SATELLITE 5G

AN INDUSTRY PERSPECTIVE

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5>>6G INNOVATION CENTRE
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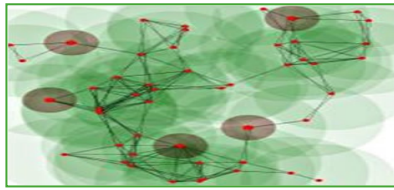
- MOBILE CELLULAR
- WIFI
- SATELLITE COMMUNICATIONS & BROADCAST
  - Broadband Fixed
  - Broadband Mobile – BB on the move
  - Broadcast – passenger vehicles
- INTERNET OF THINGS
- VEHICLE COMMUNICATIONS
- FUTURE INTERNET

FROM THEORY TO INNOVATION





Testbed: 4G & 5G Multi-Radio access network Environment Coverage

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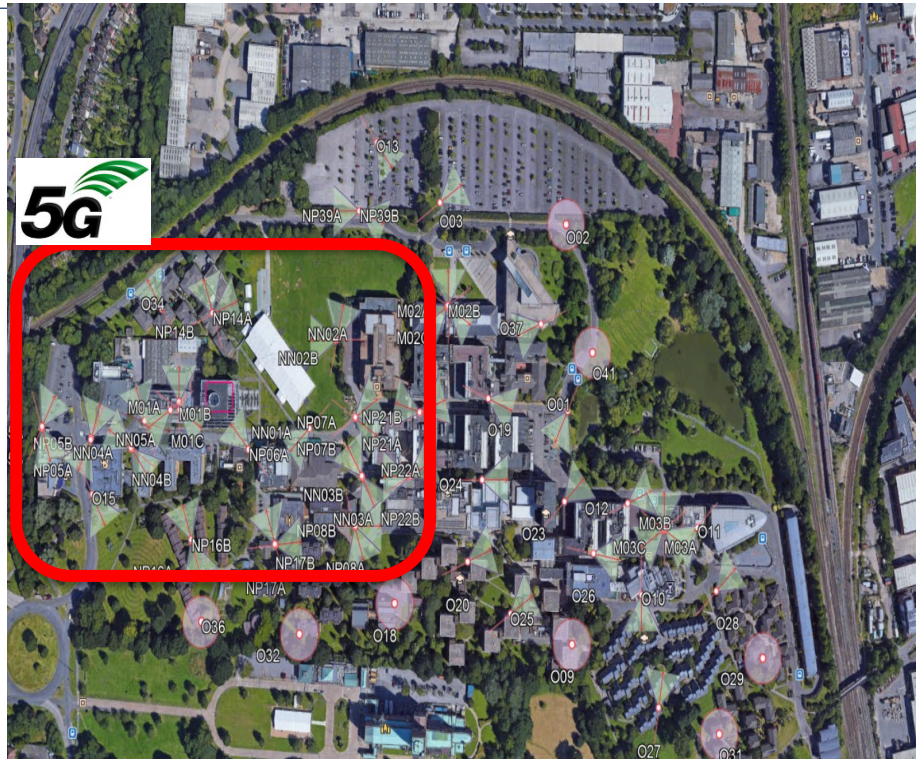
Outdoor

- 4km² coverage of dense cells
- Ultra dense C-RAN of 44 4G-TDD sites & 66 Cells
- Cell Cluster operated as 1xMacro & 15xSmallCell site/Cluster
- eMBB D-RAN of 7 5G-TDD(3.5G) Sites & 9 Cells
- URLLC RAN of 1 5G-TDD(3.5G) site & single cell
- 700MHz 4G-FDD 1 site
- 60GHz backhaul system
- Combination of SDR & 60GHz supported on a drone for popup-network
- Satellite backhauling



Indoor – Over 2 Floors

- C-RAN of 4G-TDD 6 Cells
- 4G-FDD femtos cells
- 6 x Wi-Fi-A

5GIC GLOBAL IMPACT THROUGH WORLD-FIRST

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Highlights

- 5G CORE AND 4G CORE **(MADE IN THE UK),** CAPABLE OF HOSTING IN EXCESS OF 1 MILLION USERS
- PRIVATE 5G NETWORK
- NET SLICING DEMONSTRATION IN 2018
- HIGHEST SPECTRAL EFFICIENT MMIMO (5BITS/S/HZ/ ANTENNA ELEMENT)
- WORLD'S FIRST 5G REMOTE-CONTROLLED DRIVERLESS VEHICLE, BETWEEN GUILDFORD CAMPUS & LONDON EXCEL
- ROBOT CONTROL BY 5G (URLLC)
- 5G-POWERED REAL-TIME HOLOPORTATION, MAKING 3D VIDEO-CONFERENCING, MEETINGS AND WORKING A REALITY
- **5G OVER GEO SATELLITE AND FIRST 5G OVER VLEO SATELLITE**
- FIRST E2E 5G SA TEST IN EUROPE
- 5G SMART MANUFACTURING

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5GIC: World's first 5G Centre

ART OF POSSIBLE

ROYAL ACADEMY OF ENGINEERING

WINNER OF ROYAL ACADEMY OF ENGINEERING (RAENG) 2021 FOR BEST INDUSTRY-ACADEMIA COLLABOPRATION

Satellite Role: Applications & Use Cases

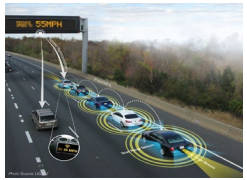
Rural Land, Sea and Air

- Mobile Broadband
- Internet of Thing
  - Narrow-Medium-Broadband applications
    - Connected transportation, e-Agri, e-Manufacturing,….

5G (Communications & Automation)






Benefits offered by Satellite to 5G- Not Just Coverage

- **New services:**
  - Earth Observation
  - PNT
  - Broadcasting
- **Cost effective Contiguous Coverage**
- **Total Energy efficient System**
- **Overcome Digital Divide**
- **Integrated Satellite-Terrestrial 5G : Complementary rather than competing networks**

PURE OR HYBRID CONSTELLATIONS WITH/WITHOUT ISLS

- DIRECT SAT TO CELL
- DIRECT SAT TO UE
- DIRECT SAT TO UT

Challenges

Based on Open Networking Principles

- 5G Open RAN functions in Space: optimum functions distribution (cost, complexity and Performance) between GEO/MEO/LEO combination and Ground Segment
- Virtualised functions on board the satellites as part of an E2E open and programmable network
- Distributed Cloud Native platform with AI/ML for Network Automation
- Uniform QoS management
- Uniform Network security
- digital on-board for dynamic RA, beam shaping and routing
- Satellite, Gateway, UT antennas
- electronically steerable multi-beam Antennas
- Multi-link and Mobility Management
- Common Ground segment (BS and Ground station)
- Integrated Communications, Positioning, Navigation and Time (CPNT) Payload
- Integrated System Digital Twin
- Many More

Thank You