# What is 5G?

## Devices and Networks for Future Embedded Mobile Internet

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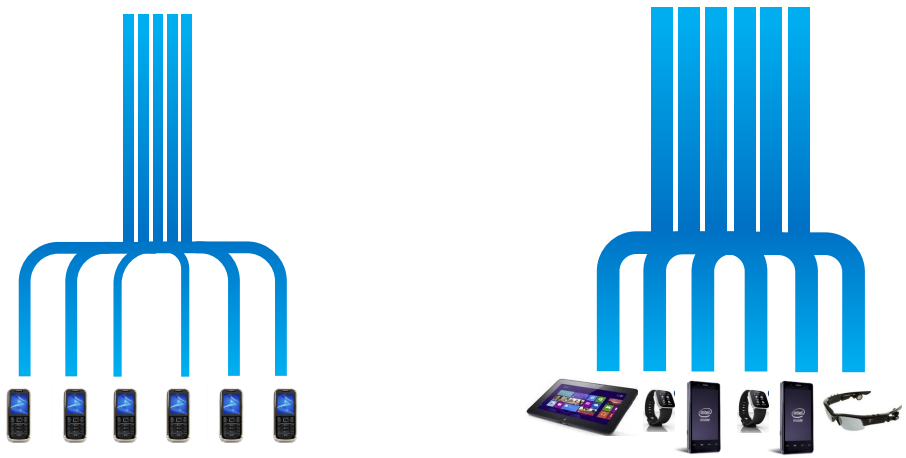
# The capacity pressure on network infrastructure

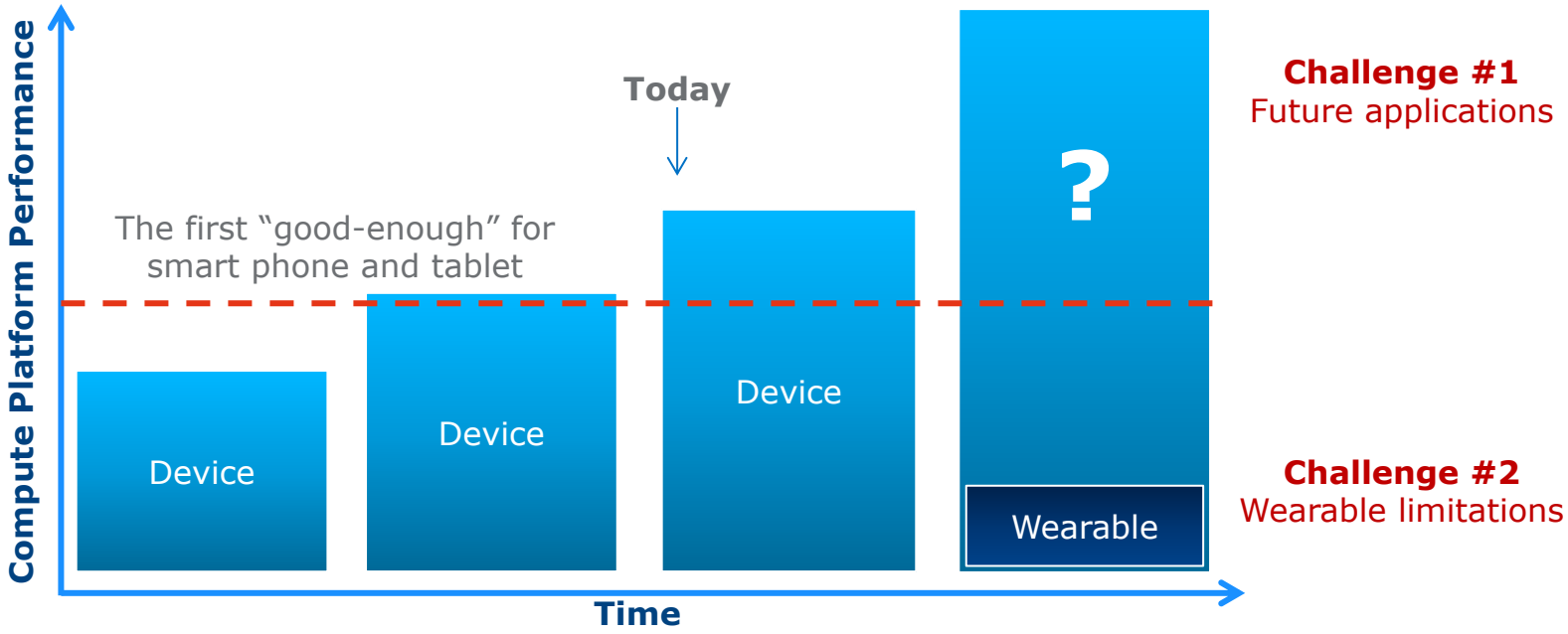


3G/4G

5G ?

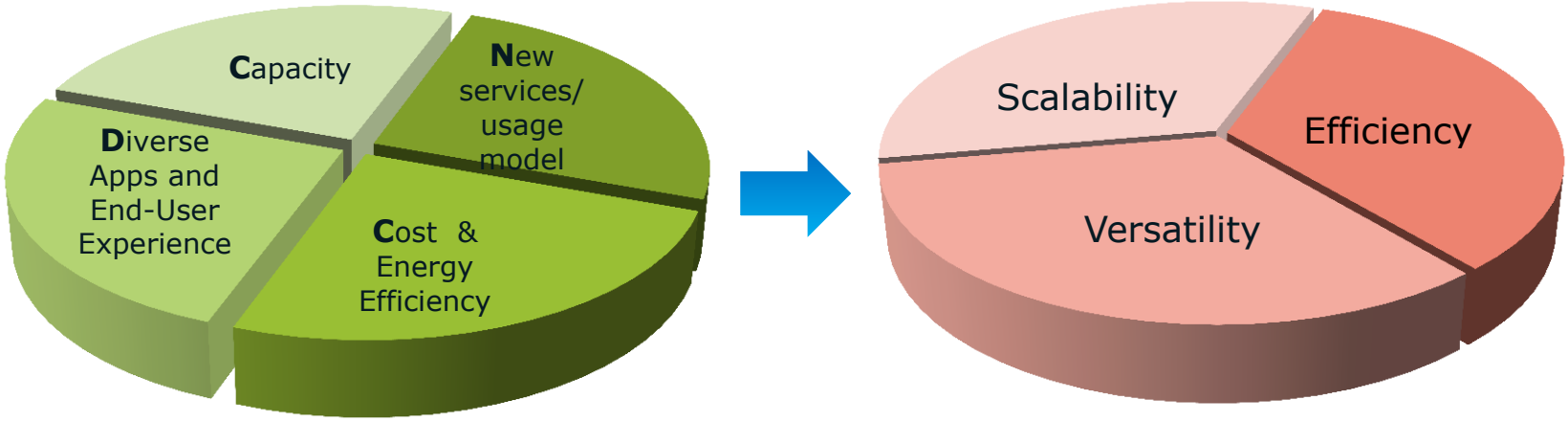
**3G offer fat pipes. 4G delivers fatter pipes.**
**5G will be even better.**

# The gap between applications and mobile compute platform




**"Good-enough" computing fueled the last 1000x capacity growth. What will enable the next 1000x capacity?**

# The drive toward scalability and efficiency




| | |
|---|---|
| **Efficiency (b/s/Hz/m2/Joule/$)** | • Best connected: D2D->adhoc->mesh; multi-RAT traffic aggregation/steering<br>• Shared spectrum, new spectrum (e.g. mmWave)<br>• Self organization network: unplanned/lightly planned deployment<br>• Energy efficiency |
| **Versatility** | • Support a large variety of KPIs, devices, apps. |
| **Scalability** | • Scalability across the optimization vectors: vertical versus horizontal |

**Technology focus is shifting from SE to NE to EE.**
**Scalable in data rate, number of devices, coordination level and applications.**

# The seemingly confusing expectations…

**10x?**

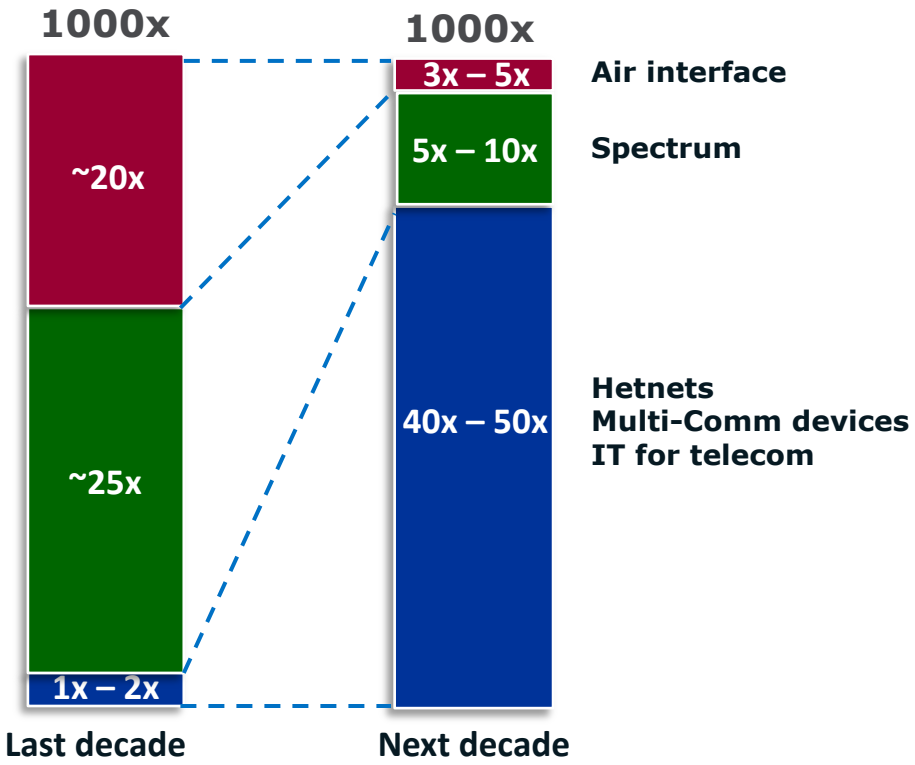
**100x?**

**1,000x?**

**10,000x?**

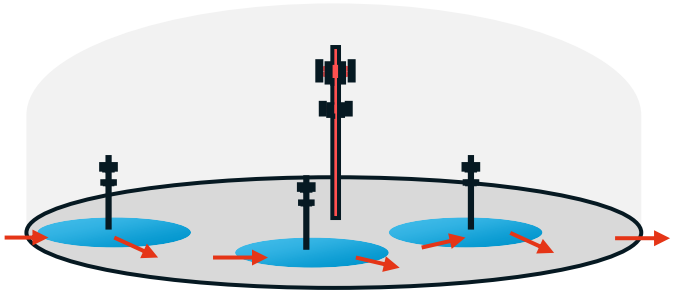
**What really matters is user's experience**

# The technology vectors for the next 1000x capacity

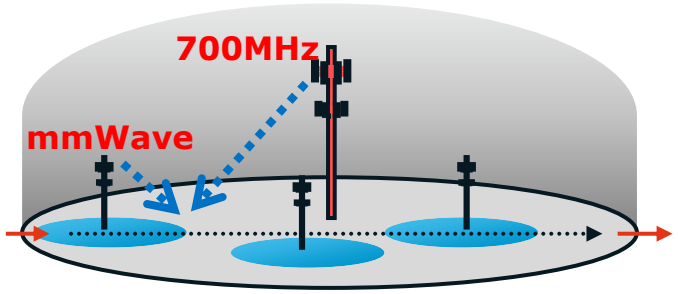



**Capacity must come from multiple vectors.**
**Gains in Air Interface and Spectrum are approaching their limit.**

# Technology trend 1 – Overlay networks for spectrum and energy saving

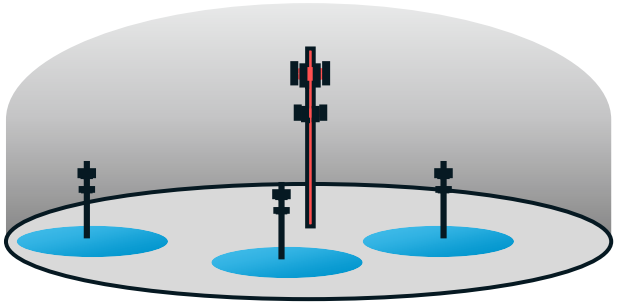


Excessive handovers in traditional heterogeneous networks

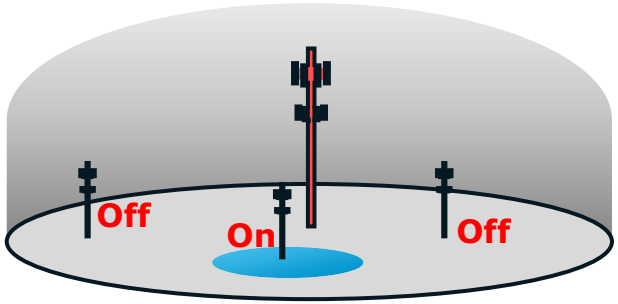



Hetnet+CA = Control plane anchored at macro-cell, traffic channels from small cells

**User experience for now, high frequency bands for future**



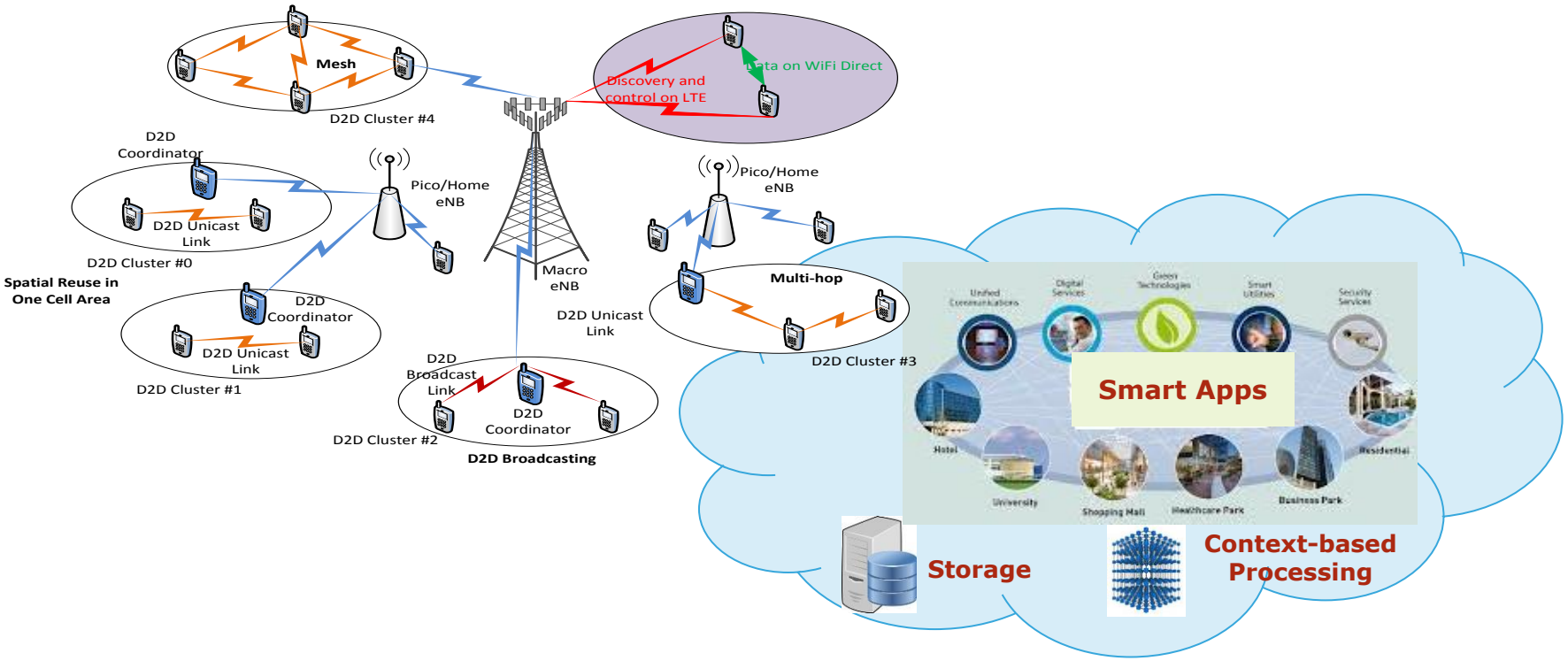
Incremental small cell deployment according to traffic growth




Turn off selected cell sites at light traffic hours

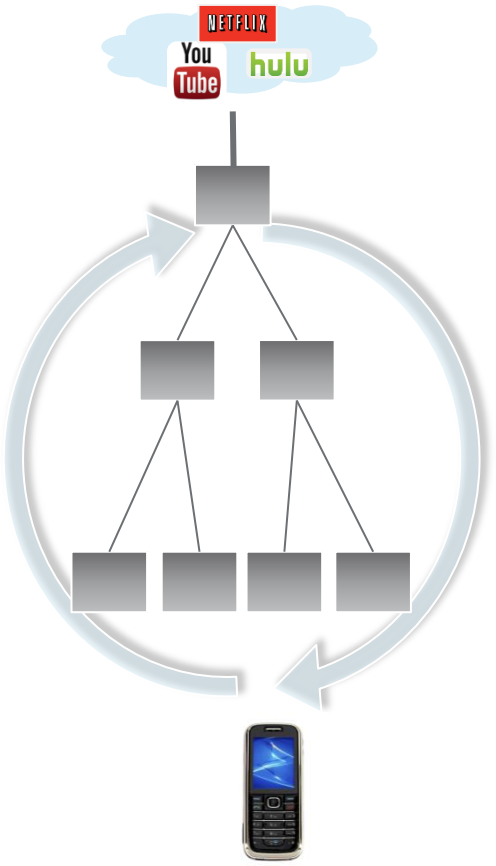
**Coverage for now, network energy saving for future**

# Technology trend 2 - Underlay networks for proximity services and wearables

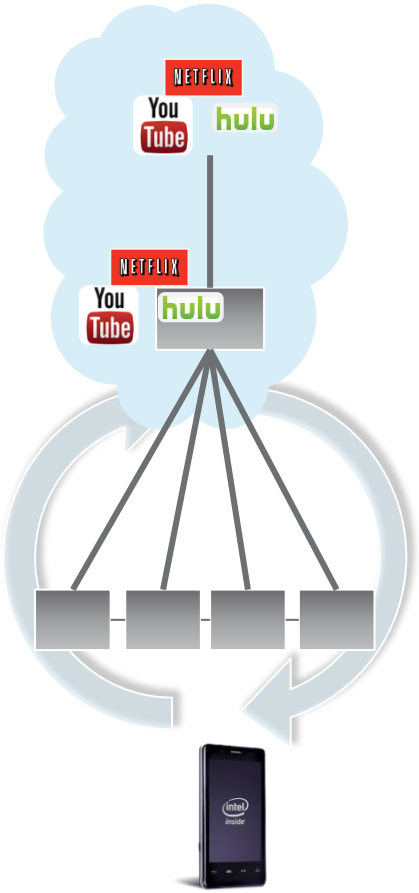



**Many devices, many underlay networks, one intelligent cloud**

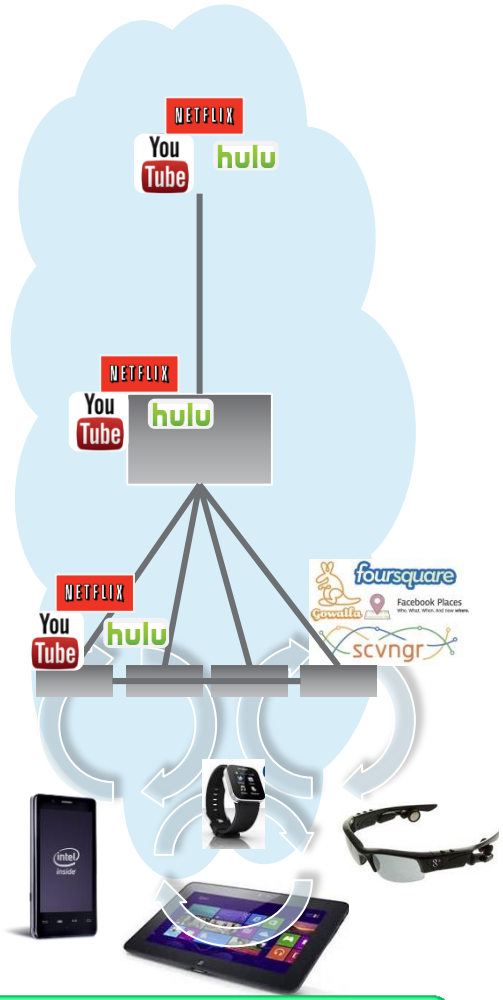
# Technology trend 3 - Cloud expansion to network edge and to devices




Remote cloud
Basic terminal

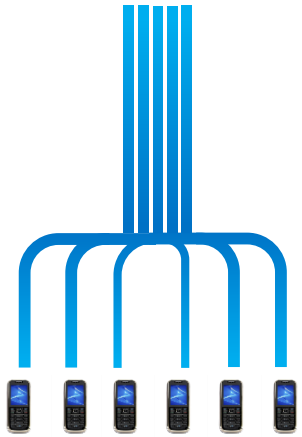



Adaptive control/
Collaboration




Sensing/
Proximity Services

# How does 5G network scale?



3G/4G

5G **without** Undelay Networks and Local Cloud

5G with **Undelay Networks** and **Local Cloud**

**Underlay networks and local cloud are essential for backbone and core network scalability**

# How does 5G meet the expectations

**10x**

**100x**

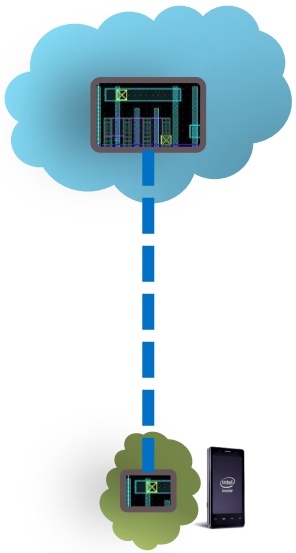
**1,000x**

**10,000x**

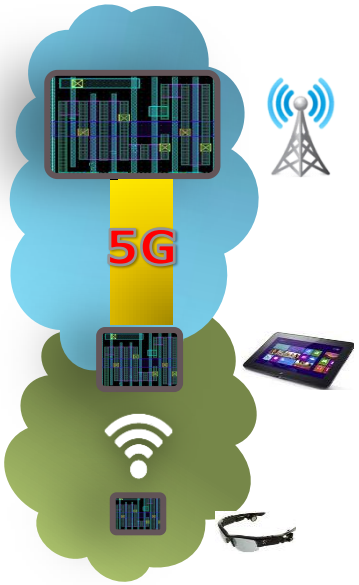
**What really matters is user's experience**

# How can 5G help mobile compute?

2G
Mobile Terminal
Compute



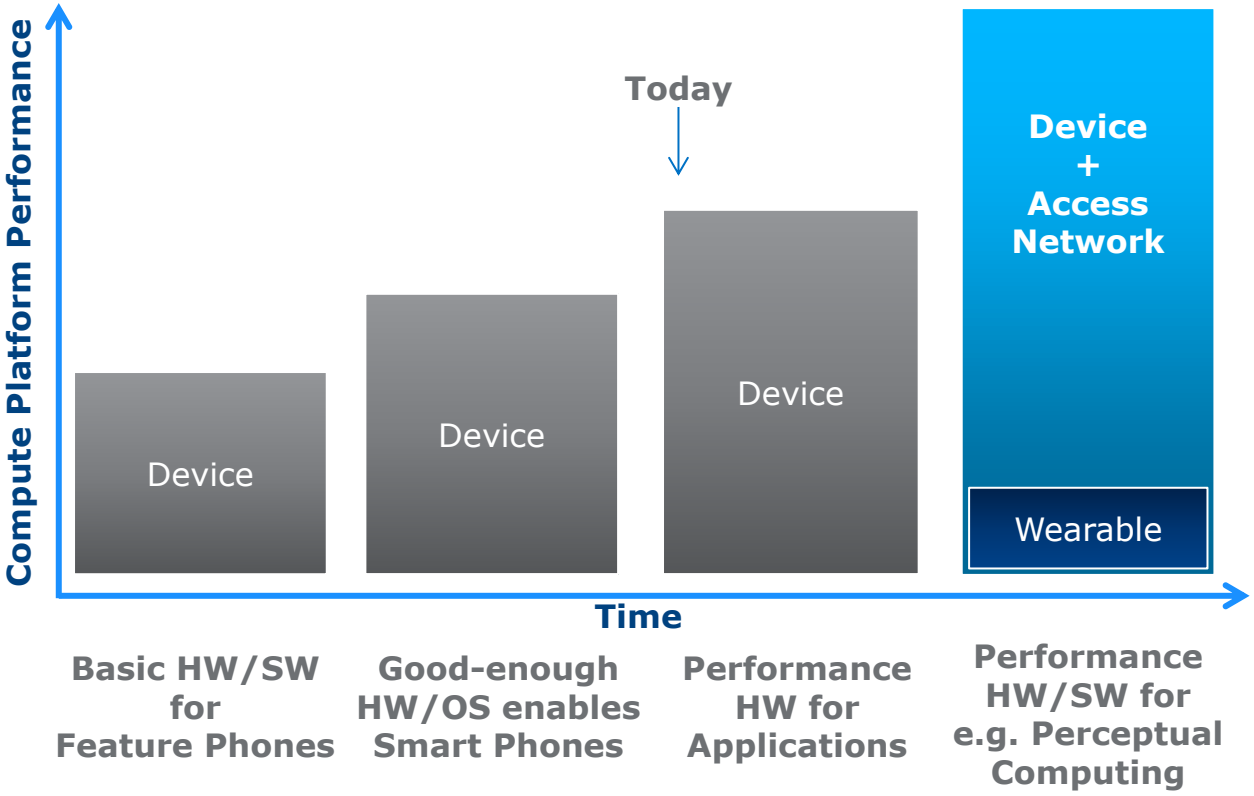
3G/4G
Network Assisted
Compute



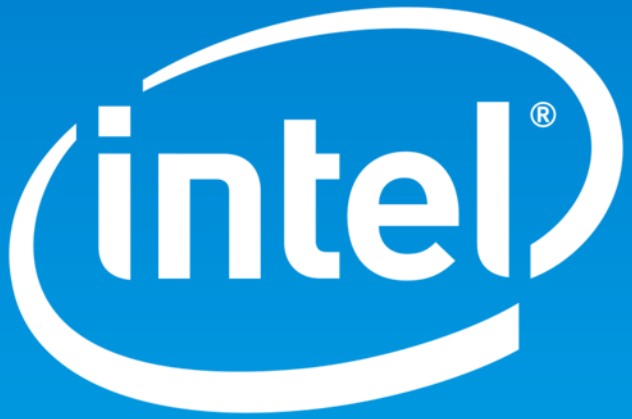

5G
Device + Access Network
Compute

**5G air interface very high bandwidth and ultra low latency make seamless device + access network compute possible**

# The platforms for the next 1000x capacity




**Future mobile compute = Device + Access Network compute platforms enabled by 5G wireless communication technologies.**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