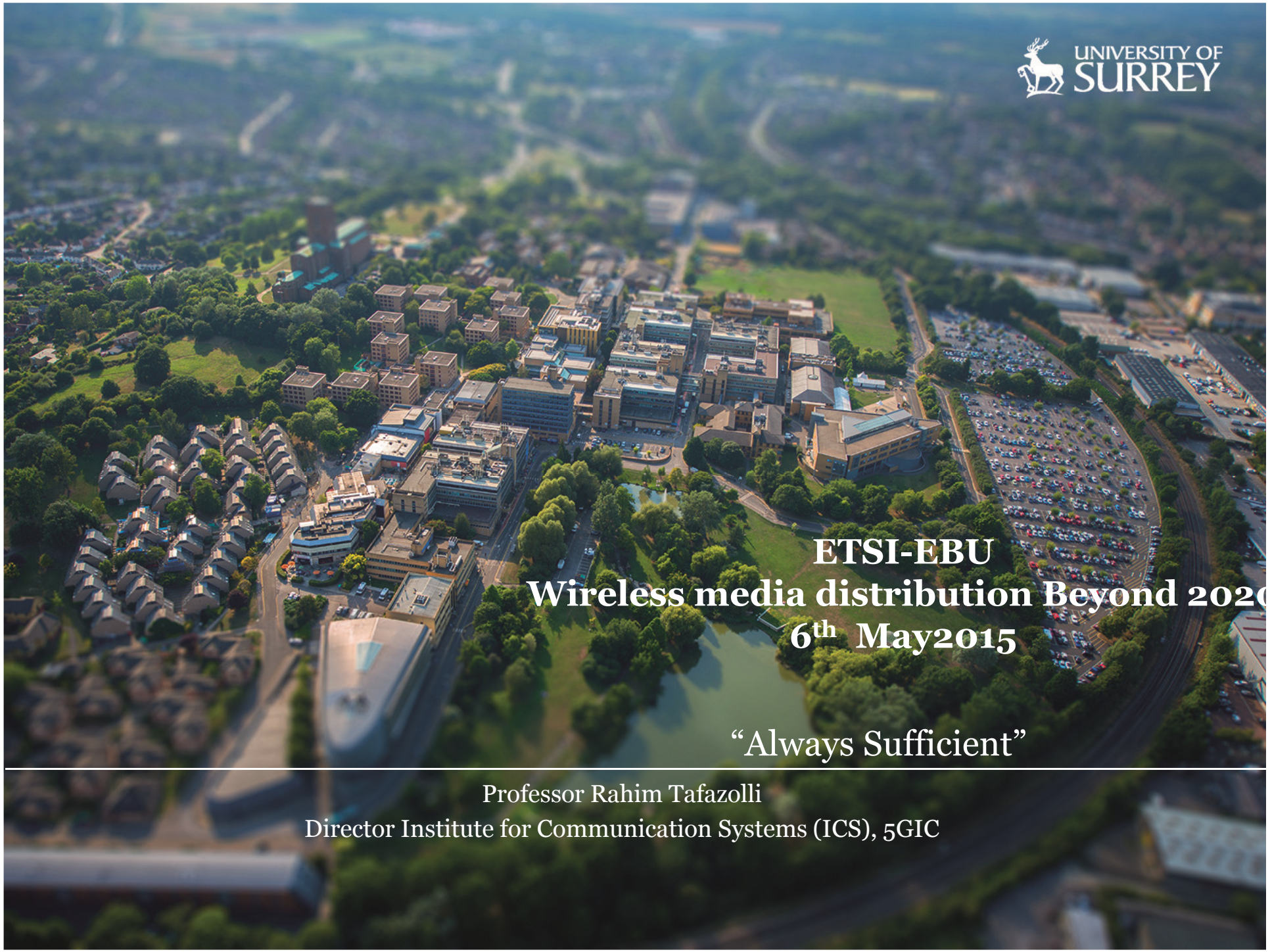

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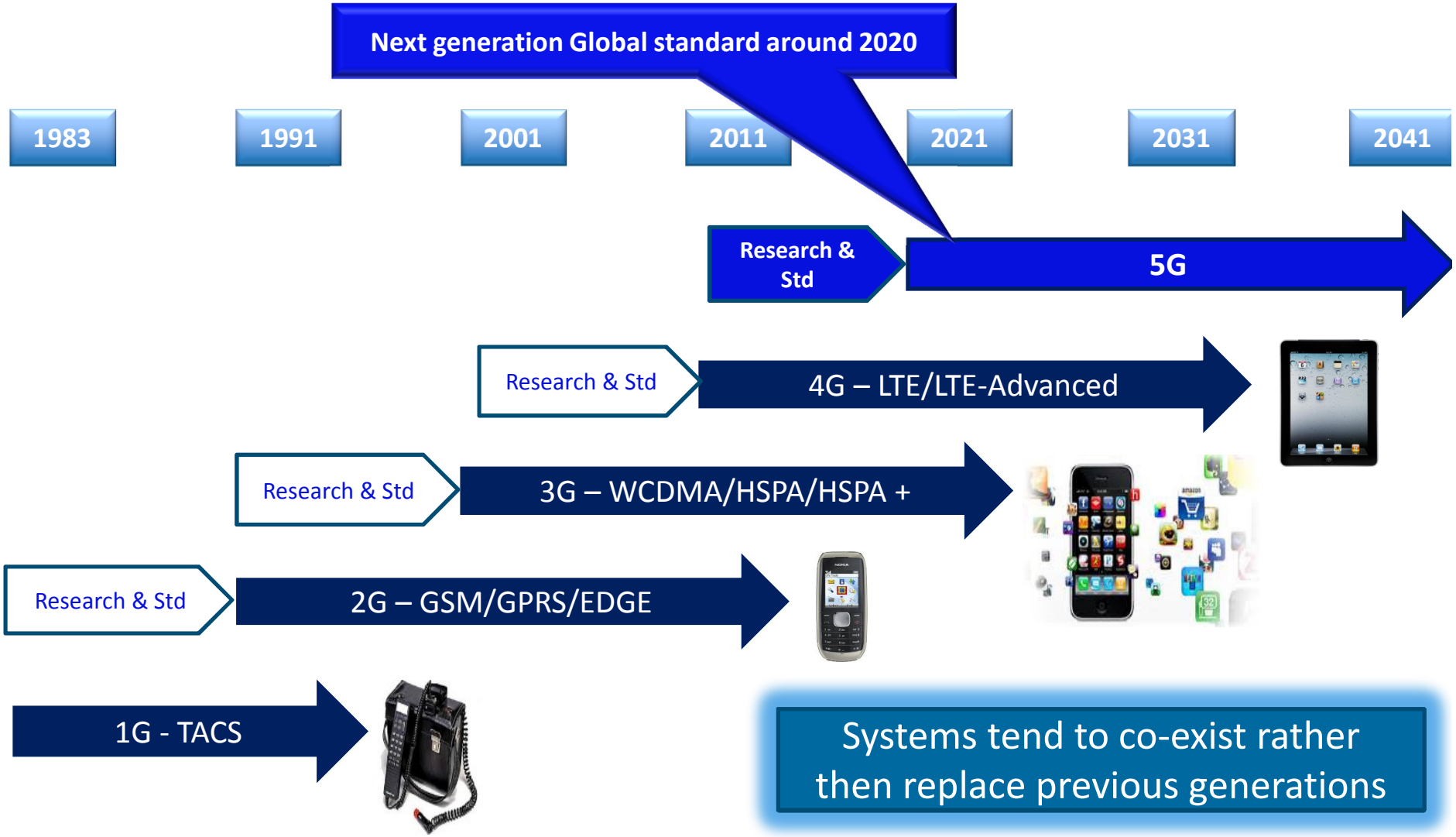
ETSI-EBU
Wireless media distribution Beyond 2020
6th May2015

"Always Sufficient"

Professor Rahim Tafazolli
Director Institute for Communication Systems (ICS), 5GIC

University of Surrey, 5GIC

Wireless Standards Evolution – 5G



Systems tend to co-exist rather then replace previous generations

Timescale getting shorter between Research/Standardisation and Commercialisation

What is 5G?

5G is SG

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Special Generation

Past 30 Years

Next 30 Years

5G
Communications & Control
User QoE,
Latency, Reliability, Flexibility, Capacity

4G
Higher, Higher Speed
Mobile Communications
DATA, voice

3G
Higher Speed
Mobile Communications
Voice + **DATA**

2G
Speed
Mobile Communications
VOICE + data

Technologies that enable Digital Economy and Society

- **Mobile Broadband Internet**
- **Transportation**
- **Energy**
- **Manufacturing**
- **Health**

Towards

- **Smart Homes, Cities and Countries**

5G in one sentence

"Always Sufficient Rate" to give users the perception of Infinite Capacity"

Killer Applications

The Internet!

Fundamental change in research approach

5GIC approach: Information T & Communication T & Control T

Start from end user QoE

- Unlike 2G….4G , designed for end device

Start from density cell network technologies

- Scalable to macro cells----------unlike previous generations
- New waveform scalable from IoT to Broadband, spectrum aggregation ….

Capacity & Energy efficiencies, Latency , Reliability

- Speed is not the differentiator between 5G and previous generations

Spectrum and system agnostic

- Uniformity operation across licenced and licenced-exempt bands
- Broadcast, Cellular, WiFi technologies all support: Data, Video, Audio

Connectivity for Communications and Control

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Major Technical Requirements compared with 4G

- **Latencies <50x**
- **Reliability/Availability >100x**
- **Energy Efficiency > 100x**
- **Capacity (b/s/Hz/m^2) > 1000x**
- **QoE**
- **Security/privacy**

4G eMBMS LTLP

Bandwidth for 72 Mb/s

- Spectral efficiency at cell edge:
- ISD: 2-to-10 km
- SE: 2.7-to-0.5 b/s/Hz
- BW: 80-to-1200 MHz

Coverage and Capacity

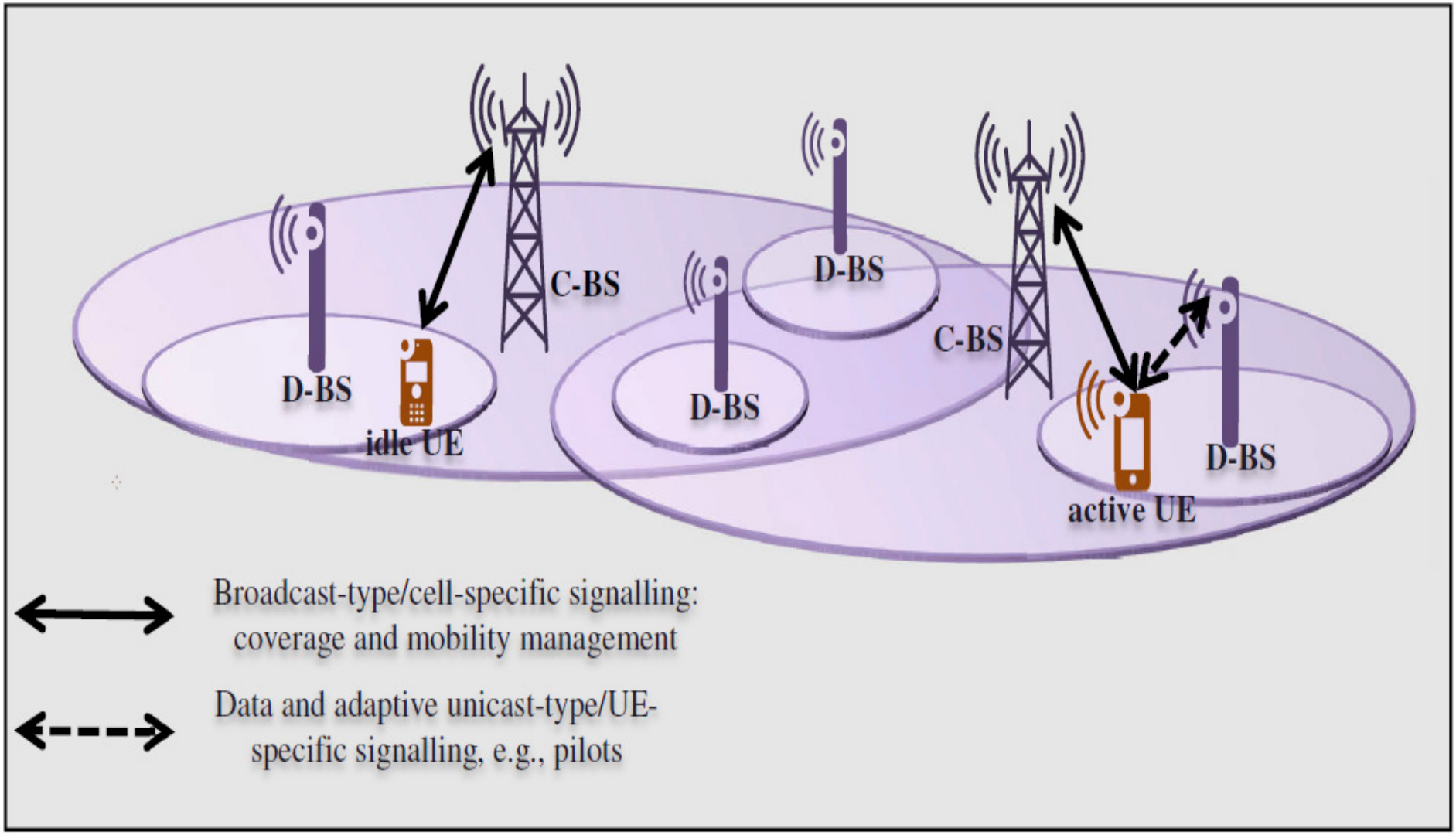
- **One size does not fit all!**

- **Low+ Medium+ High Dense cells**
  - **Capacity limited**
  - **Coverage limited**

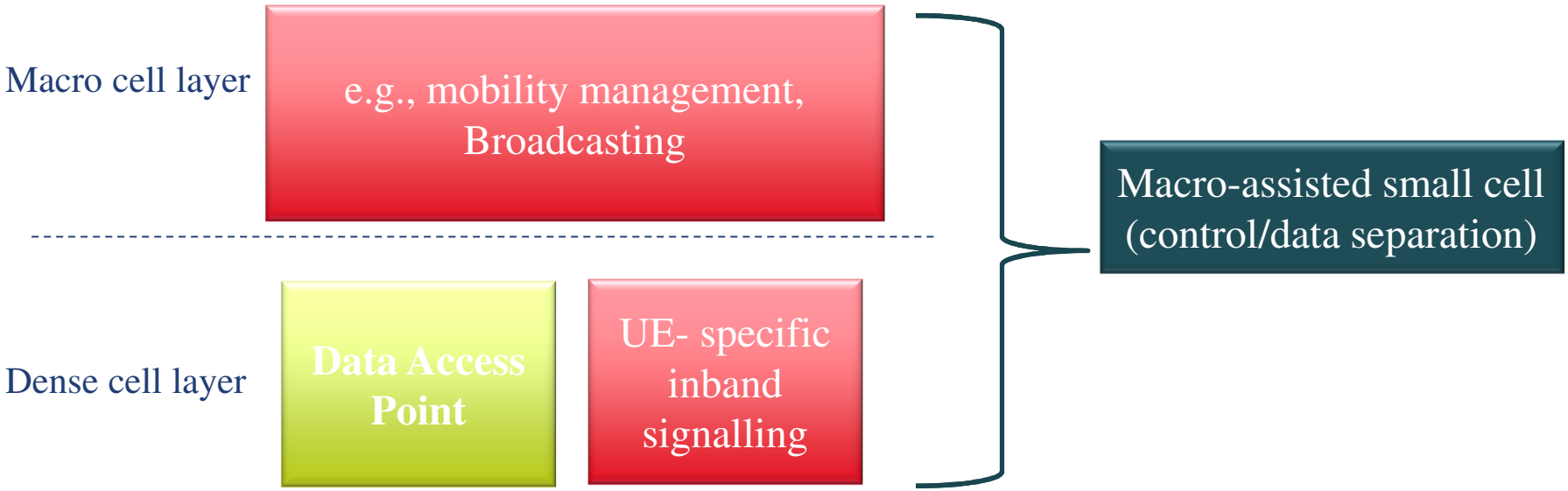
- **Frequency options**
  - **< 1GHz → Coverage**
  - **1-6 GHz → Capacity and Cost**
  - **Millimetre Band → Capacity**

5G RAN Architecture

Control and Data Planes Separation



5G RAN Macro-Assisted Dense Cell Network



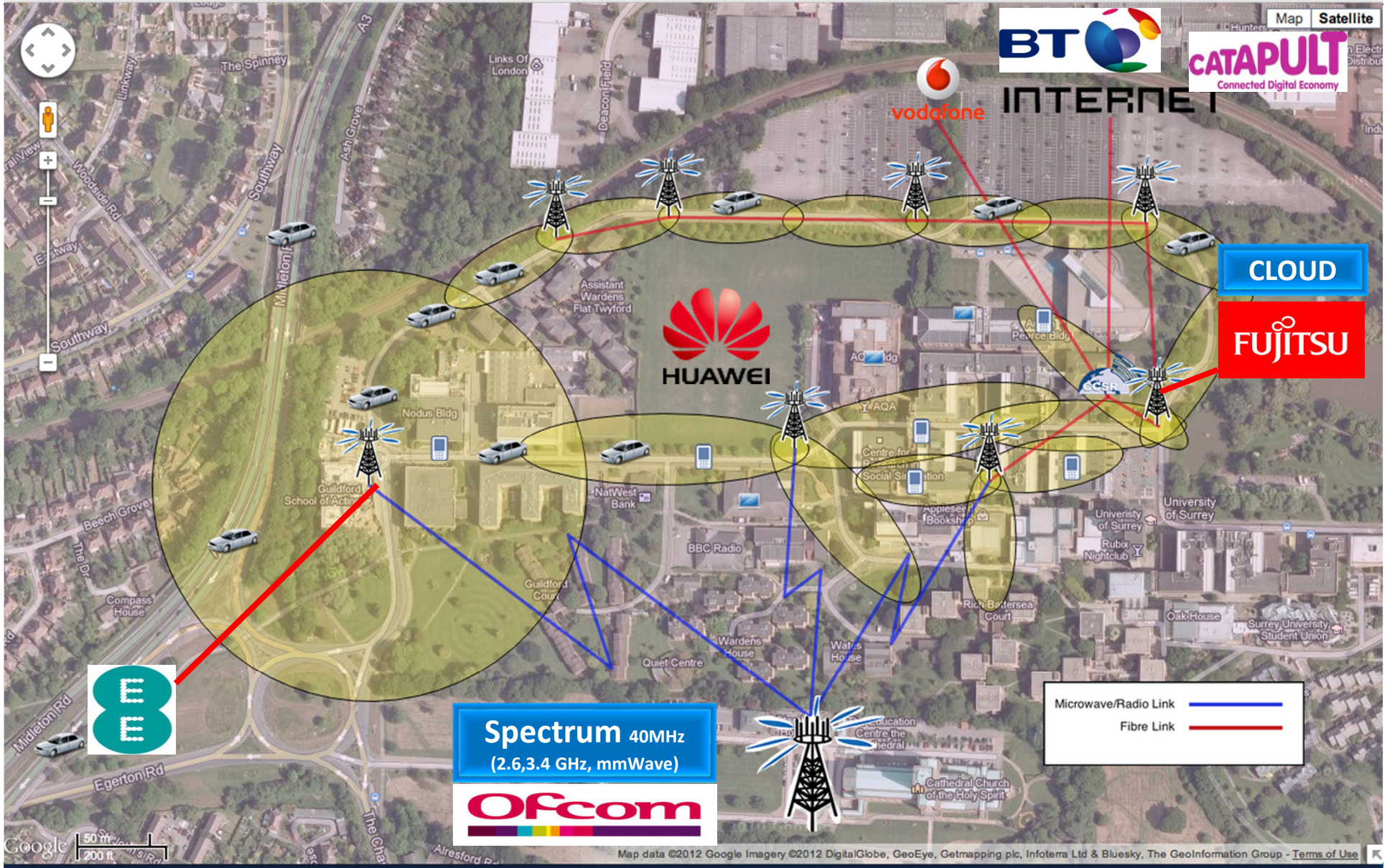
Bandwidth, How much?

Many factors influence

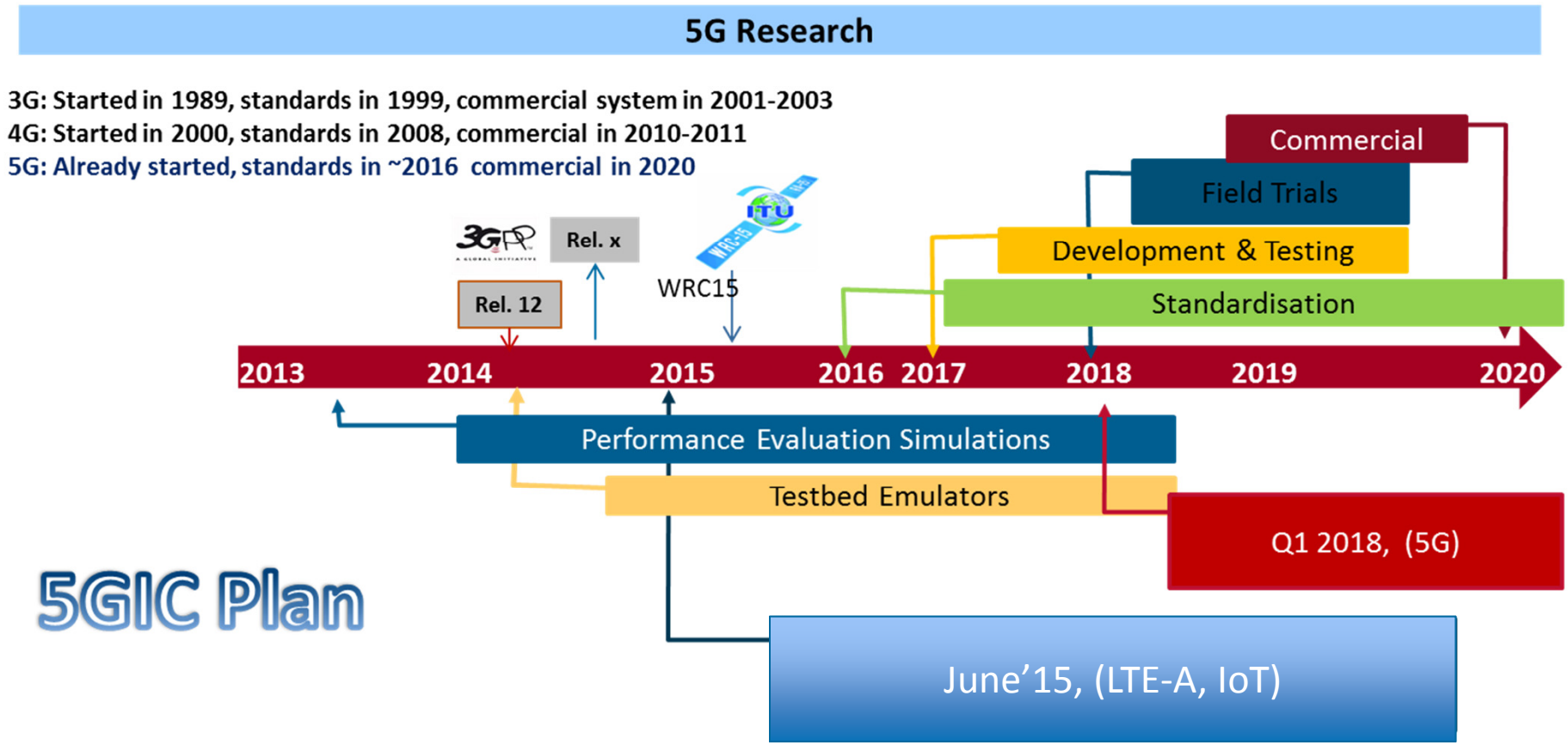
- Important ones:
  - Latency of sub-ms on air interface
  - Full diversity exploitation
  - Pilot pollution- Cell edged capacity

Initial study suggest: minimum of 100MHz

University of Surrey, 5GIC



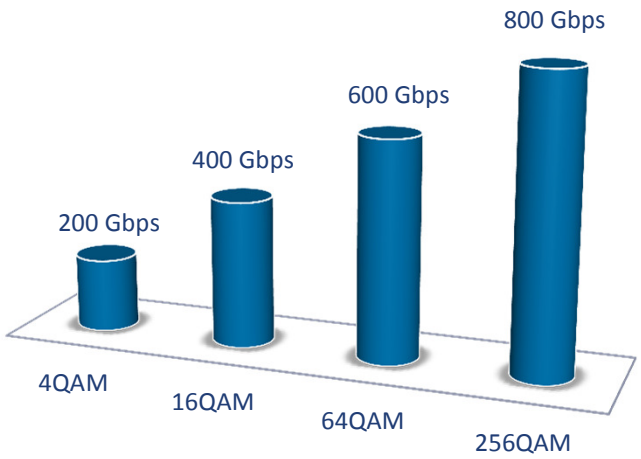
5GIC High Level Technical Activity Roadmap



Achievement highlights so far…

- **10 patents filed so far**
- Highlights of some of them are:

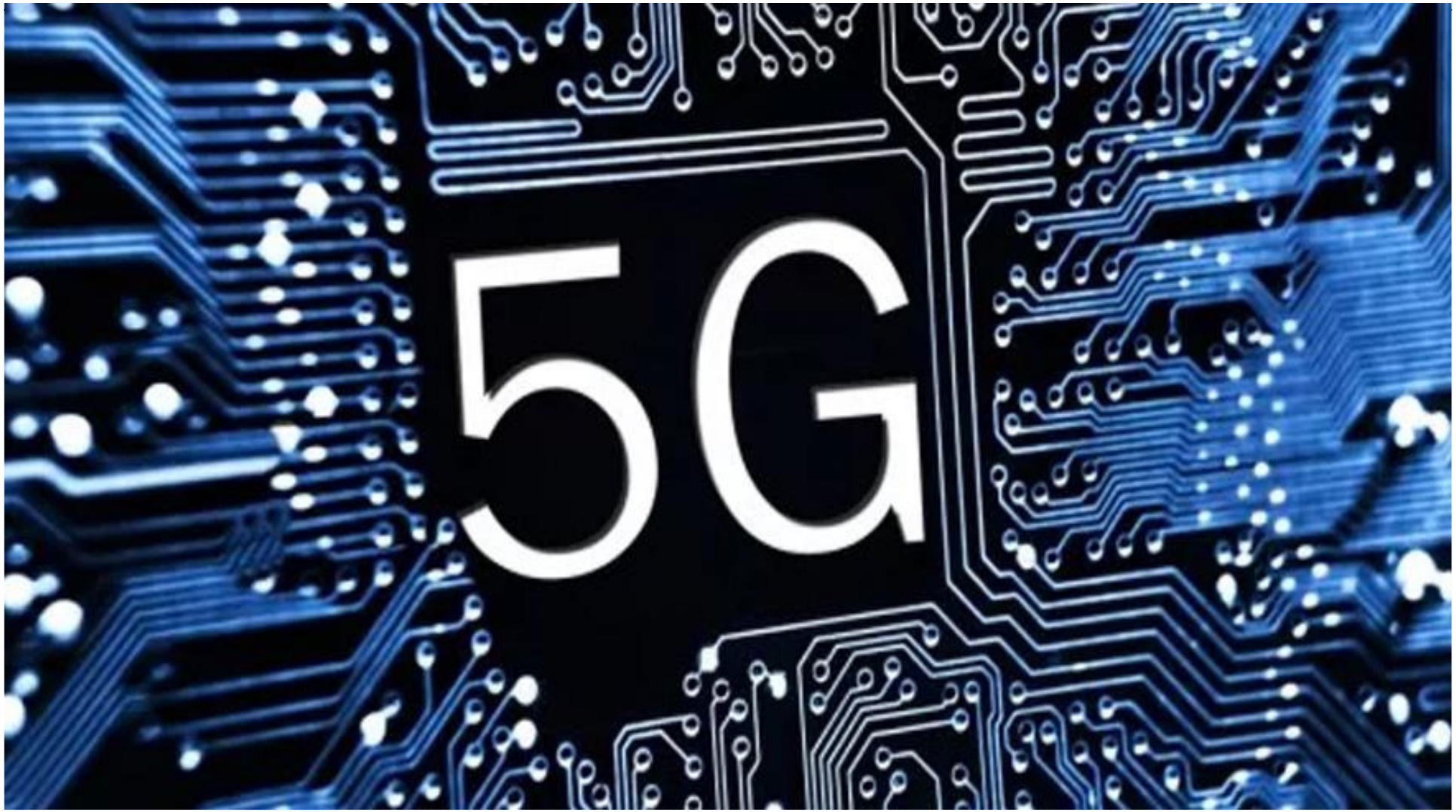
MINT
100MHz Bandwidth
1024x1024 Multi-User MIMO



- **Speed and spectrum efficiency**
- Highest-ever speed wirelessly
- >800x highest speed in 4G
- Interference is good

- **Uniform user experience, all over cell coverage**
- 15x capacity increase at cell edge compared with state-of-the-art technologies

Thank You



Landing