5G - MOVING TOWARDS DEPLOYMENT

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EVOLUTION TO A SMART AND CONNECTED WORLD

2G

Cellular Comms.

3G

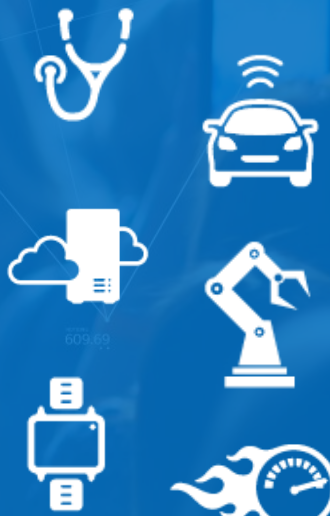
Data and the 'app' revolution

4G

Faster data rates

5G

Active, smart, and connected devices



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.

5G VERTICALS

Massive Machine to Machine

Ultra-Reliable and Low Latency

Enhanced Mobile Broadband

INTEL POWERS 5G END-TO-END
CASE OF AUTONOMOUS DRIVING

Cloud

Powerful analytics required to make sense of massive data from moving vehicles

Core Network

Network will isolate vehicle data in a ‘slice’ separating it from other types of data

Access Network

Cloud computing at the mobile edge lowering latency

Wireless Technology

5G radios integrate ‘vehicle to vehicle’ and ‘vehicle to everything’ connectivity

Smart Devices

Vehicles will have intelligence to manage internal systems and connect to cloud

INTEL – 5G ACCELERATION AROUND THE WORLD

Intel products

- Announced the Intel® 5G Modem is the world's first global modem to support 5G operation on both sub-6Ghz bands and mmWave spectrum
- Intel® GO Automotive 5G Platform announced as part of the overall Intel® GO Autonomous Driving Platform, delivers a 5G-ready platform for the automotive segment
- 2nd and 3rd 5G Mobile Trial Platforms (MTPs)

5G trials around the world

- Global trial, test, and standards engagements with global operators & telecoms equipment manufactures

ERICSSON, kt, verizon, AT&T, Telefónica, docomo, orange, NOKIA, vodafone, Sprint, 中国移动通信 CHINA MOBILE, T··, SK, BMW, And many more

Collaborations

- 5G network transformation disclosures: AT&T, Verizon, and NEC
- BMW Group, Intel and Mobileye team up to bring fully autonomous driving to streets by 2021
- China Mobile, Ericsson and Intel showcase the world's first application demonstration based on latest cellular IoT technology summer 2016

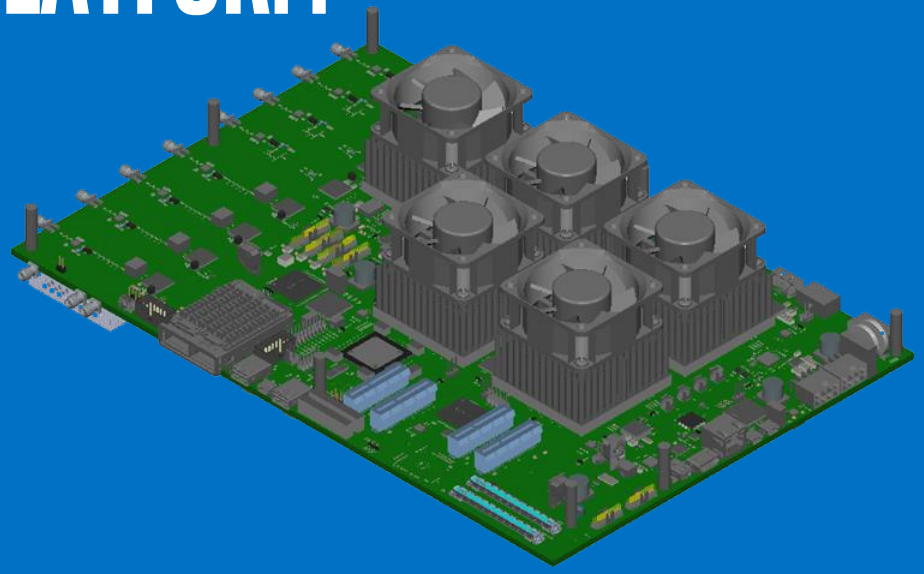
INTEL® MTP 2ND-GENERATION MOBILE TRIAL PLATFORM

- Integrated 28GHz (26.5-29.5GHz) 5G mmW RFFE
- 2x100MHz carrier aggregation (4x100MHz capable)
- Adaptive beam tracking – at base station and MTP
- 200MHz Key 5G NR features implemented:
  Low-latency sub-frame and coding design (LDPC)
  HARQ, UL-MIMO, dynamic TDD
- Demonstrated interoperability with Ericsson and Nokia 5G base stations

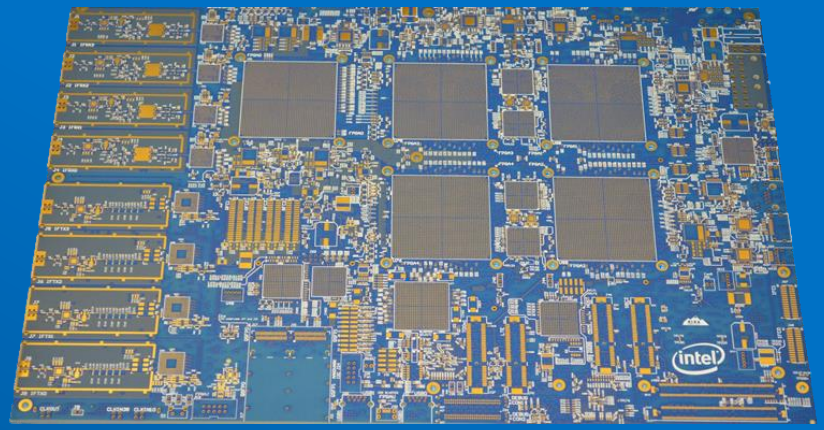
Operational: February'17

INTEL 3RD-GENERATION MOBILE TRIAL PLATFORM

- **Fully-capable, small form factor mobile solution for fast 5G end-to-end field and interoperability testing**
  - Ultra-high performance 5G architecture
  - Based on state-of-art Intel® Stratix® 10 FPGA's
  - 2x Processing Capability vs. 2nd-Gen. 5G MTP
  - Up to 10Gbps throughput



- **5G Advanced Feature Support**
  - Band support: 600-900MHz, 3.3-4.2GHz, 4.4-4.9GHz, 5.1-5.9GHz
  - 28GHz, 39GHz
  - 5G NR ASIC RTL validation and change validation
  - 3GPP NR early interoperability (Q4'17)



Operational: 2H'17

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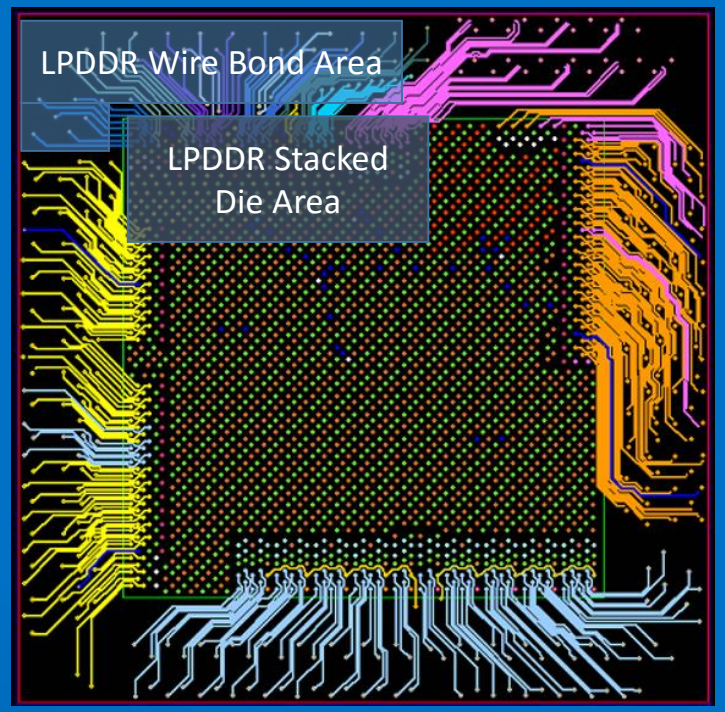
INTEL® 5G MODEM†

5G STAND-ALONE AND DUAL-CONNECTIVITY

- World's first global 5G modem with ultra-high throughput wideband operation and low latency
- Pairs with Intel 5G RFIC and 5G mm-wave RFFE
- Supports both sub-6GHz bands and mm-wave spectrum with compact, low power chip kit
- Implements multiple industry forum and proprietary 5G specifications
- Key 5G NR technology – low latency frame structure, advanced channel coding, Massive MIMO, beamforming
- Pairs with Intel® XMM™ 7360 LTE modem for 4G/5G dual connectivity

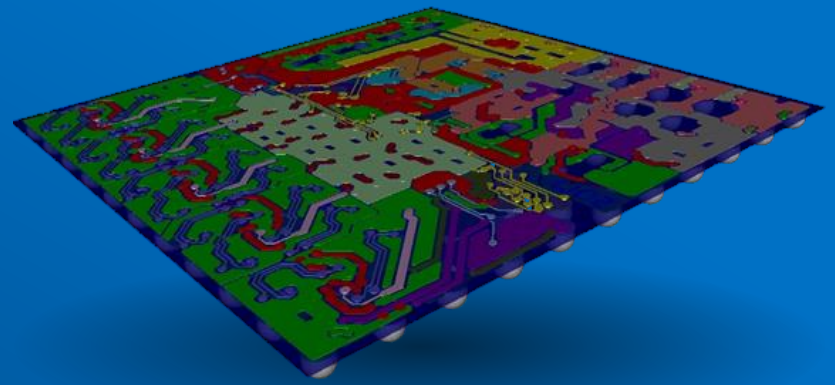
Operational: 2H '17



Gold Ridge Multichip Package (MCP)

† code named Gold Ridge

INTEL® 5G RFIC† – 5G TRANSCEIVER
SUB-6GHZ AND MM-WAVE SUPPORT

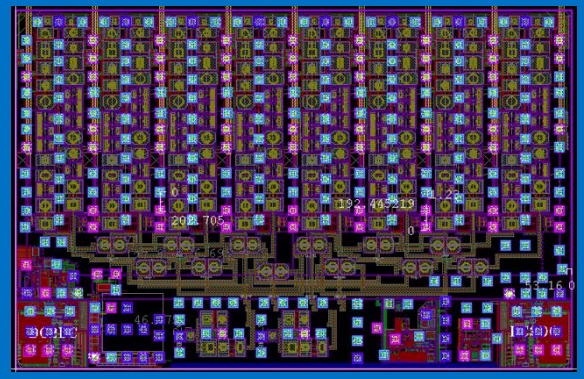


- World's first 5G RFIC to support both sub-6GHz and mm-wave 5G modes
- Flexible ultra-wideband operation up to 800MHz operational bandwidth
- Supports Massive MIMO and dual-polarization
- One SKU to support initial 5G spectrum worldwide:
  - 3.3-4.2GHz – China, Europe, Korea, Japan
  - 28GHz – US, Korea and Japan[1] transceivers

Operational: Q1'17

1. When deployed with Intel's 28GHz Segula Peak RFIC.
† code named Monumental Summit

INTEL® 5G RF FRONT-END (RFFE)††
28GHZ & 39GHZ MM-WAVE SUPPORT



Intel® 5G 39GHz mmW Layout

- Adds 39GHz to existing Intel 28GHz 5G mmW RFFE
- New distributed mm-wave architecture – supports wide-variety of form factors
- Extensible to 2x2, 4x4, 8x8, NxM Arrays
- High resolution phase-shifting network
- Ultra-wideband operation up to 800MHz
- Massive MIMO and dual-polarization support
- Support: 37.0-40.0 – USA

Operational: Q3'17

†† Code name: Tachyon Peak

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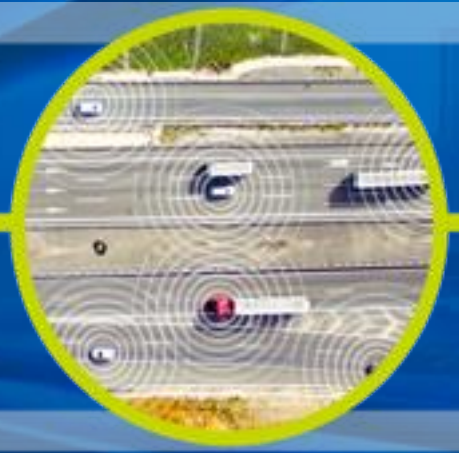
INTEL® GO™ AUTONOMOUS DRIVING PLATFORM

Autonomous driving, accelerated.

CAR

Intel GO
development platforms for autonomous driving

CONNECTIVITY



Intel GO
automotive 5G platform

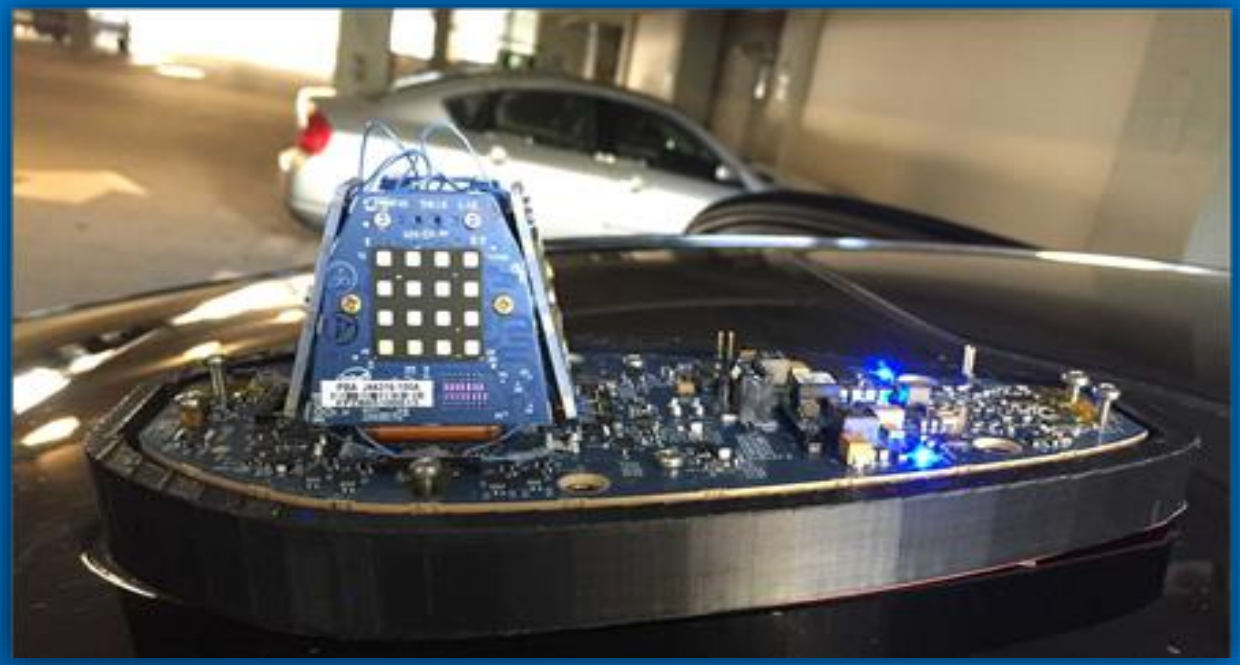
CLOUD

Intel® technologies for data center

Intel GO automotive software development kit (SDK)

INTEL® GO AUTOMOTIVE 5G PLATFORM
5G SUB-6GHZ AND 28GHZ MM-WAVE ACCESS

- Ultra-high performance 5G automotive solution
- Second generation mobile trial platform, supporting peak speeds up to 7gbps
- Shock-mounted vehicular operation
- Full-coverage via multi-panel 28GHz arrays
- Bandwidth: up to 800MHz
- Intel GO delivers high performance in vehicle compute, software development tools, robust data center platform, and latest advances in artificial intelligence



Operational: February 2017

NFV/SDN IS ESSENTIAL TO 5G NETWORKS

MOVING THE NETWORK AT CLOUD PACE

Compute, Network & Storage Pooled Resources
Standardized Commercial Grade Solutions

Dynamic Flexible Networks
Next-Generation Network Architectures

Services Delivery and Agility
Business Process Transformation

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INTEL POWERING THE VIRTUAL NETWORK

INFRASTRUCTURE FOR 5G

RADIO ACCESS TECHNOLOGY

Anchor
Booster Beanforming,
New 5G RAT

Massive MIMO

ACCESS NETWORK

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

FlexRAN: Mobile Edge
Computing, Small Cell,

Network Slicing

CORE NETWORK

vEPC

Router

Backbone

Network Slicing

NFV/SDN Foundation

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THANK YOU