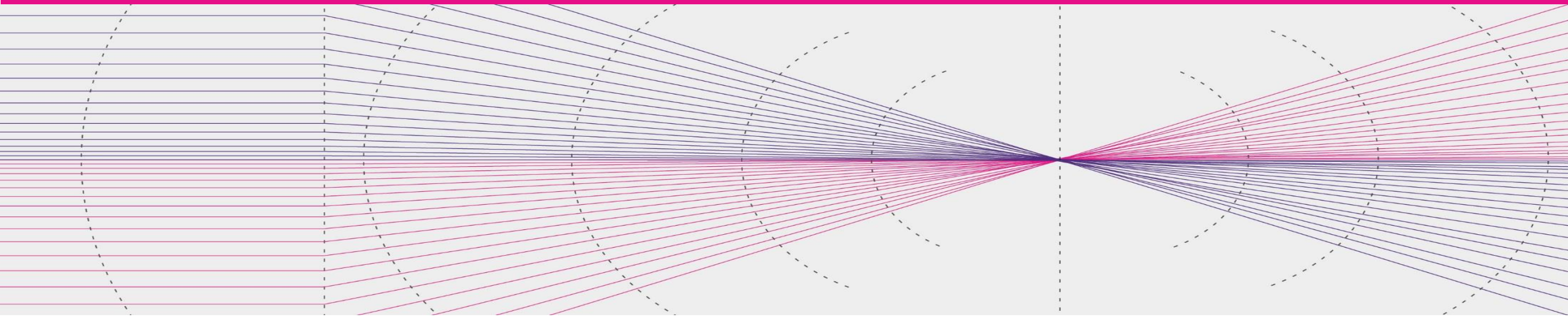
Mobile service for rural areas*

SPF Cluster 1/3 event

18 October 2021

Professor Ian Corden



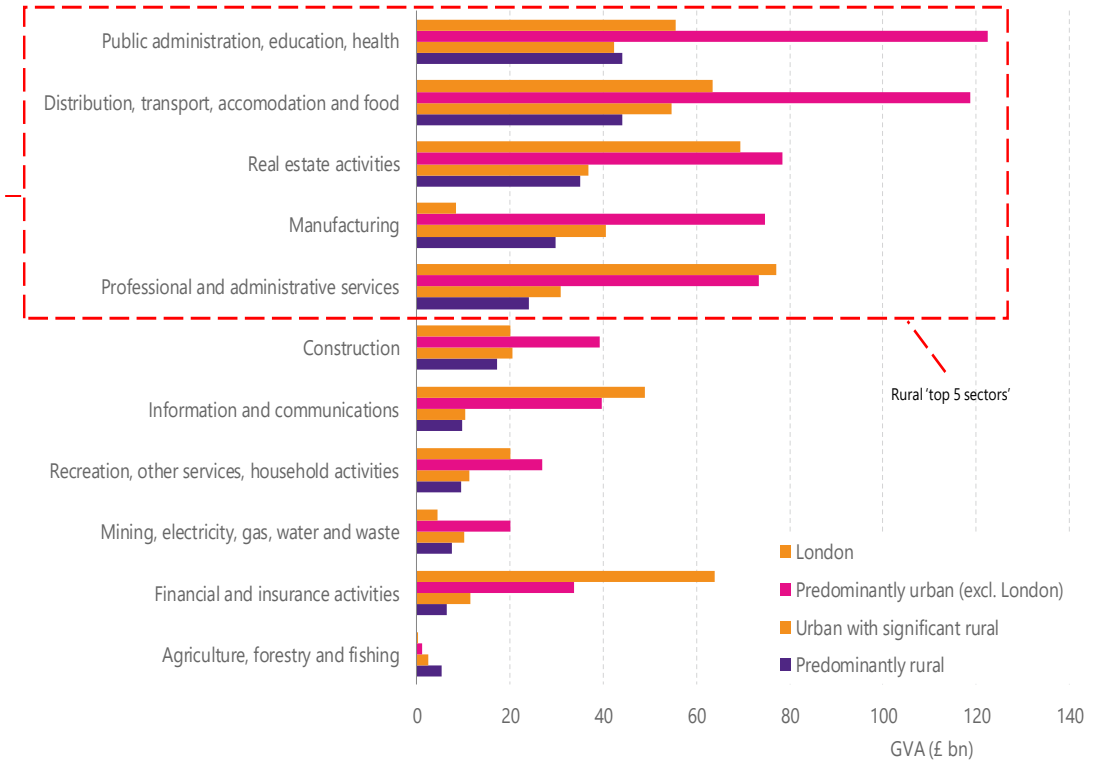
*General observations only. Detailed analysis would be required to support any policy or commercial decisions.

Clear potential exists for greater economic contribution, energy efficiency, and productivity in rural areas, with improved mobile comms

- Plum has been significantly involved in the rural segment: we authored the **DCMS 5G Rural First final report**, and have supported numerous clients in FTTP, 5G, FWA, Gigabit radio, and Project Gigabit engagements in Area 3
- We are directly engaged in **5G evolution and 6G R&D**, through our affiliation with the University of Surrey, and recent work for DCMS on ORAN, Diversification, and emerging tech

- Around **17% of the UK's population are recorded as residing in rural areas**, which cover around **75% of the landmass**
- Economic contribution from rural areas amounts to c. £300bn GVA, or **around 16% of the UK's national economy**
- By comparison, London contributes c. £425bn, or 23% of UK national GVA
- **GVA per job tends to be higher in urban areas**
- The **mix of economic activities in rural areas differs** from that in urban centres

Mix of economic activities: GVA by sector and rural-urban split

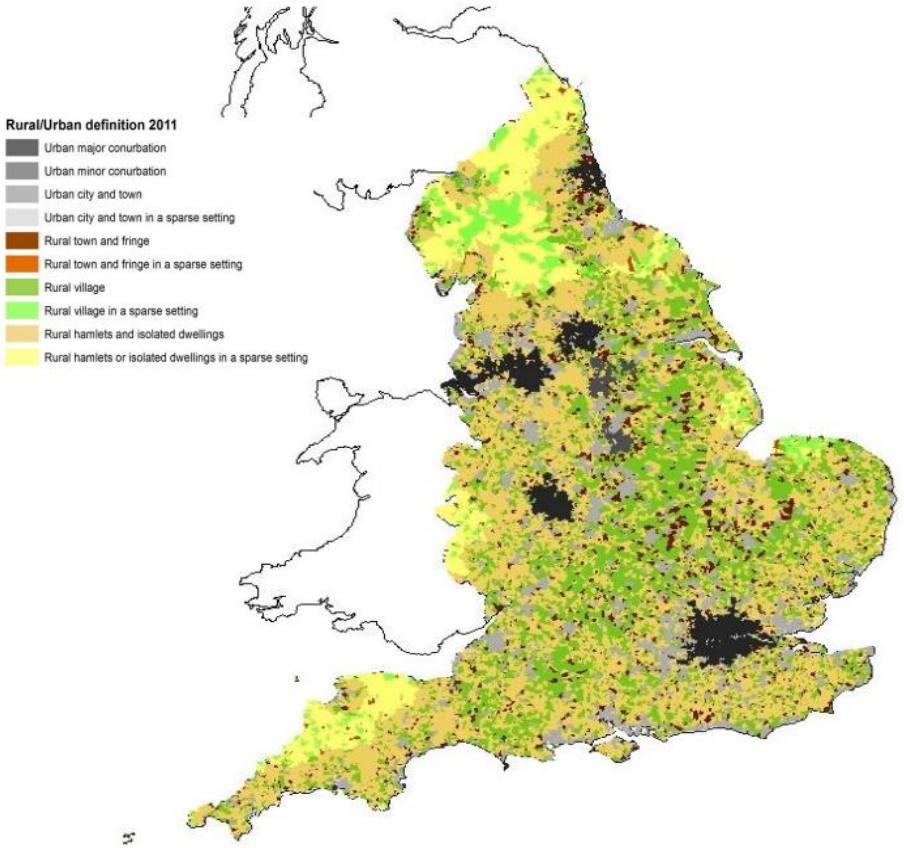


Sources: https://www.5gruralfirst.org/report-new-thinking-applied-to-rural-connectivity/

Demand levels will depend on the need for true mobility vs alternatives such as FTTP, FWA, altnets

- c. 20% of UK premises ‘rural’, c. 6m premises
- Commercially, mobile coverage follows population density,
  - but **true mobile service value is driven by overall coverage**
- As with Project Gigabit, the **devil is in the detail**:
  - Rural areas can be near to non-urban;
  - **Planning required at scale of network build**, i.e. Parish, LSOA, or lower
- On average, UK population density in rural areas is around 70 people/km2
- IOT requirements could augment this (e.g. V2X, agritech)
- Use cases may include eMBB (e.g. HD video, NHS community staff, logistics, etc)
- **Examples:**
  - 4k video conferencing / autonomous vehicle cameras: 30Mbps
  - User / device density: 100 units/km2
  - **Average aggregated data throughput demand: 3Gbps/km2**
  - **Will vary: 100Mbps/user, 500 users/km2: 50Gbps/km2**

Rural / urban areas: 2011 census data



Sources: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/260551/Census_Stats_-_Final.pdf

5G capacity in sub-1GHz bands will be similar to that with 4G, excepting any higher band overlays

- Wide area 5G coverage with sub-1GHz bands developing, but **capacity performance in these bands is limited by bandwidths available and limitations on 5G MIMO**
- Hence, **sub-1GHz capacity performance with 5G is likely to be similar to that with 4G** (excepting any high band overlays)
- Refarming in 900MHz bands may help
- 5G uplink power levels can limit performance levels
- E.g. 20 MHz duplex holding at 700 MHz
  - Cell area spectrum efficiency on average at c. 3 bps/Hz
  - Cell area coverage: 1km range assumed
  - **Cell area capacity (downlink) on average: c. 10 Mbps / km2**
  - **Around 30Mbps / sector-carrier, on average**
  - **Peak spot rates will be higher, for a limited number of users:**
  - **Burst user rates per user at c. 100Mbps feasible, depending on range from cell tower and cell loading levels**

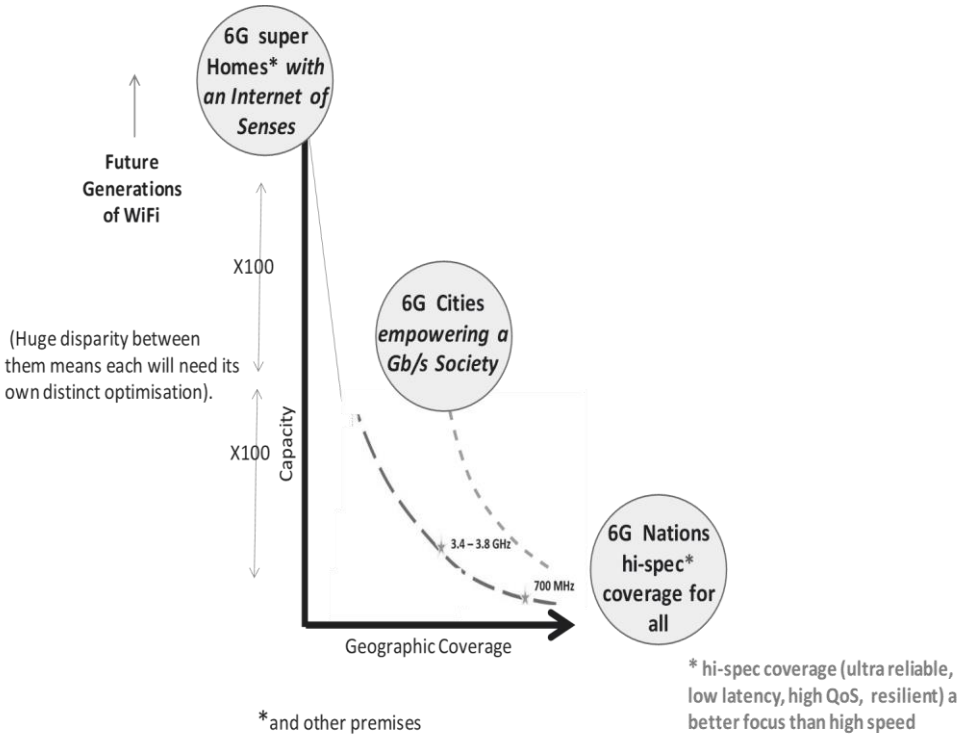
As with any wireless technology, performance will depend on balance between demand and supply

Sources: https://www.rrt.lt/wp-content/uploads/2018/10/Nokia_5G_Deployment_below_6GHz_White_Paper_EN.pdf

Wireless technology is evolving, but fundamental challenges remain; layered, demand-led solutions are likely to be most efficient

- **UK needs a coherent, integrated 5G+ / 6G strategy**
- Satcoms option remains costly, with limited quality
- 3GPP global development likely to continue, but **wireless ecosystem is widening (e.g. ORAN, FWA, etc)**
- General recognition in the industry that **evolution with ever more capacity and coverage is becoming economically and physically challenging**: more capacity, needs more BW, needs higher bands, needs smaller cells, need more capex, more EBITDA margin pressure for opcos
- **Mobile technology is evolving from a 'one size fits all' to 'solution matched to needs'**
- **6G is evolving with separated wireless domains** (macrocells, smart cities, indoors), together with band overlays (similar to FTTP Areas 1, 2, 3)
- **For rural areas, localised solutions may be required, depending on demand:**
  - E.g. crop areas coverage with 5G band overlays, 26GHz FWA, 60GHz mesh
  - Note: not all use cases need 5G; e.g. camera drones store photo data, can be uploaded at day end to fixed broadband

With conventional wireless systems, including 5G, capacity goes down as coverage goes up, fixed a given level of investment



Sources: Professor Stephen Temple, SPF-DCMS supported UK University Hosted 6G Research Workshops, 2021

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