

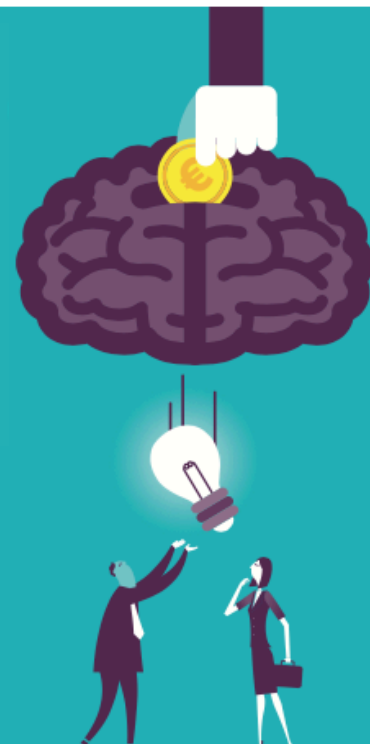


Rigorous empirical
research on
intellectual property

The Internet of Things and 5G: An Overview

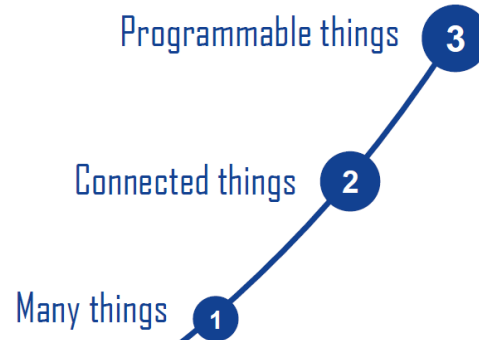
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Member of 4iP Council

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The Past: Connecting People

The Future: Connecting Things in a Programmable World



1bn fixed internet connections by 2005

Mobile internet with 5 bn people connected by 2020

Programmable World with 50 bn things connected by 2025

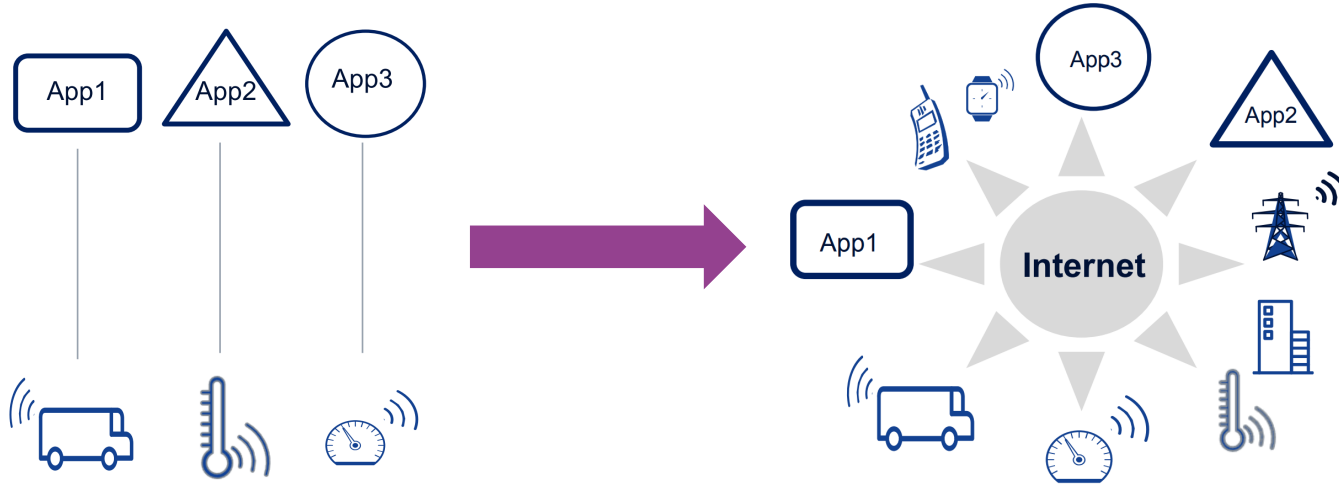
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IoT is fundamentally a sensor, connectivity, and data analytics revolution

IoT is part of something bigger: The connected,

Transformation from Point Solutions to IoT

From the Intranet of Things to the Internet of Things



- < 5 Billion connected people
- Humans and ad-hoc M2M connections only source of data
- Data meaningful in context
- From product...

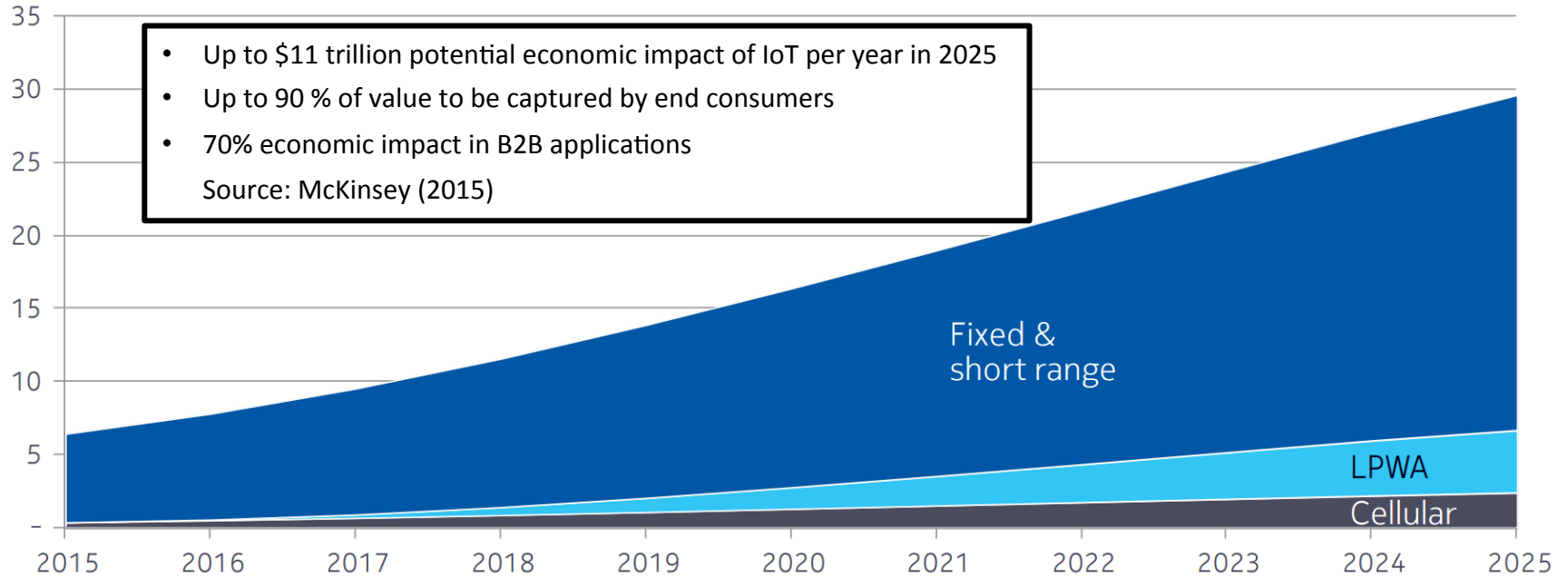
Before

- 50 Billion connected “things”
- Data disassociated from any source
- ...to almost everything delivered as a Service

2025

Huge Economic Potential from Billions of IoT connections

But realisation of this potential is also difficult and uncertain



- Up to \$11 trillion potential economic impact of IoT per year in 2025
 - Up to 90 % of value to be captured by end consumers
 - 70% economic impact in B2B applications
- Source: McKinsey (2015)

Graph: Machina Research (May 2015)

Five Key Challenges for the Internet of Things

Robust connectivity:
Latency, availability,
coverage

1

Standardisation:
Standard connectivity
for billions of things

2

Interoperability and
open interfaces:
Enabling platforms to
talk with each other

3

Privacy and security:
Prevent malware
injection and data
misuse

4

Domain knowledge:
Deep, vertical-specific insights

5

Wireless Connectivity for the Internet of Things

5G – The Next Generation Cellular Standard

- Open standard, operating on licensed radio spectrum
- In development, initial rollout later this year

“an open standard must be aimed at creating unrestricted competition between vendors and unrestricted choice for users” (Digital Standards Organisation)

Scarce Resource: Licensed Radio Spectrum

- Natural Oligopoly: licensed network operators
- Unlicensed-spectrum technologies for LPWAN create competitive pressure
- Market will grow tremendously

Alternative Technologies for LPWAN

LPWAN = low power, wide-area network

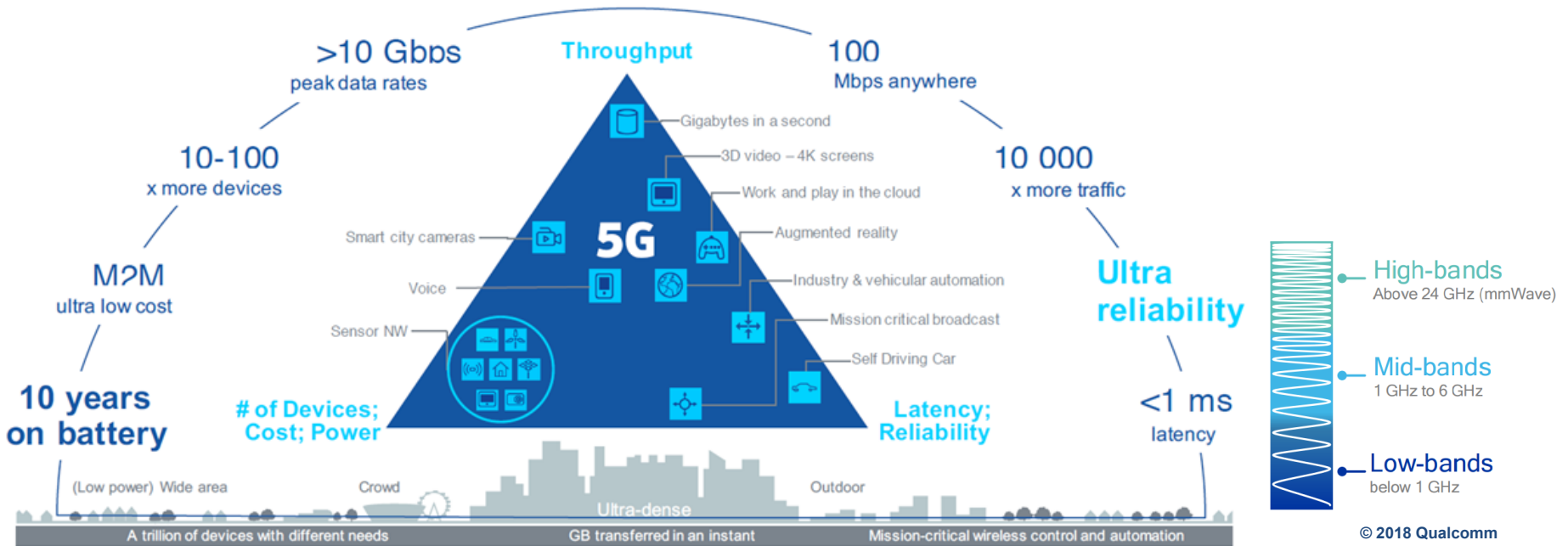
- Fixed, med-to-high density connections (smart cities / buildings)
- Long-life, battery-powered applications
- Operating on unlicensed spectrum
- Proprietary technologies already being rolled out

Example: SigFox

- Inexpensive radios by multiple manufacturers
 - Software / network as a service - SigFox as network operator
-
- Can address only a subset of foreseen IoT use cases

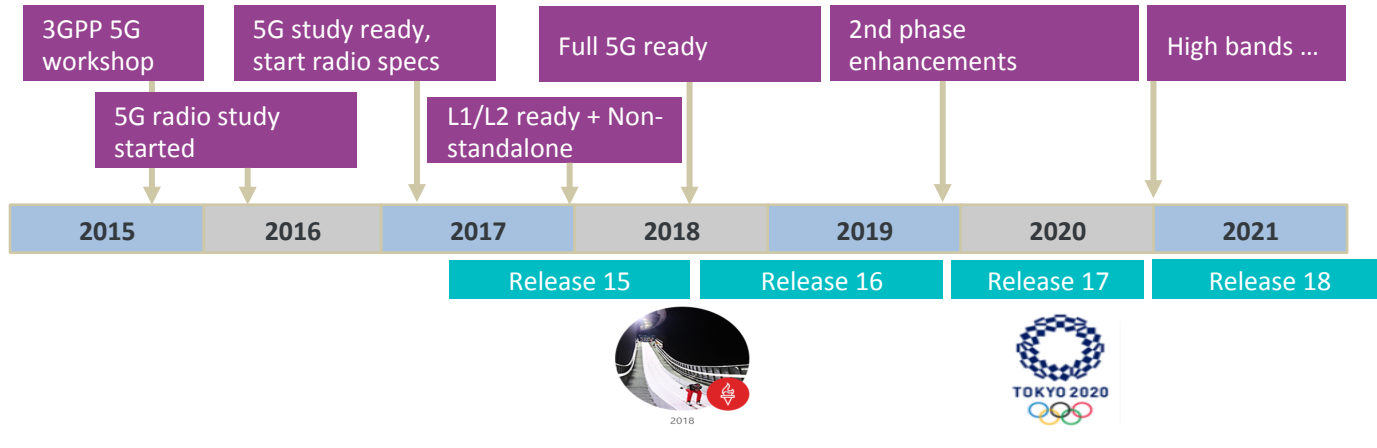
5G: The Next Cellular Generation

Diverse Services, Diverse Spectrum, Diverse Deployments



The Process towards 5G

Building on Previous Standard Generations for Accelerated Roll-Out



- 3GPP Release 15 standard development prioritizes non-standalone NR (new radio) to accelerate 5G rollout
- Non-standalone NR specs frozen in March 2018, will utilize LTE network architecture for higher bandwidth
- 5G commercial rollout now scheduled to begin in late 2018
- Development of 5G will continue with Release 16 and beyond