

Horizon 2020: Europe's Major New
Collaborative Research Programme

Strategic Research and
Innovation Agenda
"Internet on The Move"

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Net!Works



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Scope of EU Net!Works Technology Platform

- Networking technologies for superfast to low information rate connectivity and communications between:
 - **people, devices, machines, businesses**
- Through
 - **mobile, wireless and fixed networking media.**

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Importance of Connectivity

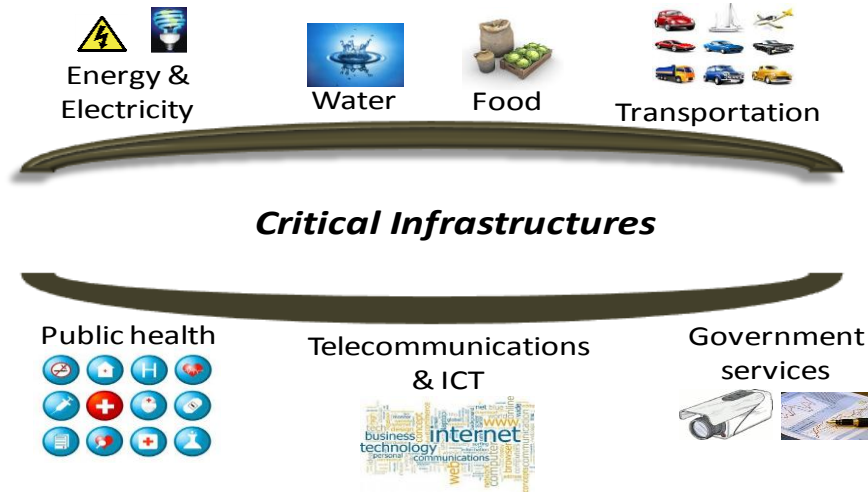
-**THE OXYGEN OF DIGITAL ECONOMY**

.....beyond just connecting people

- ICT transformative technology in modernisation & efficiency of other industries
 - Transportation, Health, all utility services
- By 2020, globally, connectivity
 - >7 billion people
 - > 50 billion “things”

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ICT as "National Critical Infrastructure"



"Fully connected digital economy"
Telecommunication and ICT infrastructure role:

- Transporting and controlling of all the other national Critical Infrastructures
- Become "**Super**" critical national infrastructure

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Trends and Drivers

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- Internet is the killer application
- Smart phones have made “Internet on The Move” a norm and necessity
- Internet contents are becoming complex and rich
- Staggering exponential increase in mobile data volume
- Capacity doubles only every 10 years
- Energy consumption exponentially increasing with traffic
- New and stringent requirements imposed on Internet and communication networks as
 - “Super” national critical infrastructure
- Data rate gap increasing between fixed and mobile networks
- Introduction of new services and functionalities too long

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Enabled by smart phones and broadband mobile



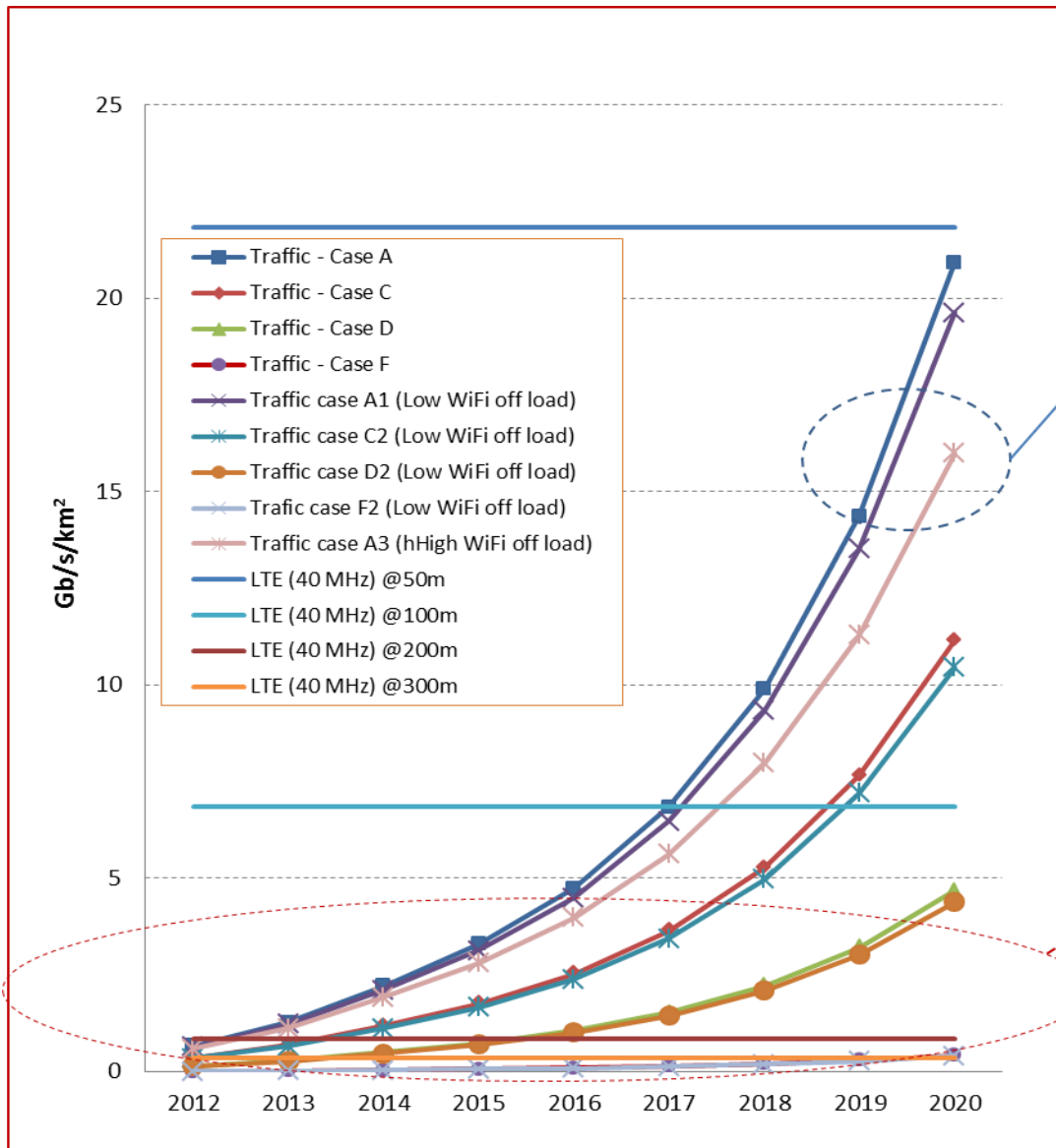
The Internet!



Internet Services Trend

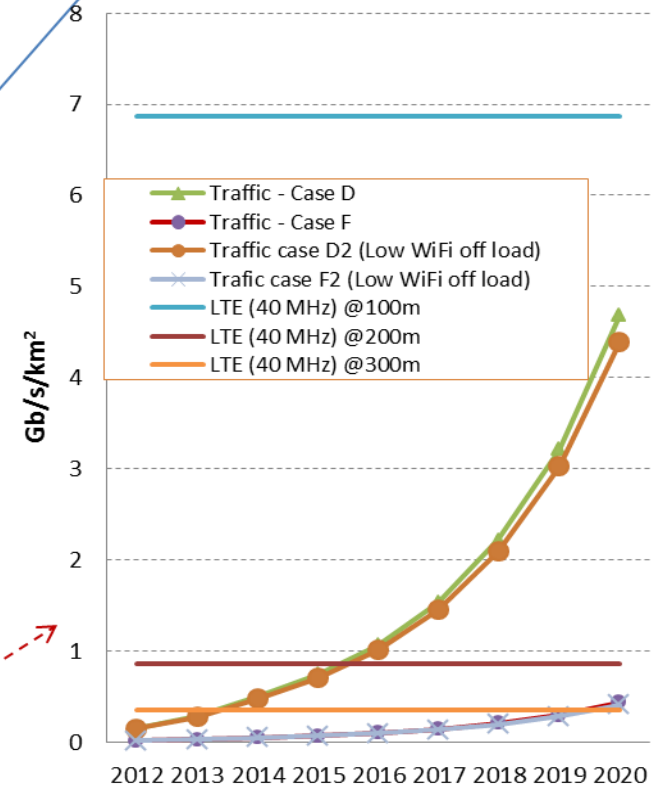
- Internet is getting more complex with rich multi-media content
- Web pages getting more complex
 - Avg web page size has tripled in past 5 years
 - +75% HTTP requests from images, up from 20% in '03
 - +90% of web pages have images today
- Video and HD
 - Average file size on the web = 10 MBytes
 - Video accounts for ~99% of all bytes transferred
 - And they are growing in size and length; 90% of videos are +3min, up from under 1 min in '97

Bandwidth Floor



Traffic demand after WiFi off load of :

- ~ 6% (case A2) in 2020
- ~ 25% (case A3) in 2020



Case A: Working population inner city
 Case C: Offices
 Case D: Peak
 Case F: Mean

ISD (Inter-site Distance) represents cell densities

Ref: InterDigital- Surrey "Vision beyond 2020"



Challenges

- **Spectrum, Capacity and Energy Crunch**
- **Tsunami of Data and Internet of Things**
- **Emergency Network**

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Wireless Standards Evolution – 5G

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Next generation Global standard around 2020

Peak "5G" volume around 2040

1983

1991

2001

2011

2021

2031

2041

Research & Std

5G-Internet on the Move

Research & Std

4G – LTE/LTE-Advanced

Research & Std

3G – WCDMA/HSPA/HSPA +

Research & Std

2G – GSM/GPRS/EDGE

1G – TACS

Peak LTE volume around 2030

LTE overtakes 3G around 2020

Interest on the Move

Average of 10 years research and standardisation, 20 years from intro to peak volume

Drive Towards All IP communications, maximise network capacity, high throughput & low latency



Why New Air-Interface?

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- **Objectives is NOT link spectral efficiency**
- Low control signalling overhead for management, relaxes the stringent time-frequency control inherent in OFDMA
- Flexible implementation of carrier aggregation across highly fragmented spectrum including license-exempt band
- Highly energy efficient
- Allow full-duplex operation
- Sub-millisecond Air-Interface latency
- Support fast/reliable spectrum sensing for opportunistic spectrum sharing with and without database support
- Support distributed MAC between network and mobile device
 - Support of device to device communications
- Scalable for Machine type communications
-

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Emphasis on Air-Interface and Wireless Mesh backhaul

- **Area Spectral Efficiency**
- **Low latency**
- **Low signalling Overhead**

Uniformity between

- **Licensed and Licensed-exempt Bands and services of Broadcast, Mobile Communications and WiFi**

Use of mmWaves

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Big Data

- **Big Big Data**
- **Big small Data**
 - **User, Network and application aware networking**
 - **Information Centric networking with Context Information**
- **Distributed micro-servers**
- **Local caching, computing, achieve low latency**

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Acknowledgement

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