



# 5G - Towards Deployment

Dr. Rao Yallapragada,  
Director, Advanced Technologies  
Intel's Communications and Devices Group

*3<sup>d</sup> Global 5G Event in Tokyo, Japan, May 24-25, 2017*

# Legal disclaimers

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at [\[intel.com\]](https://www.intel.com).

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

Intel, the Intel logo, Intel. Experience What's Inside, the Intel. Experience What's Inside logo and XMM are trademarks of Intel Corporation in the U.S. and/or other countries.

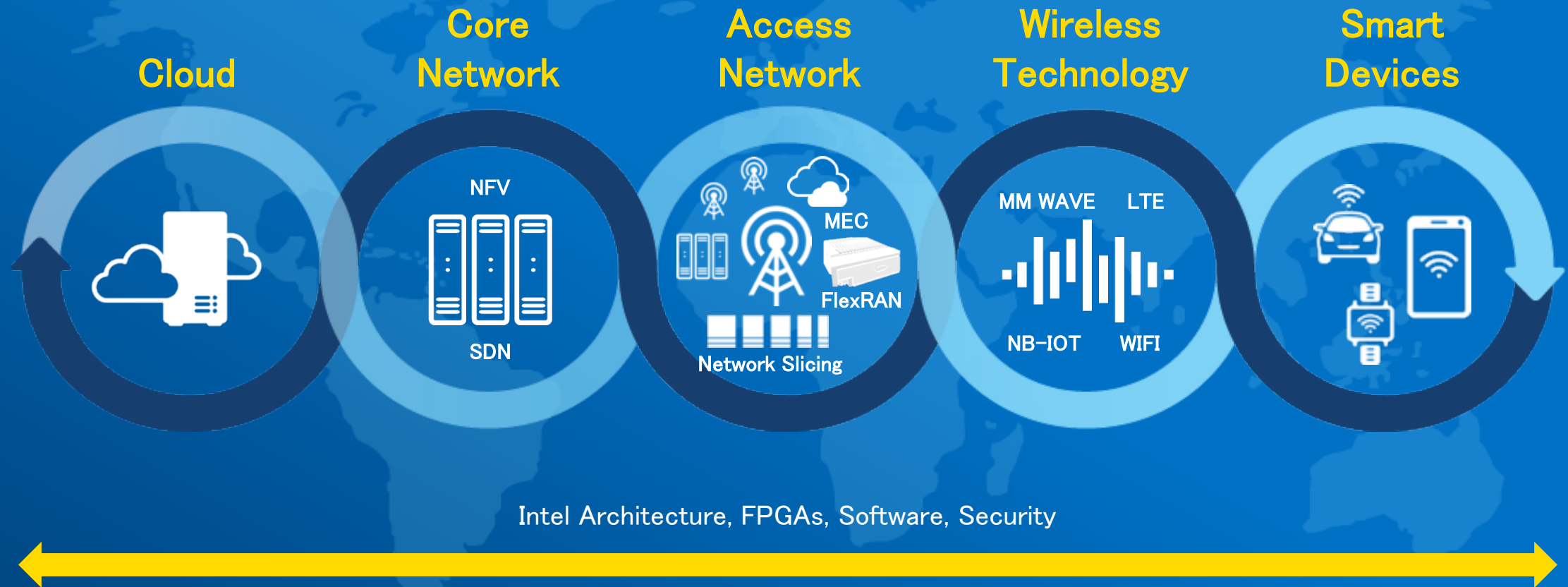
\*Other names and brands may be claimed as the property of others.

© 2017 Intel Corporation.



# Intel powers 5g end-to-end

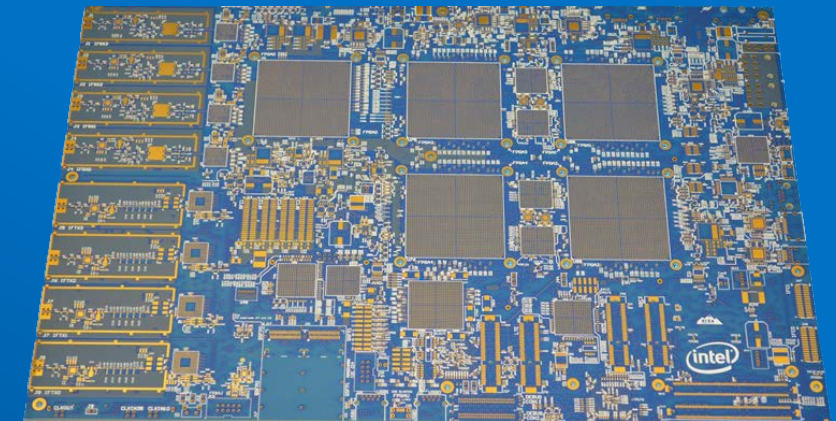
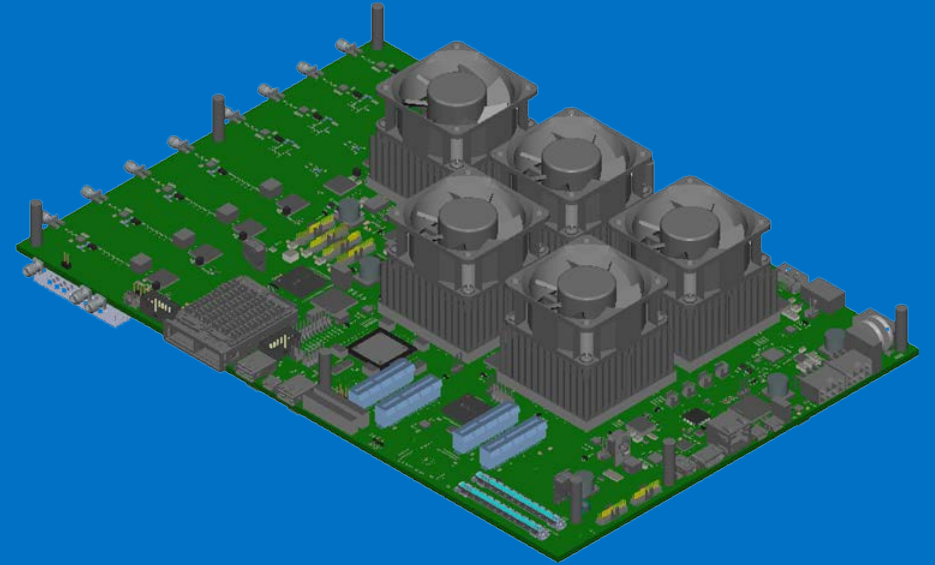
## Intel's Scale Meets 5G Scope





# Intel's 5G Mobile Trial Platform Breaking New Ground

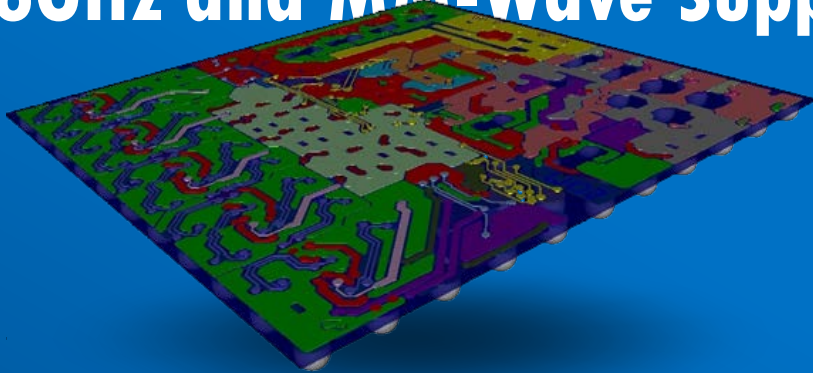
- Fully-capable, small form factor mobile solution for fast 5G end-to-end field and interoperability testing
  - Ultra-high performance 5G architecture
  - Based on state-of-art Intel® Stratix® 10 FPGA's
  - 2x Processing Capability vs. 2nd-Gen. 5G MTP
  - Up to 10Gbps throughput
- 5G Advanced Feature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



# Intel® 5G RFIC† – 5G Transceiver sub-6GHz and MM-Wave Support

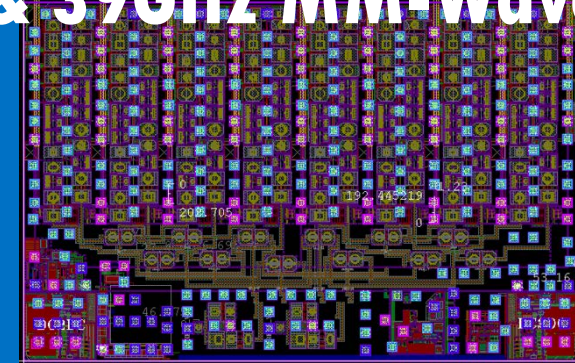


- World's first 5G RFIC to support both sub-6GHz and mm-wave 5G modes
- Flexible ultra-wideband operation up to 800MHz operational bandwidth
- Supports Massive MIMO and dual-polarization
- One SKU to support initial 5G spectrum worldwide:
  - 3.3–4.2GHz – China, Europe, Korea, Japan
  - 28GHz – US, Korea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

Operational: Q1' 17

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

# 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

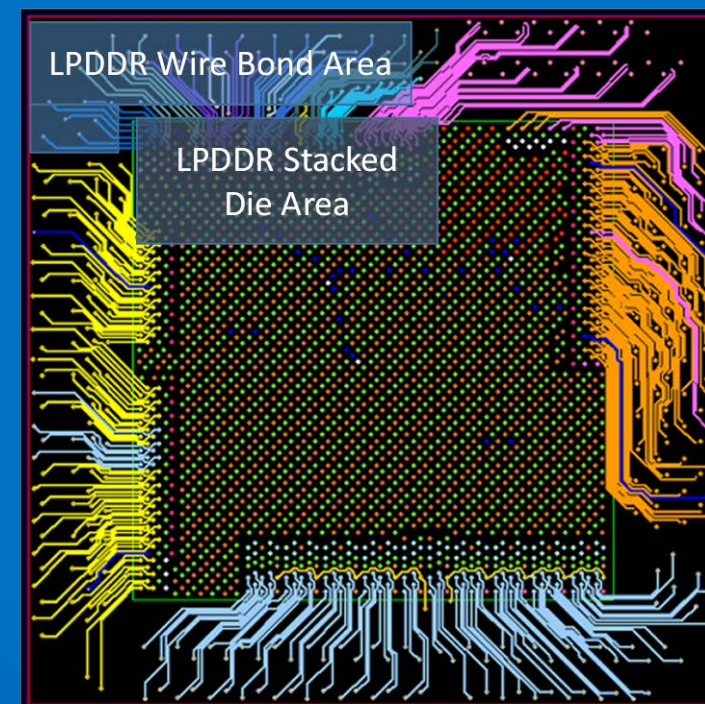


# Intel® 5G Modem†

## 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® 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

# Intel Powering the Virtual Network Infrastructure for 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



## CORE NETWORK

vEPC

Router



Backbone



Network Slicing



NFV/SDN Foundation



# 5g end-to-end portfolio

Wireless Technologies

2016

LTE-A Pro

Wi-Fi\*  
LTE  
MM WAVE  
NB-IOT

2017

Rel-14  
End Q1 '17

Rel-15 NSA-NR  
Q4 '17

2018

First Public  
Showcase of  
5G Devices

2019

Rel-15  
Q3 '18

First  
Commercial  
Network

2020

Rel-16  
Q4 '19

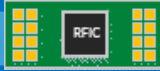
RF/ HW

28 GHz



Sub 6 GHz

39 GHz



Sub 6 GHz

39 GHz



Sub 6 GHz

60 GHz follow-on

BBIC

BB 1.0

BB 2.0

5G-IOT

BB 3.0

+XMM

5G-IOT

FPGA  
Mobile Trial  
Platform

2nd Gen



3rd Gen



4th Gen



Continuously evolving

Smart  
Devices



Network  
Infrastructure

Massive MIMO



FlexRAN



MEC



FlexRAN



Network Slicing



# 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 Connectivity Platform announced as part of the overall Intel® GO In-Vehicle Development Platforms, delivers a 5G-ready platform for the automotive segment.
- 2<sup>nd</sup> and 3<sup>rd</sup> 5G Mobile Trial Platforms

## 5G Trials around the world

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

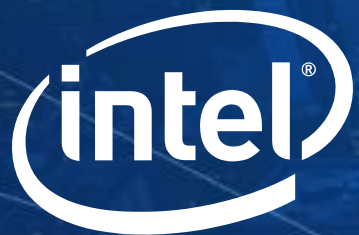


And  
many  
more

## Collaboration

- 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





**Thank You**