5G : CONNECTED WORLD OF TOMORROW

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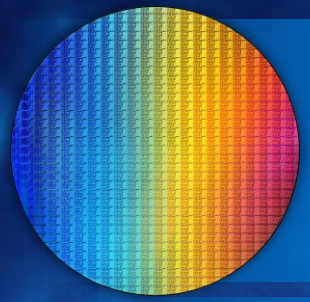
INTEL TECHNOLOGY LEADERSHIP



MAKE THE WORLD'S BEST SEMICONDUCTORS

BE THE LEADING END TO END PLATFORM PROVIDER FOR THE NEW DATA WORLD

LEAD THE ARTIFICIAL INTELLIGENCE & AUTONOMOUS REVOLUTION

DELIVER THE BEST CUSTOMER EXPERIENCES ON THE PLANET

SEMICONDUCTOR LEADERSHIP ENABLES PLATFORM LEADERSHIP

CO-OPTIMIZED PROCESS AND PRODUCT DESIGN

CO-OPTIMIZED PRODUCTS

FPGA

CPU

SoC

MEMORY

MODEM

INTEL'S INTEGRATED DEVICE MANUFACTURER MODEL IS FOUNDATIONAL TO DELIVERING BEST-IN-CLASS PLATFORMS

INTEL DELIVERS END TO END PLATFORMS

DEVICES/EDGE

NETWORK

CLOUD/DATA CENTER

MEMORY

4G/5G

SOFTWARE


intel
experience
what's inside™
5G

EVOLUTION TO A SMART AND CONNECTED WORLD

2G

Cellular Comms.

3G

Data and the ‘app’ revolution

4G

Faster data rates

5G

Reactive, smart, and connected devices

WHAT IS 5G

Smart City & Buildings

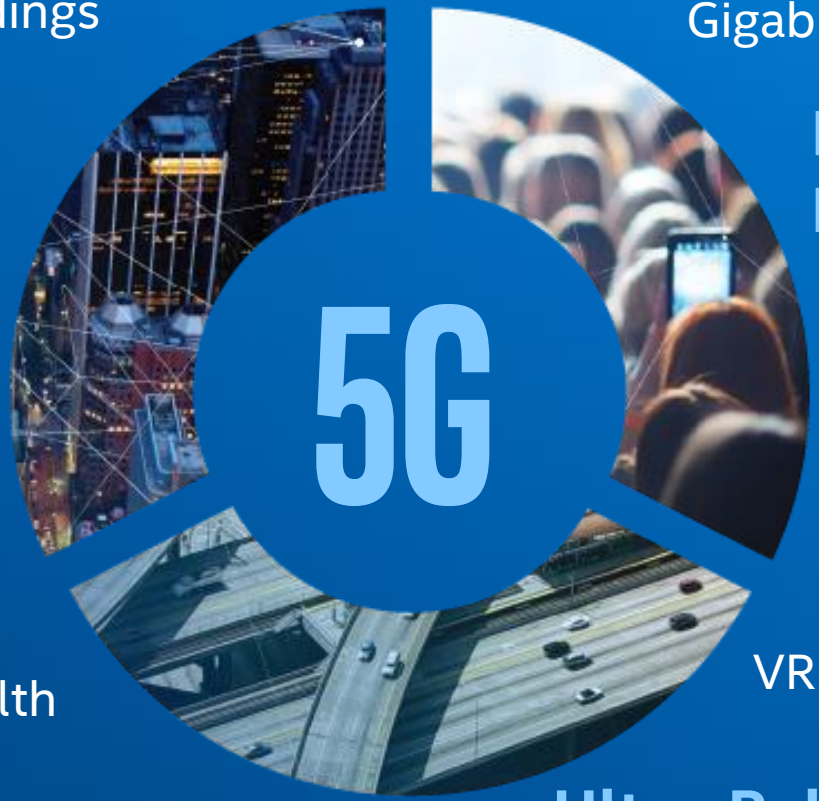
CPE, Drones, Phones, Tablets

Massive Machine to Machine

Machine Learning

Health

Autonomous Driving



Gigabits/sec

Enhanced Mobile Broadband

3D Video and UHD Screens

Work and Play in the Cloud

VR Gaming

Ultra-Reliable and Low Latency

EVERYTHING SMART, EVERYTHING CONNECTED — 5G IS COMING

In the next few years, 5G will fundamentally transform our lives, bringing us a society and environment where everything is smarter and more connected.

Forging New Industries

Improving Lives

Disrupting Business Models

THE INCOMING FLOOD OF DATA

The rise of connected things and media by 2020

- **212B** sensors
- **50B** devices
- **47%** connections will be machine to machine

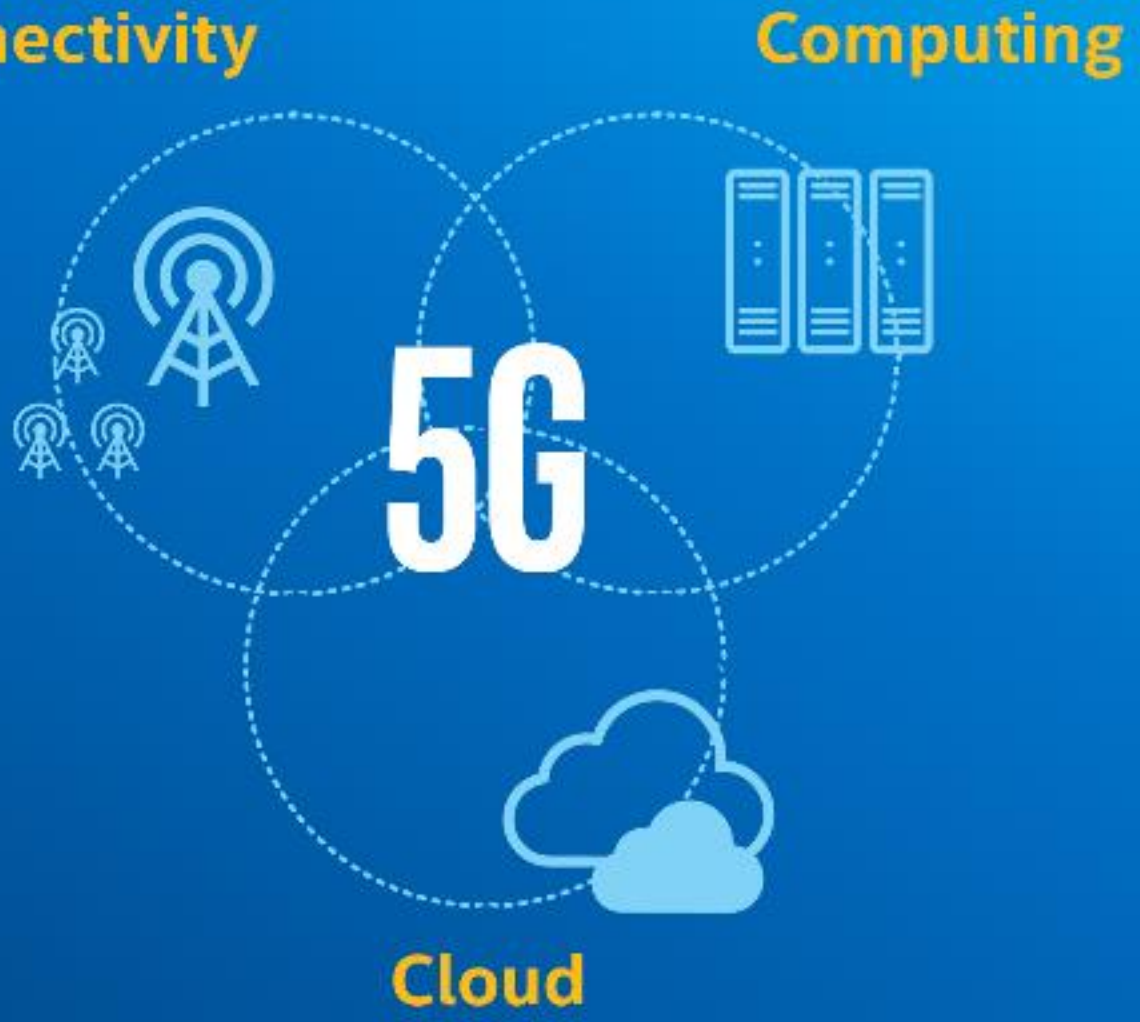
Generating tremendous amounts of data every day in 2020

- Internet users **1.5 GB** per day
- Self-driving cars **4,000 GB** per day
- Connected planes **20,000 GB** per day
- Connected factory **1 Million GB** per day

Source: Amalgamation of analyst data and Intel analysis.
And VNI Global Traffic Forecast. VNI stands for Visual Networking Index.

WHAT IS 5G?

- A new network of networks bringing the worlds of wireless, computing, and cloud together
- 5G is about connecting things as much as connecting people. It will connect everything, including billions of people and tens of billions of things.
- 5G's scale and scope will require a completely re-architected network



5G + IOT REQUIRES NETWORK TRANSFORMATION

3.3 ZB GLOBAL DATA TRAFFIC
ANNUALLY BY 2021[1]

$1.4 TRILLION SPENDING ON IOT
BY 2021[2]

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TRANSFORMING
Architecture
Value Chain
Business Process
Workforce

VIRTUALIZED SOFTWARE DEFINED CLOUD ENABLED

AGILITY + SCALE WITH IA

Sources: 1. Cisco Visual Networking Index: Forecast and Methodology, 2016–2021. 2. IDC, Worldwide Spending on the Internet of Things Forecast 2017

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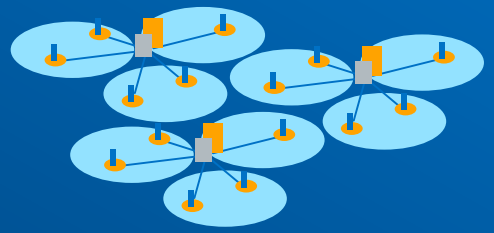
AN END-TO-END NETWORK APPROACH IS ESSENTIAL GOING FORWARD WITH 5G

RADIO ACCESS TECHNOLOGY

Anchor
Booster Beamforming,
New 5G RAT



Massive MIMO

ACCESS NETWORK

FlexRAN: CRAN/vRAN,
Split/Macro/Small Base Solution

FlexRAN: Mobile Edge
Computing, Small Cell,

Network Slicing

EDGE & CORE NETWORK

vEPC

Router

Backbone

Network Slicing

NFV/SDN Foundation

5G: COMPUTING + COMMUNICATIONS

What it Solves

- Higher capacity & lower latency for devices, applications and services
- Scalability for massive connections/ devices
- Energy Efficiency, longer battery life
- Higher frequency bands, new wave forms, multi-rat connections
- Efficient Processing

5G SPECTRUM OUTLOOK ALIGNMENT 2020

	Low- to Mid-range (MHz)	High-range (GHz)
USA	600 C-Band (3700-4200)	71-76, 81-86 (Backhaul/lite-licensed) 37-38.6, 38.6-40 27.5-28.35
Europe	700 L-band (1427-1518) C-band (3400-3800)	24.25-27.5 40.5-43.5
APAC	700 K: 3400-3700 J: 3600-4200, 4400-4900 C: 3300-3400, 3400-3600, 4800-5000	K: 26.5-29.5 J: 27.5-29.5 C: 24.75-27.5

Global Radio Alignment

EXAMPLE: COMPOSITE OF SERVICES SMART STADIUM VENUE

Smart Stadium Venue

- Integrated services targeted for stadium venue
- Live camera signals and instant replays
- Drones 360 Cameras deliver real time video
- Stadium displays become personal
- Navigation
- Personal Advertising
- Stadium security

The network is becoming personal

https://www.intel.com/content/www/us/en/communications/smart-stadium-powered-5g-video.html

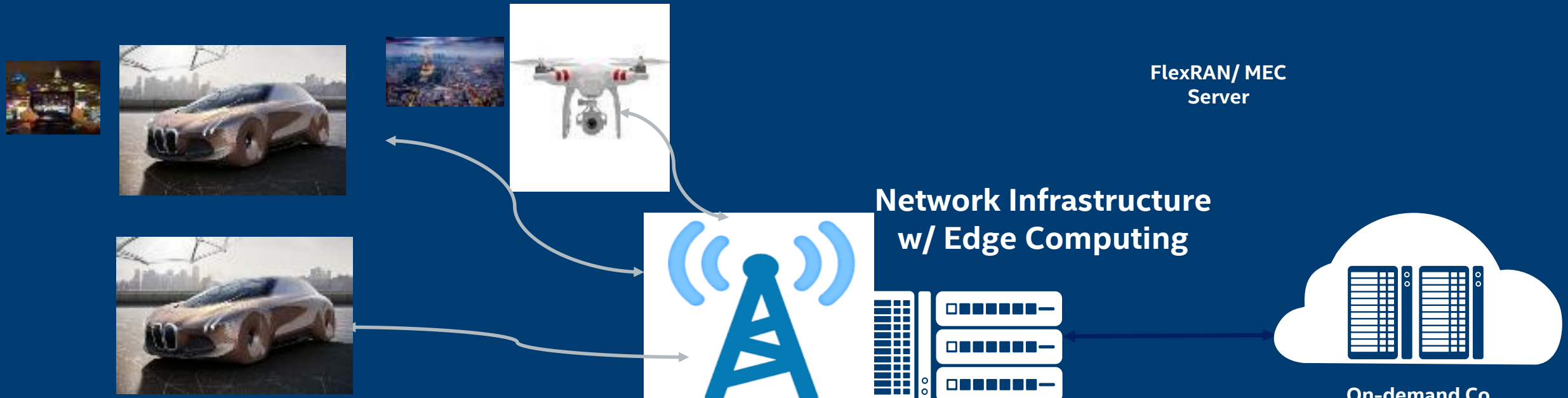
EXAMPLE: CONNECTED WORKER AR/VR

- Wearable mobile hub
- Wearble helmet with AR/VR
- Self Contained Breathing Apparatus (BLE)
- Upload and AR/VR via Cellular/5G
- Analytics

Intel® IoT Industrial Wearables

Connected Worker using 5G (earlier can be LTE and NB-IOT)

EXAMPLE: V2X IN AUTONOMOUS DRIVING (AD) CARS



- Safety Applications
- Cooperative Driving
- Augmented Reality (AR) Navigation
- Augmented Reality Tourism
- Augmented Reality for Passengers Rich Experience

Summary

- Data demand is increasing drastically. 5G will transform industry, life-style, business model. Network transformation is unavoidable.
- Technology is ready. Global harmonized frequency is needed
  - f = [600/700MHz] > 20 MHz/operator
  - f = [3300 – 4200, 4400 - 4990 MHz] > 100 MHz/operator
  - f > [24 GHz] > 1 GHz /operator
- Security & Privacy provisions also need to be aligned with international practices.
- AI, Deep Learning, Machine Learning need to be advocated.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THANK YOU