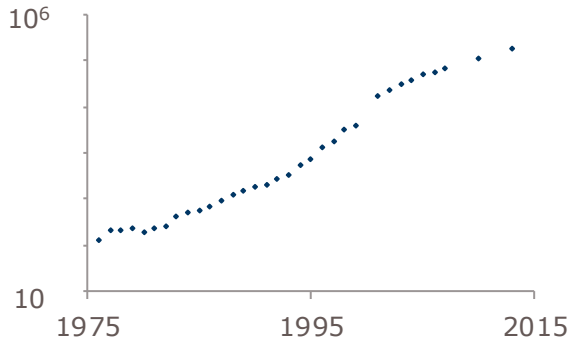
	Cheaper	Faster	More compact
Storage	Price per GB ($)	Latency (ms)	GB/inch^2
Processing	Cost of a processor cycle ($)	Processor speed (MHz)	# Transistors / processor
Transmission	Price per Mbps ($)	Download speed (bps)	Spectral efficiency (bits/Hz/site)

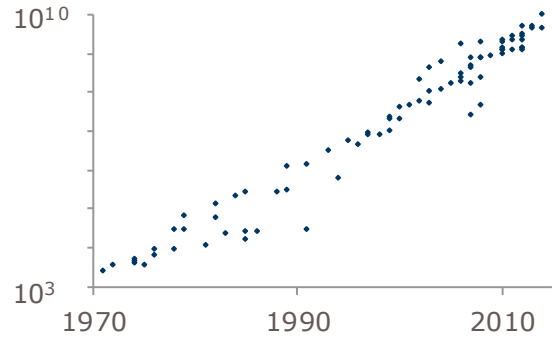


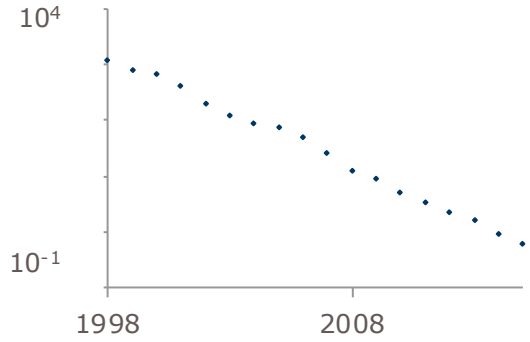


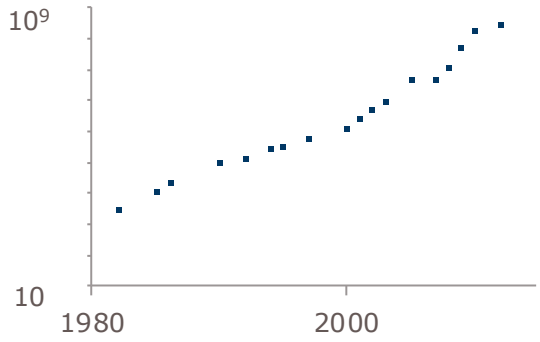


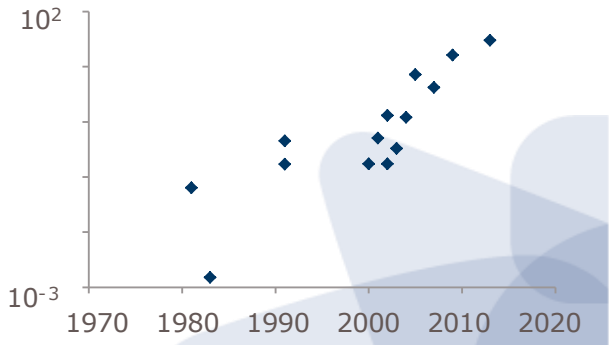




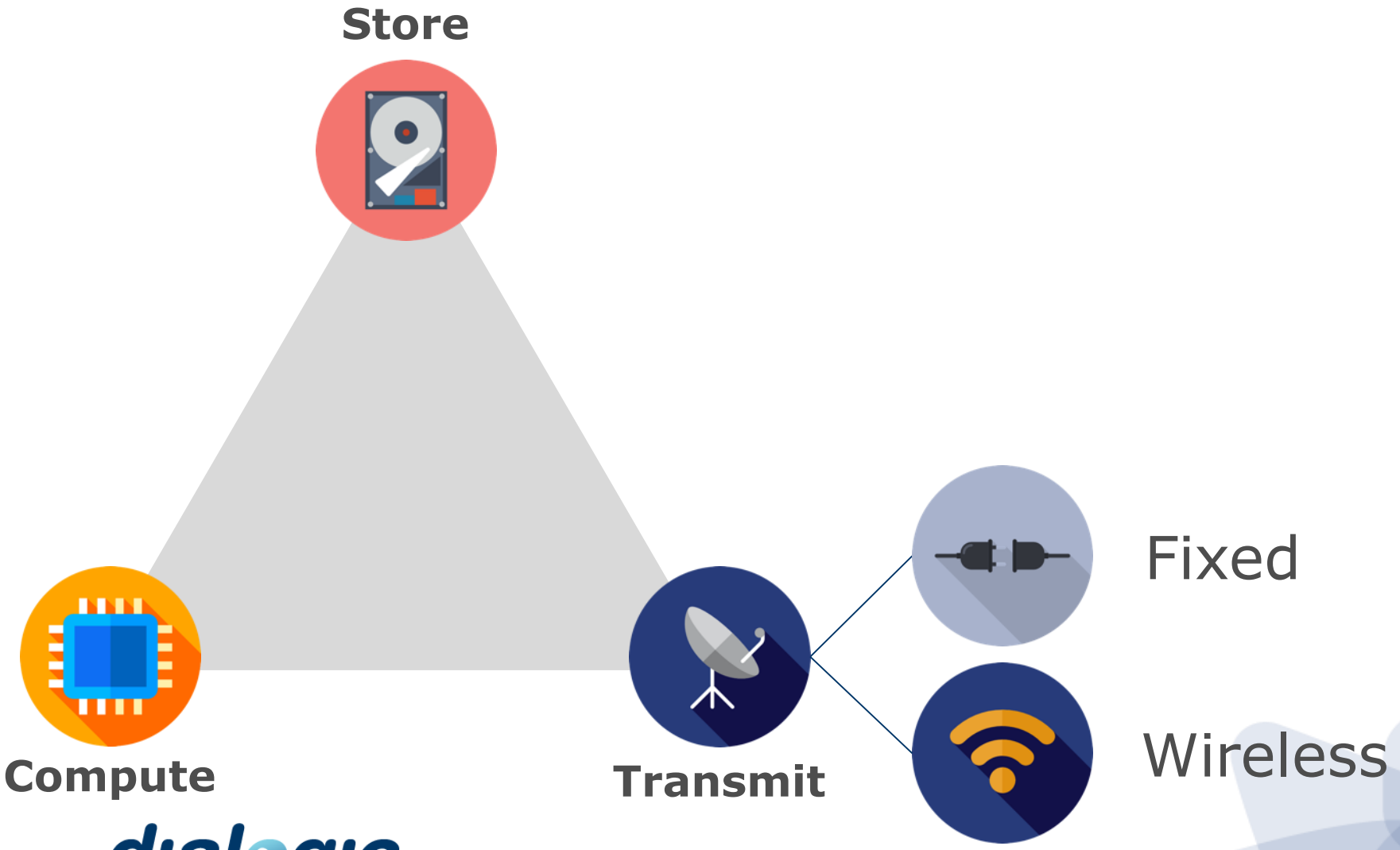








Fundamental trade-off



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There is future demand but we do not yet know what will drive it

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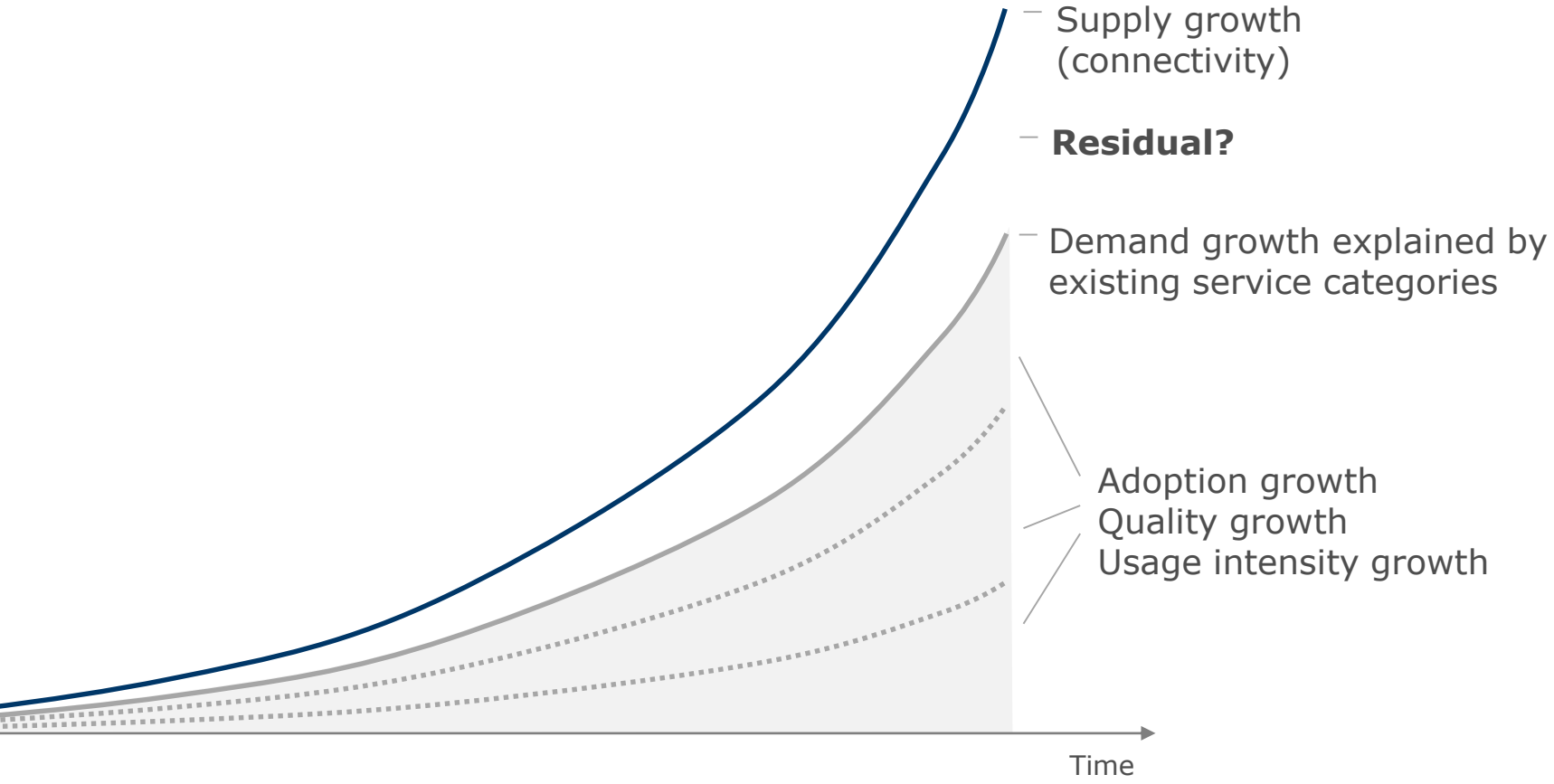
NETFLIX

YouTube

napster®



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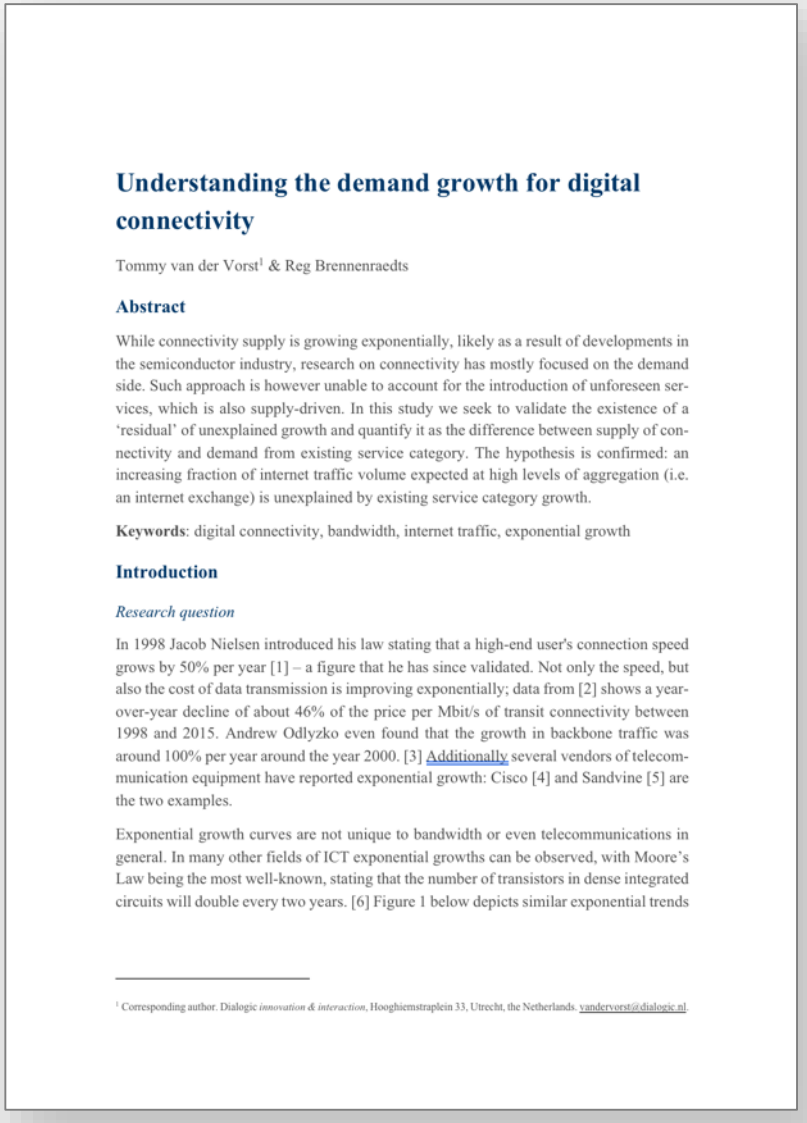

Understanding the demand growth for digital connectivity

Tommy van der Vorst[1] & Reg Brennenraedts

Abstract

While connectivity supply is growing exponentially, likely as a result of developments in the semiconductor industry, research on connectivity has mostly focused on the demand side. Such approach is however unable to account for the introduction of unforeseen services, which is also supply-driven. In this study we seek to validate the existence of a 'residual' of unexplained growth and quantify it as the difference between supply of connectivity and demand from existing service category. The hypothesis is confirmed: an increasing fraction of internet traffic volume expected at high levels of aggregation (i.e. an internet exchange) is unexplained by existing service category growth.

Keywords: digital connectivity, bandwidth, internet traffic, exponential growth

Introduction

Research question

In 1998 Jacob Nielsen introduced his law stating that a high-end user's connection speed grows by 50% per year [1] – a figure that he has since validated. Not only the speed, but also the cost of data transmission is improving exponentially; data from [2] shows a year-over-year decline of about 46% of the price per Mbit/s of transit connectivity between 1998 and 2015. Andrew Odlyzko even found that the growth in backbone traffic was around 100% per year around the year 2000. [3] Additionally several vendors of telecommunication equipment have reported exponential growth: Cisco [4] and Sandvine [5] are the two examples.

Exponential growth curves are not unique to bandwidth or even telecommunications in general. In many other fields of ICT exponential growths can be observed, with Moore's Law being the most well-known, stating that the number of transistors in dense integrated circuits will double every two years. [6] Figure 1 below depicts similar exponential trends

[1] Corresponding author. Dialogic *innovation & interaction*, Hooghiemstraplein 33, Utrecht, the Netherlands. vandervorst@dialogic.nl.

ITS Seoul 2018

Session B1

Monday (25-6)

15:10 – 16:35

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Thank your for your attention!

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