4G vs 5G, the 1000x Capacity Challenge…
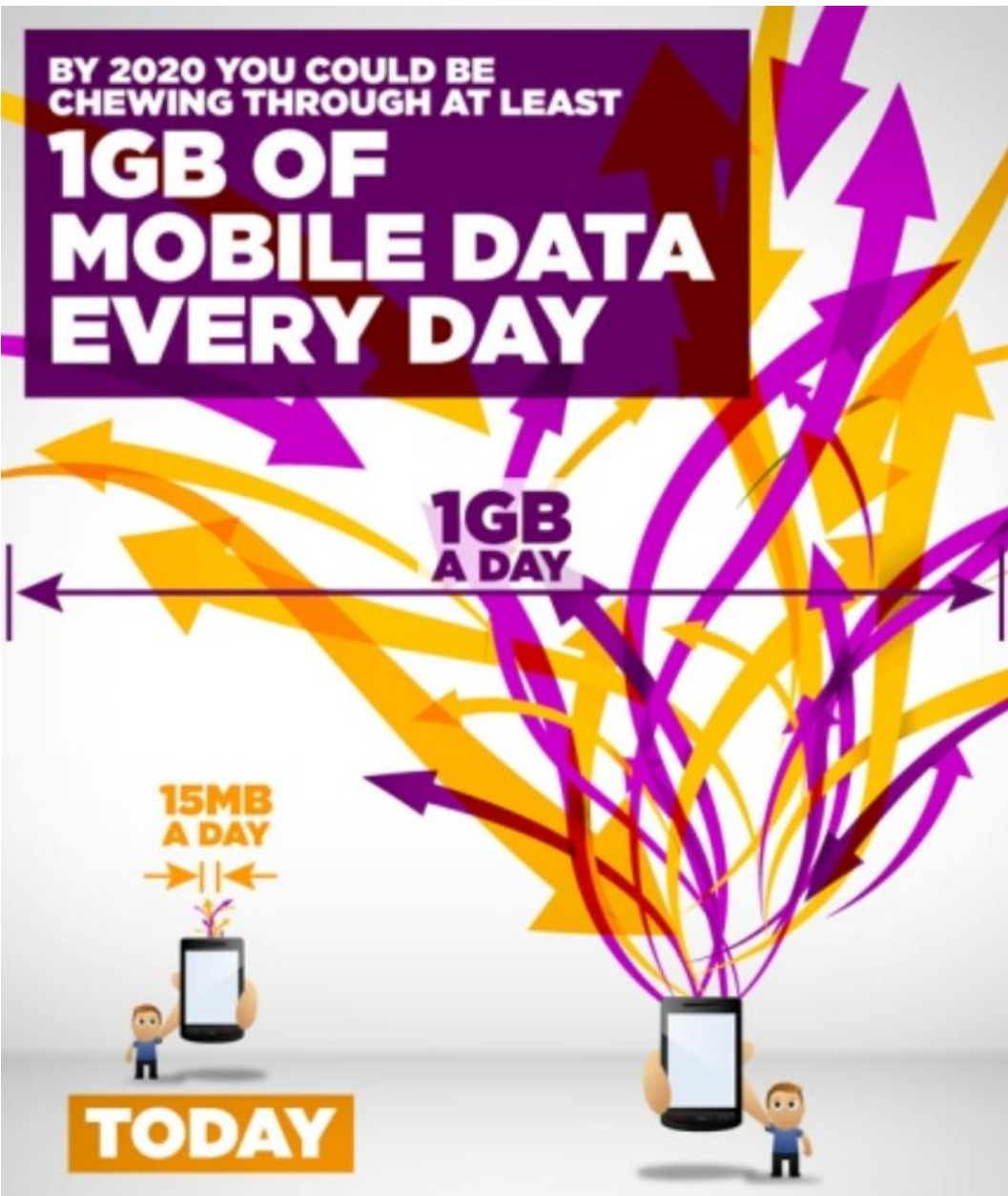## Dimitris Kolokotronis

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The Connected Life by 2020

2020
24 Billion
Total Connected Devices

2011
9 Billion
Total Connected Devices

2020
12 Billion
Mobile Connected Devices

2011
6 Billion
Mobile Connected Devices

Revenue Opportunity For
Mobile Network Operators in 2020

$1.2 Trillion

7x increase on 2011 expected revenues

Revenue opportunity for connected devices in vertical sectors

Health
$69 Billion

Automotive
$202 Billion

Consumer electronics
$445 Billion

Utilities
$36 Billion

Europe
$305 Billion

North America
$241 Billion

Middle East Africa
$87 Billion

Asia Pacific
$447 Billion

Latin America
$92 Billion

CREATING OPPORTUNITIES THROUGH CROSS-INDUSTRY COLLABORATION

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The IoT...

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The Internet of Everything

Internet of Things
(assets, devices, mobile and static sensors)

Internet of People
(social networking, crowd-sourcing, workflow)

Internet of Services
(cloud-based solutions, processes, tools and operations)

Internet of Data
(Linking of Open Data)
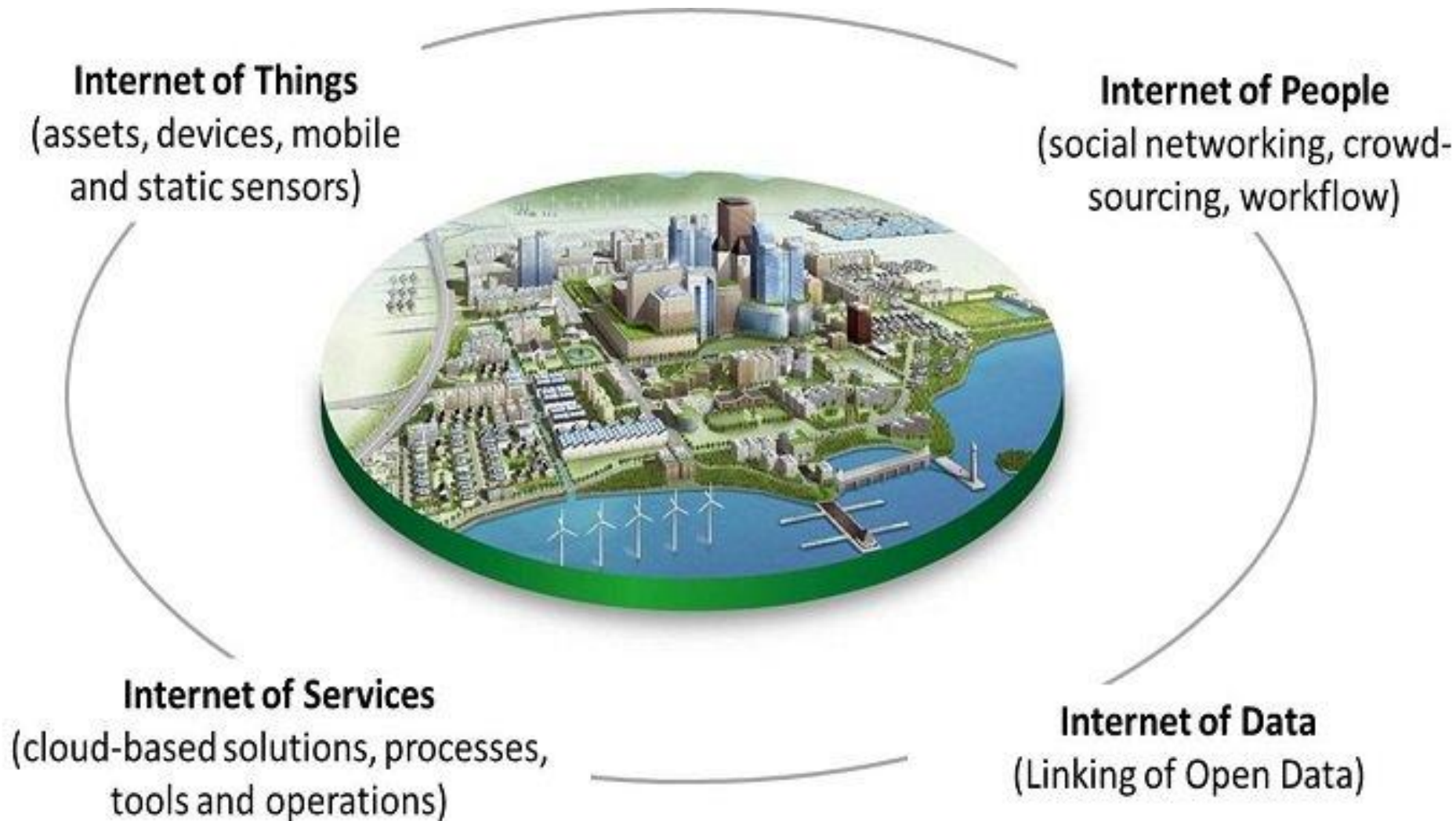
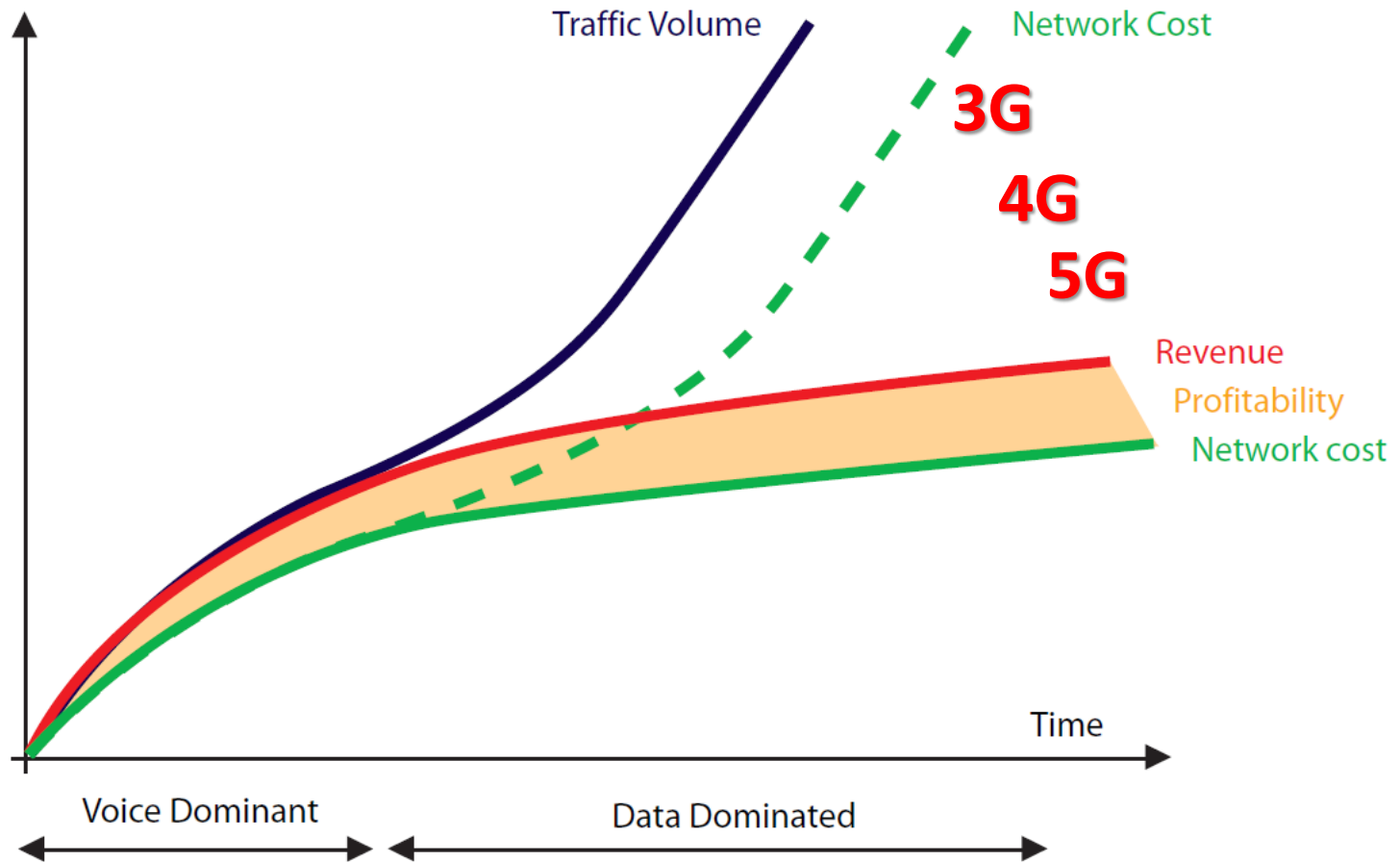**6th Infocom Mobile World 2016**

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Industry preparing for

1000x

data traffic growth

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The cost per bit must be reduced for operators to remain profitable
Source: Nokia Siemens Networks

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$$C_{Supply} = B_{MHz} \times E_{\frac{Mb}{s}/MHz} \times N_{Cells}$$

$$C_{2020}/C_{Today} = 1000 \approx 3 \times 6 \times 56$$

SK Telekom's presentation at the 3GPP workshop on "Future Radio in 3GPP"

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Bandwidth Boost: Carrier Aggregation (CA)

Conventional Network

20 MHz

20 MHz

20 MHz

Channel #1
(up to 150 Mbps)

20 MHz

2nd & 3rd LTE radio channels are idle

Up to 150 Mbps

LTE Advanced Network
(Carrier Aggregation)

20 MHz

10 MHz

10 MHz

CH.#1 (up to 150 Mbps)

CH.#2 (up to 150 Mbps)

CH.#3 (up to 150 Mbps)

Aggregated Data Pipe
(up to 300 Mbps)

40 MHz

Up to 300 Mbps 2X faster

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$$C_{Supply} = B_{MHz} \times E_{\frac{Mb}{s}/MHz} \times N_{Cells}$$

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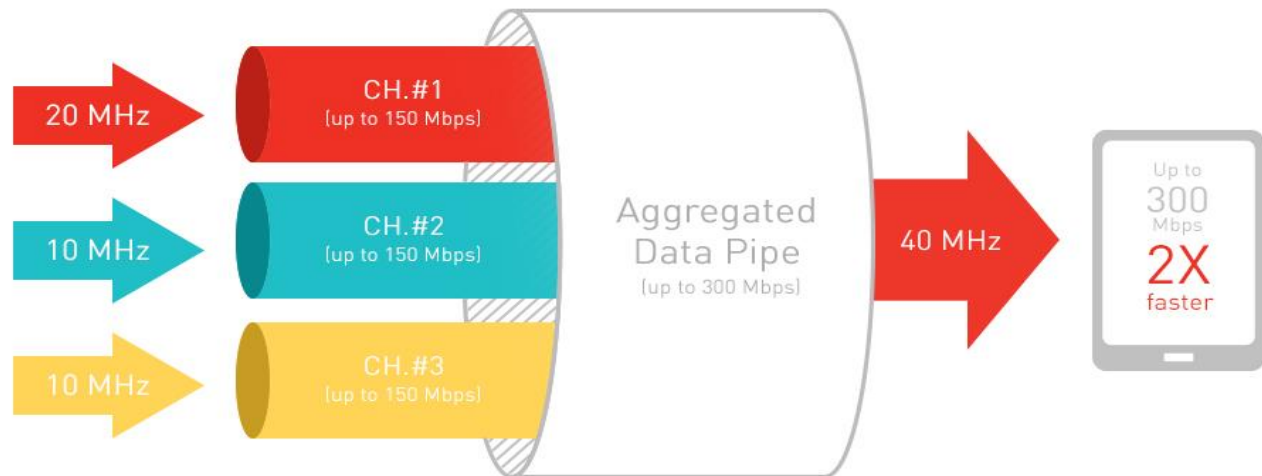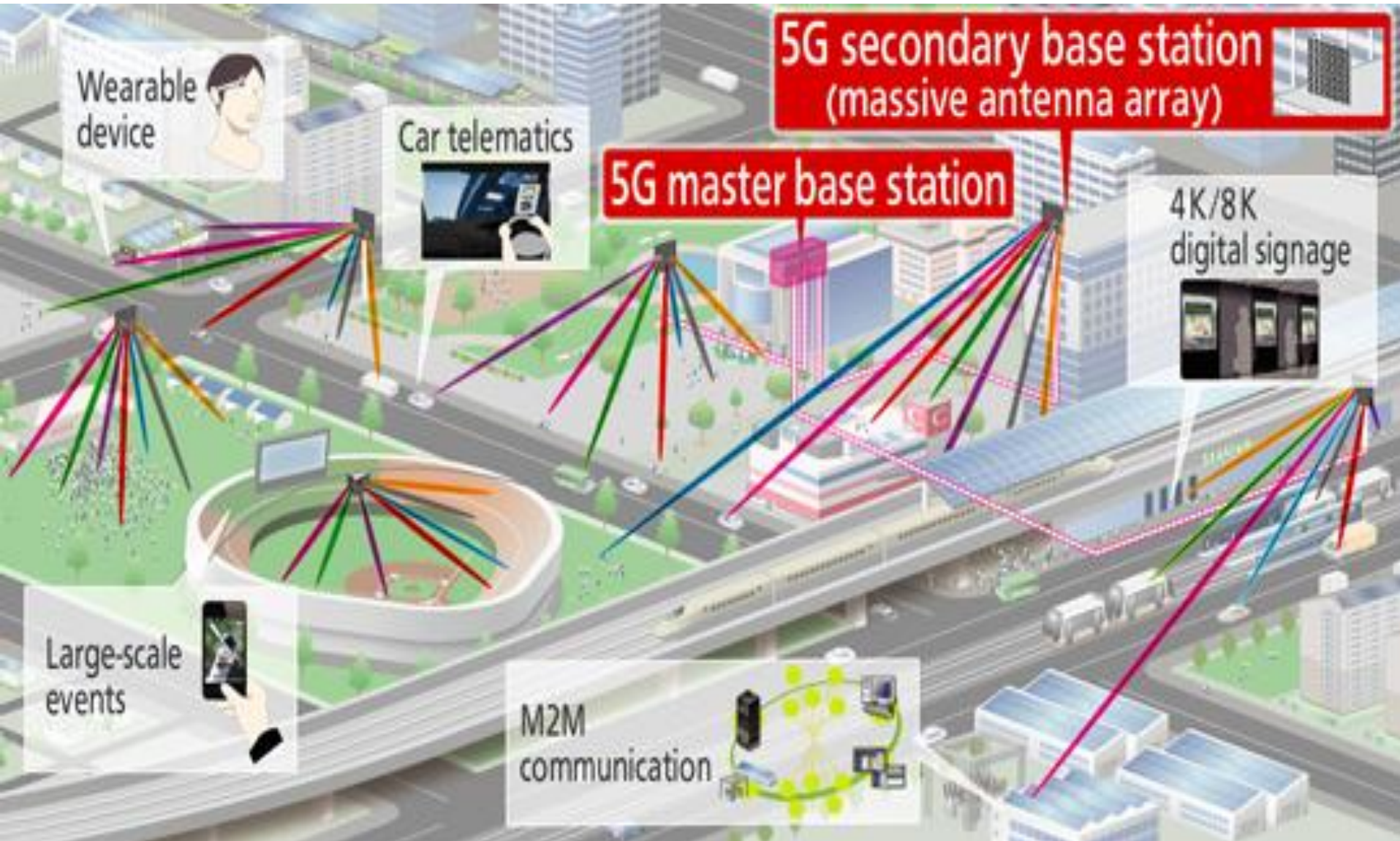**5G aims to boost further CA...**

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Efficiency Boost: MIMO & CoMIMO

Wearable device

Car telematics

5G master base station

5G secondary base station (massive antenna array)

4K/8K digital signage

Large-scale events

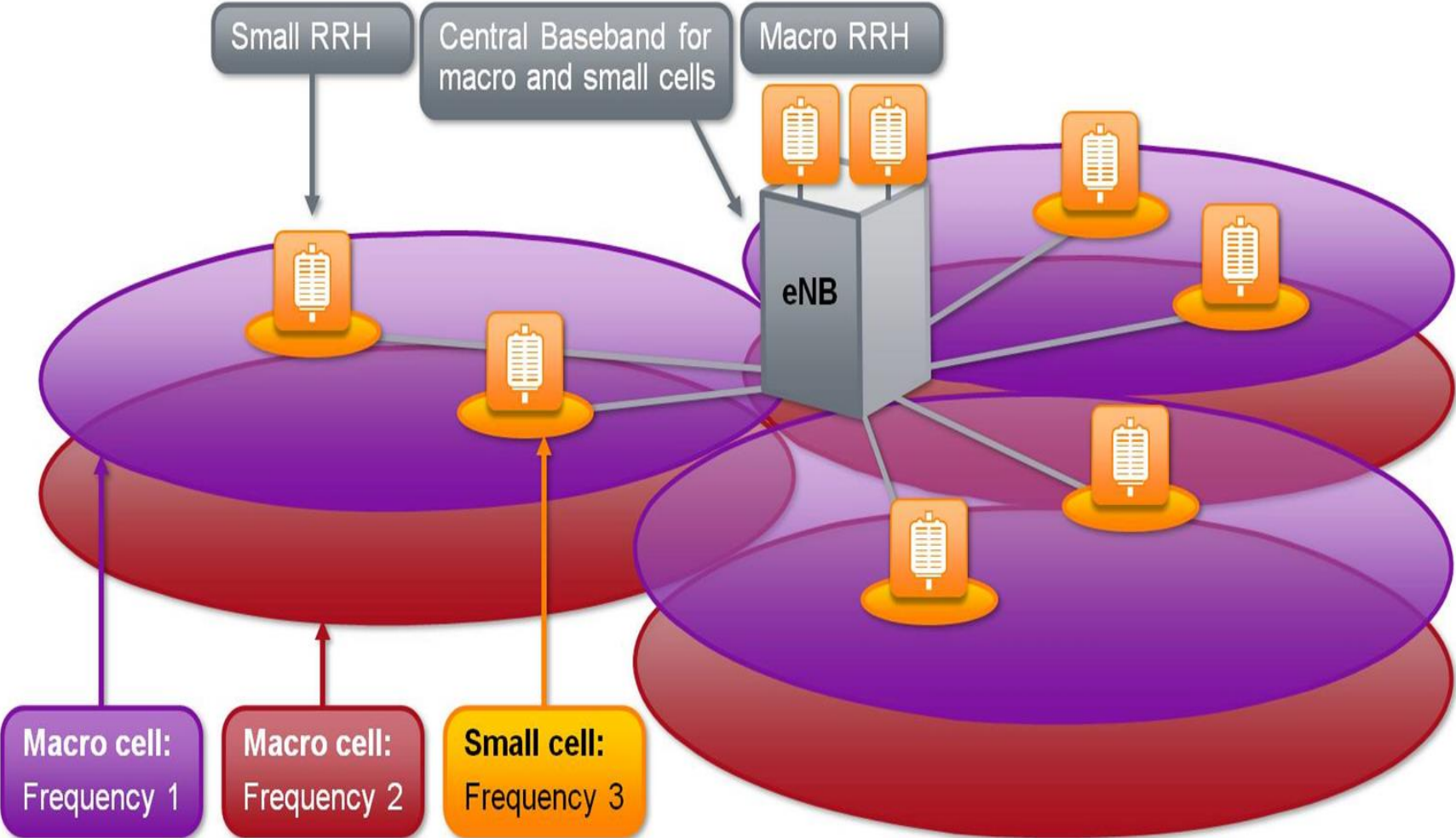M2M communication

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$$C_{Supply} = B_{MHz} \times E_{\frac{Mb}{s}/MHz} \times N_{Cells}$$

$$C_{2020}/C_{Today} = 1000 \approx 3 \times 6 \times 56$$

5G aims to boost further MIMO…

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Heterogeneous Networks (HetNet)

Small RRH

Central Baseband for macro and small cells

Macro RRH

eNB

Macro cell: Frequency 1

Macro cell: Frequency 2

Small cell: Frequency 3

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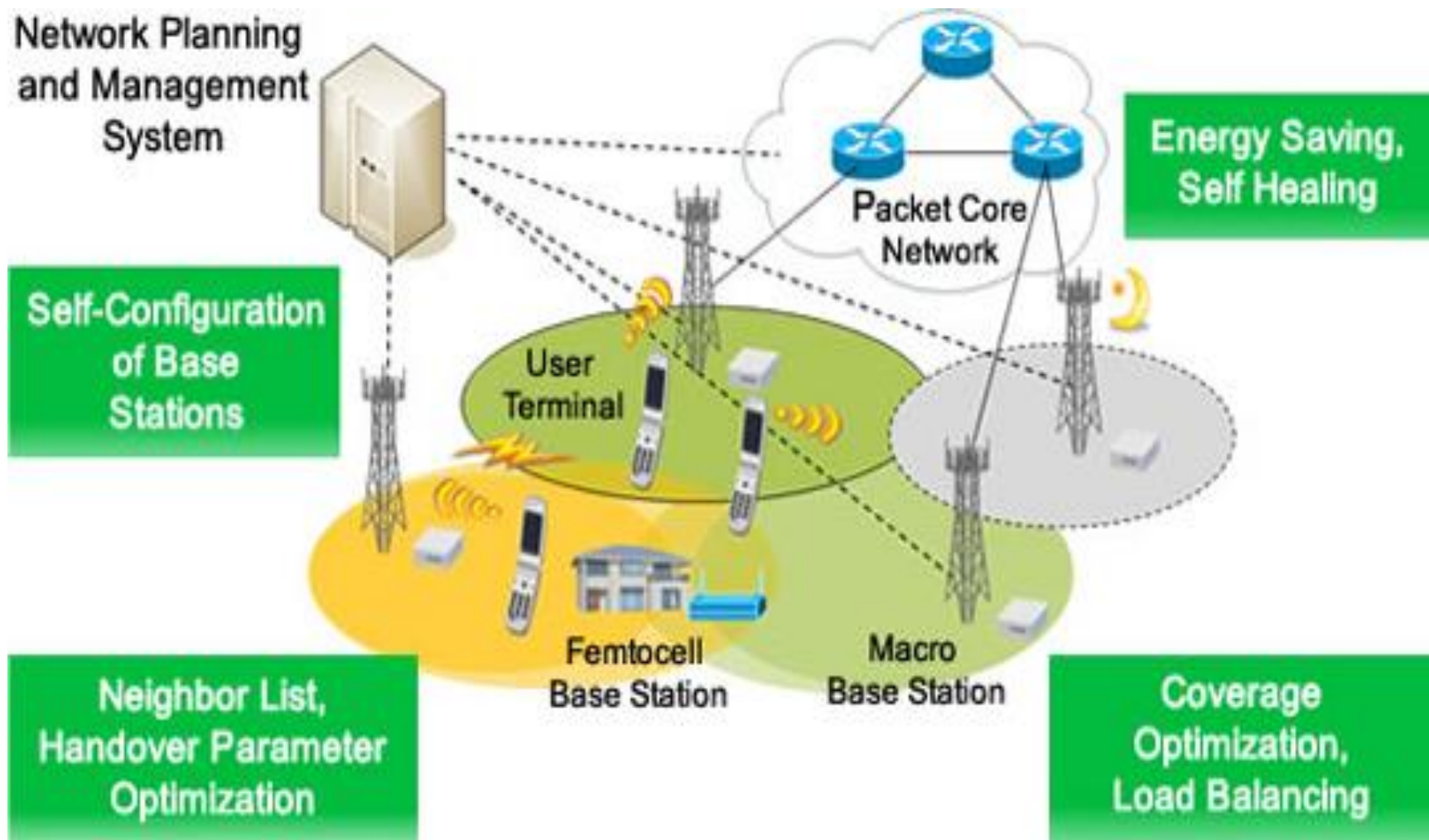
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$$C_{Supply} = B_{MHz} \times E_{\frac{Mb}{s}/MHz} \times N_{Cells}$$

$$C_{2020}/C_{Today} = 1000 \approx 3 \times 6 \times 56$$

5G aims to control HetNet's…

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Self Organizing Networks (SON)

Network Planning and Management System

Packet Core Network

Energy Saving, Self Healing

Self-Configuration of Base Stations

User Terminal

Femtocell Base Station

Macro Base Station

Neighbor List, Handover Parameter Optimization

Coverage Optimization, Load Balancing

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$$C_{Supply} = B_{MHz} \times E_{\frac{Mb}{s}/MHz} \times N_{Cells}$$

$$C_{2020}/C_{Today} = 1000 \approx \boxed{3 \times 6 \times 56}$$

5G aims to AUTO-TUNE all...

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Network Type

How long would it take to download the two-hour-long "Guardians of the Galaxy"?

What you could do while waiting

3G
384 Kbps
(2001)
+5

4G
100 Mbps
(2009)
+5

5G
10 Gbps
(2020)
+5

26 hours

6 minutes

3.6 seconds
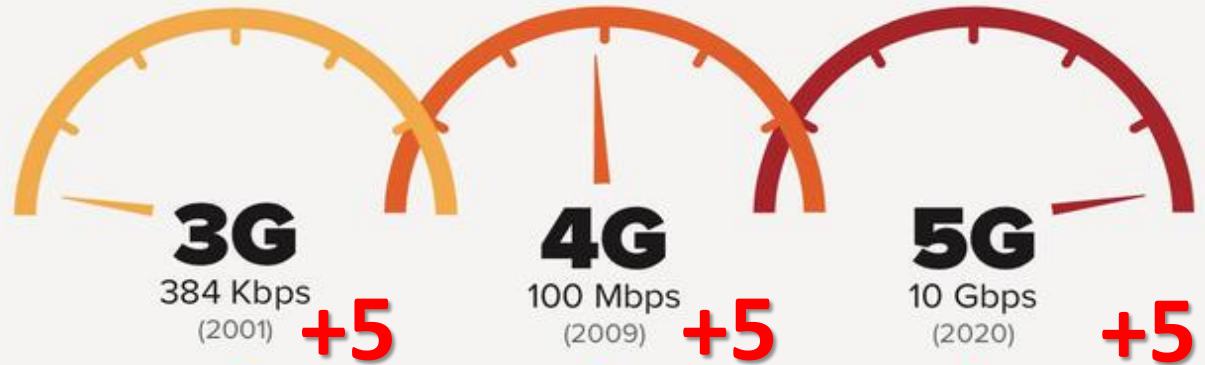
Fly from New York to Sydney, including check-in times

Run a quick mile
Catch up on Facebook

Ask, "Is it downloaded yet?"

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In the meantime…

The Economist | World politics | Business & finance | Economics | Science & technology | Cultur...
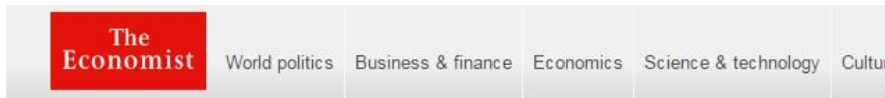
Mobile telecoms

Wireless: the next generation

A new wave of mobile technology is on its way, and will bring drastic change

Feb 20th 2016 | NEW YORK | From the print edition   Timekeeper   f Like ⟨17K   ▼ Tweet

THE future is already arriving, it is just a question of knowing where to look. On Changshou Road in Shanghai, eagle eyes may spot an odd rectangular object on top of an office block: it is a collection of 128 miniature antennae. Pedestrians in Manhattan can catch a glimpse of apparatus that looks like a video camera on a stand, but jerks around and has a strange, hornlike protrusion where the lens should be. It blasts a narrow beam of radio waves at buildings so they can bounce their way to the receiver. The campus of the University of Surrey in Guildford, England, is dotted with 44 antennae, which form virtual wireless cells that follow a device around.

"The other camp, explains Mr Téral, favours a revolutionary approach: to jump straight to cutting-edge technology. This could mean, for instance, **leaving behind the conventional cellular structure of mobile networks**, in which a single antenna communicates with all the devices within its cell. Instead, one set of small antennae would send out concentrated radio beams to **scan for devices**, then a second set would take over as each device comes within reach. It could also mean **analysing usage data to predict what kind of connectivity a wireless subscriber will need next and adapt the network accordingl**y—a technique that the 5G Innovation Centre at the University of Surrey wants to develop."

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- We use the conventional cellular structure
- We use the legacy antennas
- We scan for devices in azimuth plane
- We analyze usage data
- We predict optimum directionality
- We adapt the network accordingly

We have installed and tested our systems on live networks and proved that we can offer over 30 percent capacity boost on a legacy 3G technology... TODAY!!!

Imagine what this boost will be on 5G that rates are 10-fold...

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Thank you

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