Disruptive Analysis

Don't Assume

6G & Selected Future Regulatory Touchpoints

Dean Bubley, Disruptive Analysis

For a Regulatory & Policy Audience

February 2024

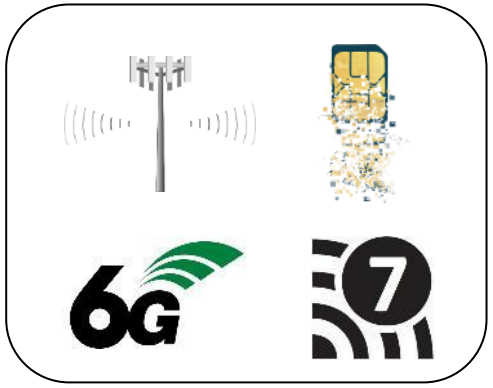
dean@disruptive6G.com @disruptivedean

Image credits: Pixabay.com / Dean Bubley / Midjourney AI / sources as stated

Disruptive Analysis
Don't Assume

Dean Bubley & Disruptive Analysis @disruptivedean

- Tech/telecom analyst & strategic consulting since 1991
- Covering Internet, 5G, 6G, Spectrum, FTTX, Wi-Fi, Edge/Cloud…
- Regulatory, economic, societal & geopolitical aspects of telecoms
- Advisor to telcos, large & small vendors, investors, government
- Biases: Against monopolies, lazy incumbency & hype



Network Tech, Policy & Business Models

Communications Apps & Services

Telecom-Futurism

Industry Analyst Consulting & Reports

Disruptive Analysis

Don't Assume

Some key 6G themes for regulators

- Likely timelines & variables for 6G – when, why & how?
- Lessons to learn from 5G hype & flawed expectations
- Economic & geopolitical considerations for 6G
- The importance of indoor wireless connectivity to communications, and how that may influence 6G evolution
- Policy and regulatory implications to consider re. competition, metrics (6G coverage, throughput), and more
- Rural/remote coverage (eg via satellite integration with 6G)
- Future evolution paths for local/private 5G spectrum & other spectrum sharing mechanisms in the 6G era
- The R&D landscape in which 6G technologies evolve
- Spectrum outputs / studies from WRC-23 & WRC-27
- *Also, not a full 6G regulatory map (eg quantum security)*

Disruptive Analysis

Don't Assume

6G TIMELINES & MAIN PHILOSOPHIES

February 2024

Disruptive Analysis

Don't Assume

Why are we talking about 6G now? Isn't 5G enough?

- 5G was overhyped & has not matched expectations (yet?)
- Wireless R&D is continuous. "6G" tech will emerge anyway
- 10-year cycles help focus efforts
- New/clearer requirements, eg coverage
- A lot has changed since 5G design (& ongoing)
  - Sustainability & energy
  - Geopolitics
  - Realistic use-cases for advanced wireless
  - Shifting industry structure (eg P5G, FWA)
  - AI & cloud
  - Spectrum landscape
  - Other wireless tech (satellite, WiFi7 etc)

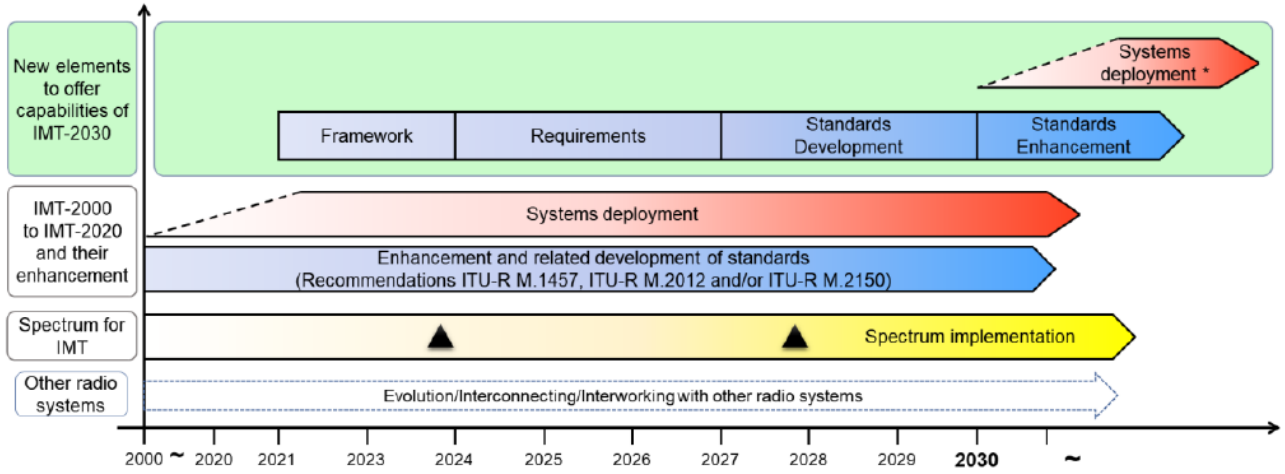
Disruptive Analysis

Don't Assume

6G / IMT2030 & 5G Advanced 3GPP timelines

FIGURE 3

Anticipated perspective of the timelines for IMT-2030

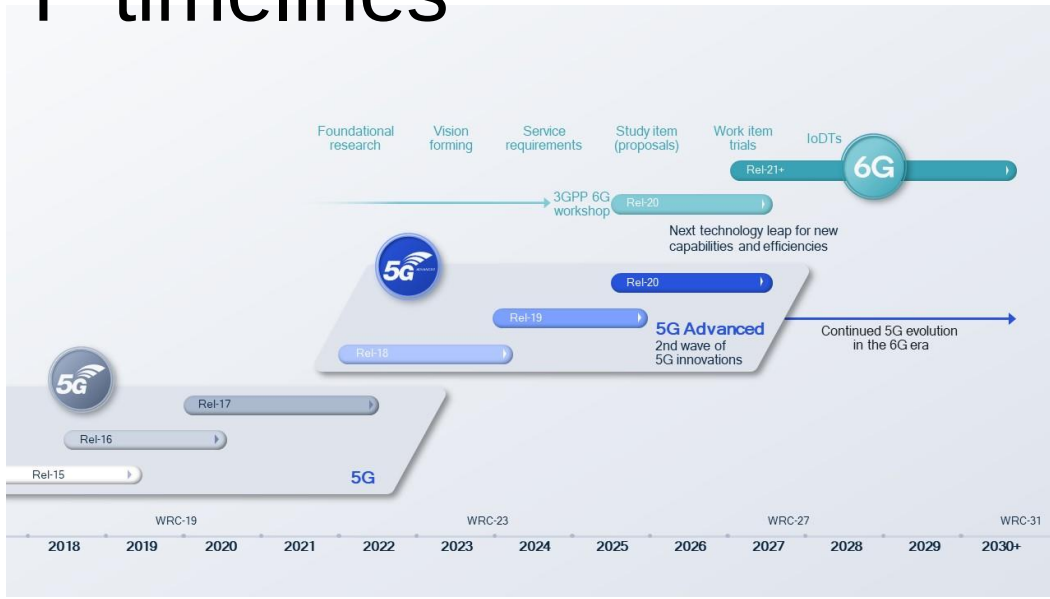


The sloped dotted lines in systems deployment indicate that the exact starting point cannot yet be fixed.

▲ : Possible spectrum identification at WRC-23, WRC-27 and future WRCs

* : Systems to satisfy the technical performance requirements of IMT-2030 could be developed before year 2030 in some countries.
: Possible deployment around the year 2030 in some countries (including trial systems)

Source:ITU



Source:Qualcomm

Release 19 is also very important – as it will provide a bridge to 6G which is starting to be discussed.

Wanshi Chen confirmed that the focus of the technical work is very much on finishing with Rel-18 and then on Rel-19 - from the first quarter of 2024 – which is set to be an 18 month release. All three TSGs (RAN, CT and SA) have now endorsed a timeline for 6G work that is connected really well with Rel-19. The first Rel-20 workshops will be in March 2025, with an aim to approve the Rel-20 package – including 6G studies - June 2025, in line with the Rel-19 functional freeze.

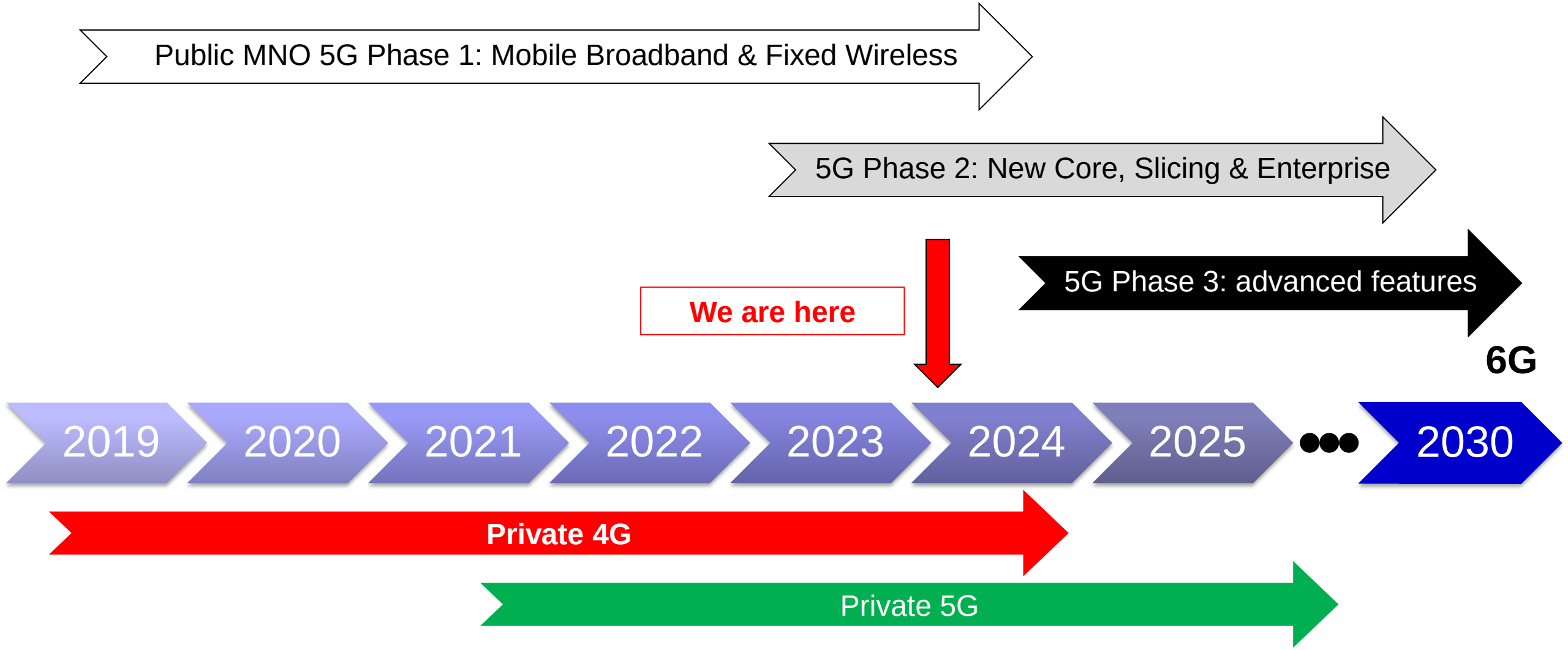
So, Rel-20 for studies and Rel-21 for specification work on 6G and the TSG RAN IMT-2030 submission, which is very important for 3GPP.

Source:3GPP

Disruptive Analysis

Don't Assume

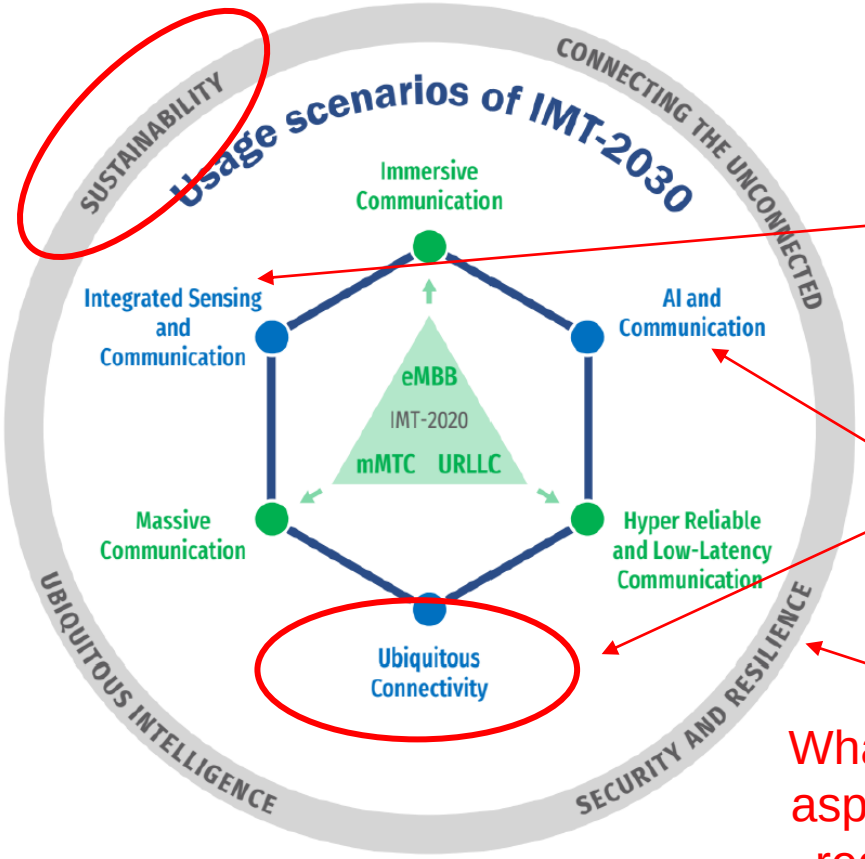
5G continuing to evolve into the 6G era (eg standalone)



Disruptive Analysis

Don't Assume

Intended use-cases & capabilities = new regulatory angles



Sensing

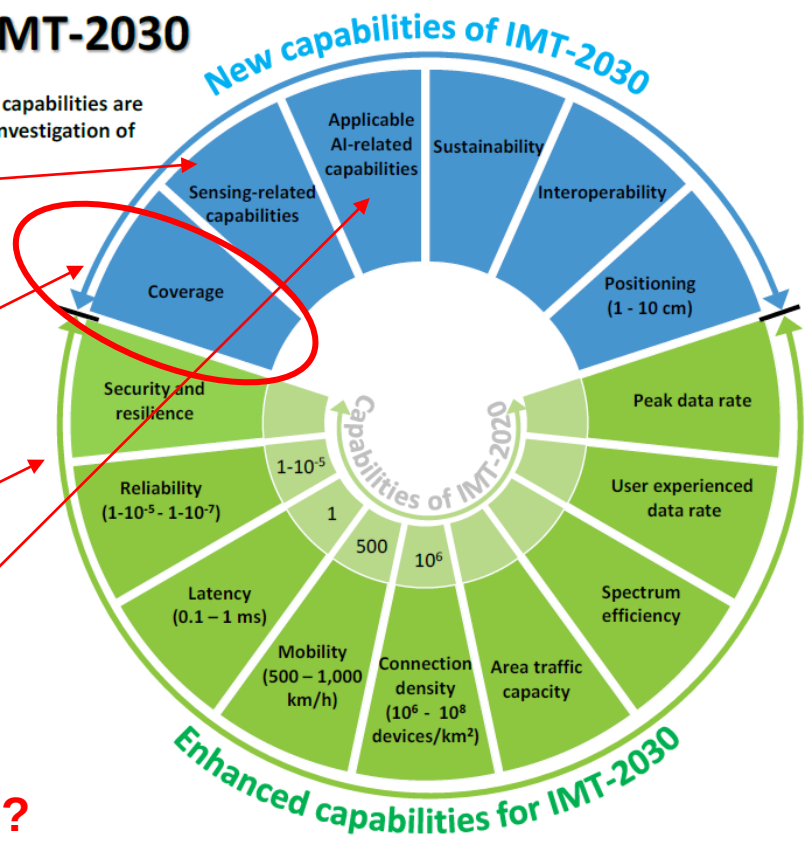
Coverage / ubiquity

What does this mean in practice?

What security aspects need regulation?

AI native

Fit with AI rules?



Source: ITU-R M.2160

Disruptive Analysis

Don't Assume

Three paths ahead – can regulators consider all scenarios?

Maximum tech evolution "Metaverse for Dolphins"

Maximum usefulness (Prioritise key issues & opportunities)

Minimum disruption (MNO status quo)

Disruptive Analysis

Don't Assume

6G: MAKING IT INDOOR-CENTRIC

A SPECIFIC EXAMPLE WHERE POTENTIAL 6G-ORIENTED REGULATION COULD ADDRESS A KEY ISSUE & OPPORTUNITY

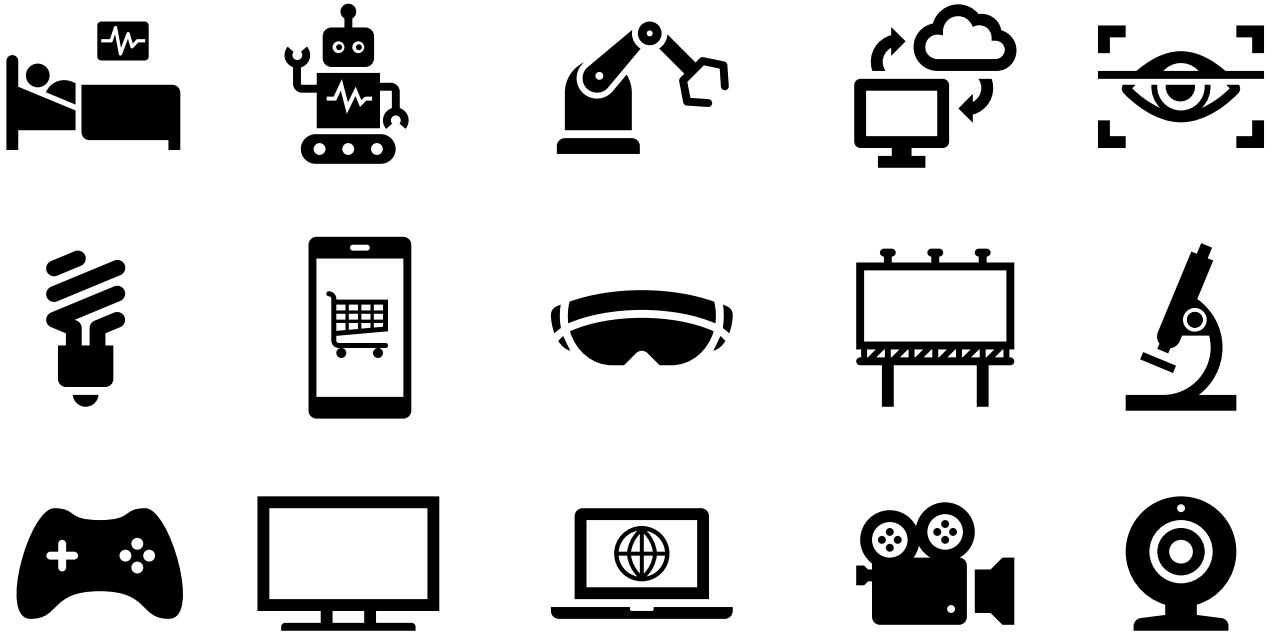
February 2024

Disruptive Analysis

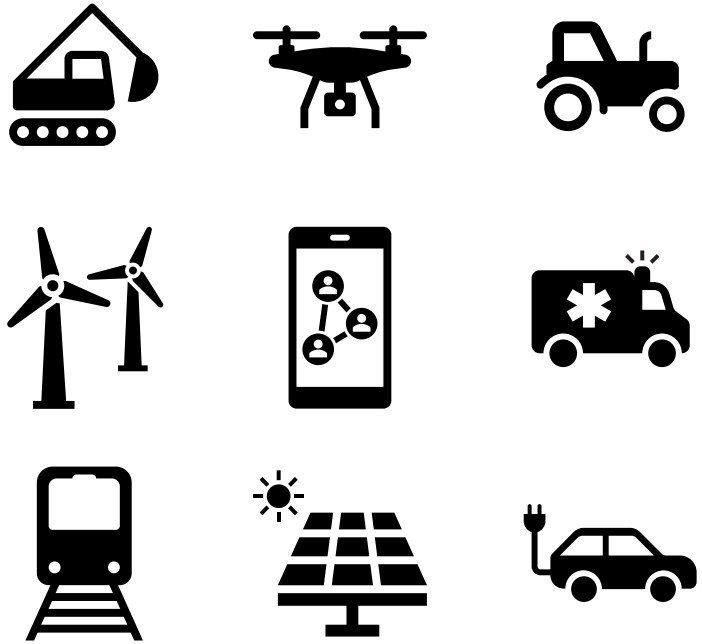
Don't Assume

c80% wireless use/value indoors. Regulation rarely follows

Indoor



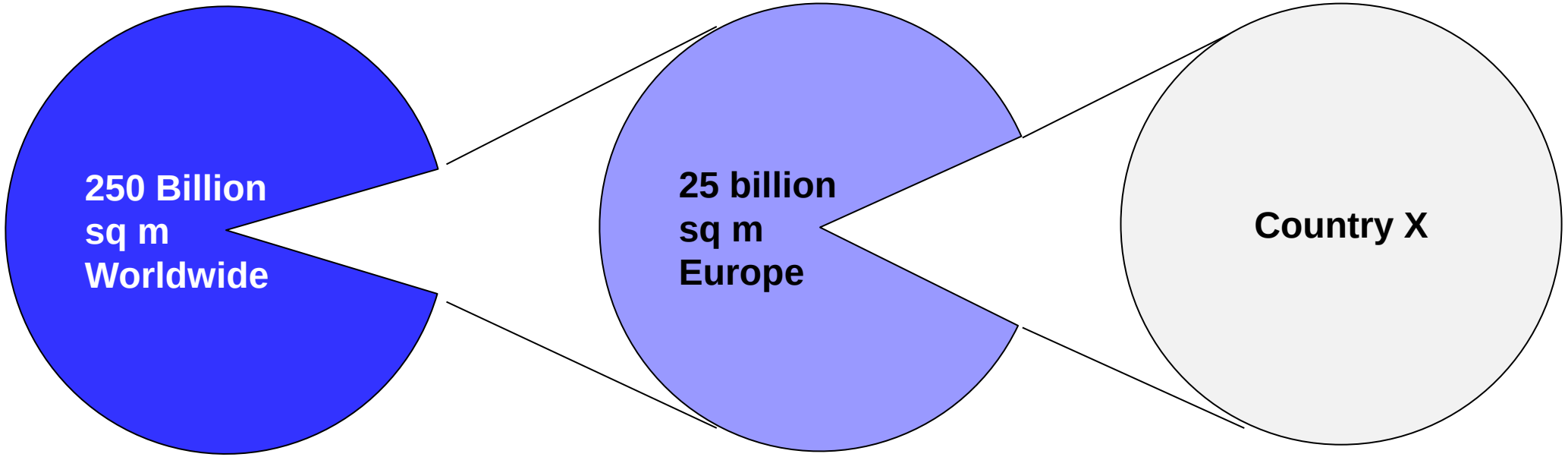
Outdoor



"Up to 80% of mobile traffic is generated indoors"
"Indoor coverage becomes more important but also more challenging with 5G" – Ericsson, 2021

Disruptive Analysis
Don't Assume

There is a huge amount of in-building area



Indoor wireless system costs:
from $1-100 per sq m
(Basic Wi-Fi to multi-carrier digital DAS)

Note: 1 sq m = approx 10 sq ft

Disruptive Analysis

Don't Assume

Many **regulatory touch-points** for indoor 5G & 6G

- Mandates on indoor systems
- Indoor stats & KPIs (what / how?)
- Spectrum – shared, unlicensed, platforms
- Guidance for consumers, venues businesses, local gov
- Hybrid private + neutral host networks
- Alignment with other rules (eg construction, inclusion, security)
- Wi-Fi offload & integration rules? + Wi-Fi calling
- Energy / sustainability aspects
- 6G innovations & R&D, eg RIS, AI, dMIMO, sensing etc

… and R&D, indoor subsidies, competition impact & “Gigabit to the Room” targets

Disruptive Analysis

Don't Assume

RETHINKING METRICS FOR THE 6G ERA

February 2024

Disruptive Analysis

Don't Assume

Key priority for policy/regulatory: **Good** stats, not **Easy** stats

Easy Statistics

Overall retail data traffic, PB/mo

Overall telecoms capex

Telco reported profits

Market capitalisation

Consultant top-down “GDP impact”

Consultant “traffic demand forecast”

Vendor & trade association / consultant reports & studies

Homes passed by FTTX

Good Statistics

Traffic / value split between
- Indoor vs. outdoor use
- Consumer vs. business
- Mobile bband vs. FWA
- Solo vs. shared networks
- Uplink vs downlink

Impact of tower/infra spin-outs

Requested vs. “sent” data

Impact of outliers

GDP impact vs. baseline/alternatives

Homes connected to FTTX

Disruptive Analysis

Don't Assume

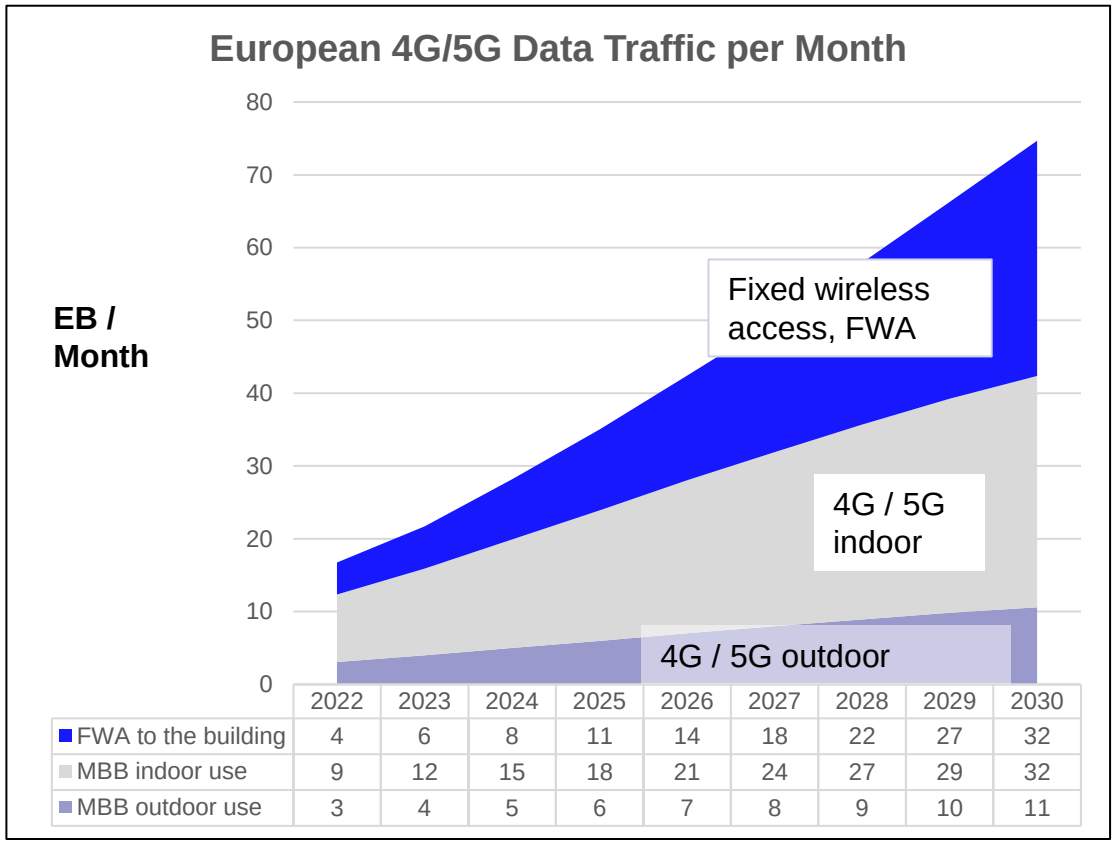
What metrics & KPIs would you collect for 6G, ideally?

- **Imagine starting with a blank sheet of paper in 2030**
- What data wish-list would you have?
- Example: Granular coverage data
  - By technology (5G, 5G SA, 5G Rel 18+, 6G etc)
  - By location – indoor, outdoor, rural, 3D, area, population, end-devices
  - Corrections for tech advancements, eg beamforming, dynamic networks
  - Access to 3rd-party or shared infra, eg satellite, federated Wi-Fi, neutral hosts
- Example: Data traffic
  - By use-case, eg FWA (fixed wireless) vs MBB (mobile broadband) vs. private 5G / 6G
  - By scenario, eg indoor vs outdoor, uplink vs. downlink, macro vs. small cell vs. RIS
  - Fine details, eg usage density, spectrum band usage
- Deployments & CAPEX
  - How is cloud / software treated? Or passive elements like RIS?
  - 3rd party assets eg private networks, neutral hosts, indoor infrastructure

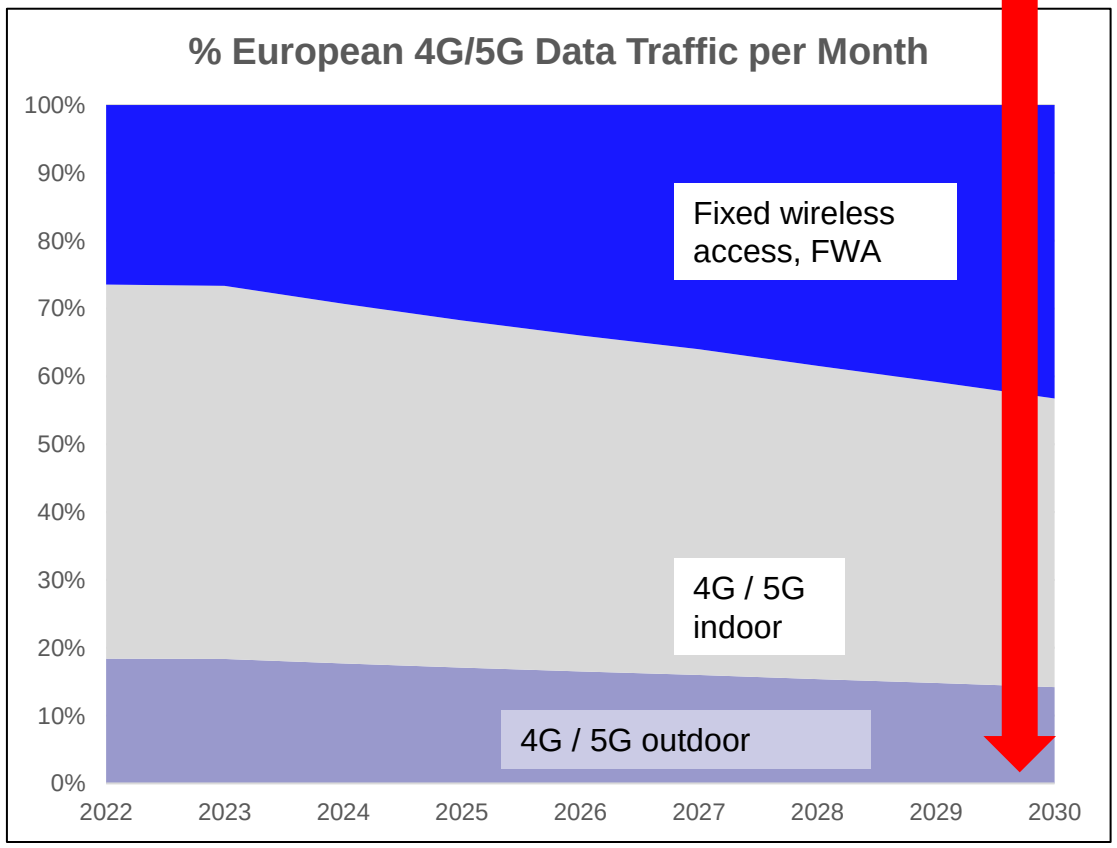
Disruptive Analysis
Don't Assume

Spectrum policy: base on detail, not headline stats

Implications for 6G era?



	2022	2023	2024	2025	2026	2027	2028	2029	2030
FWA to the building	4	6	8	11	14	18	22	27	32
MBB indoor use	9	12	15	18	21	24	27	29	32
MBB outdoor use	3	4	5	6	7	8	9	10	11



Source: Disruptive Analysis estimates, based on Ericsson Mobility Report February 2024 data
Version 1.0, published 22 / 6 / 2023 on Dean Bubley's LinkedIn
Contact via LinkedIn or information@disruptive-analysis

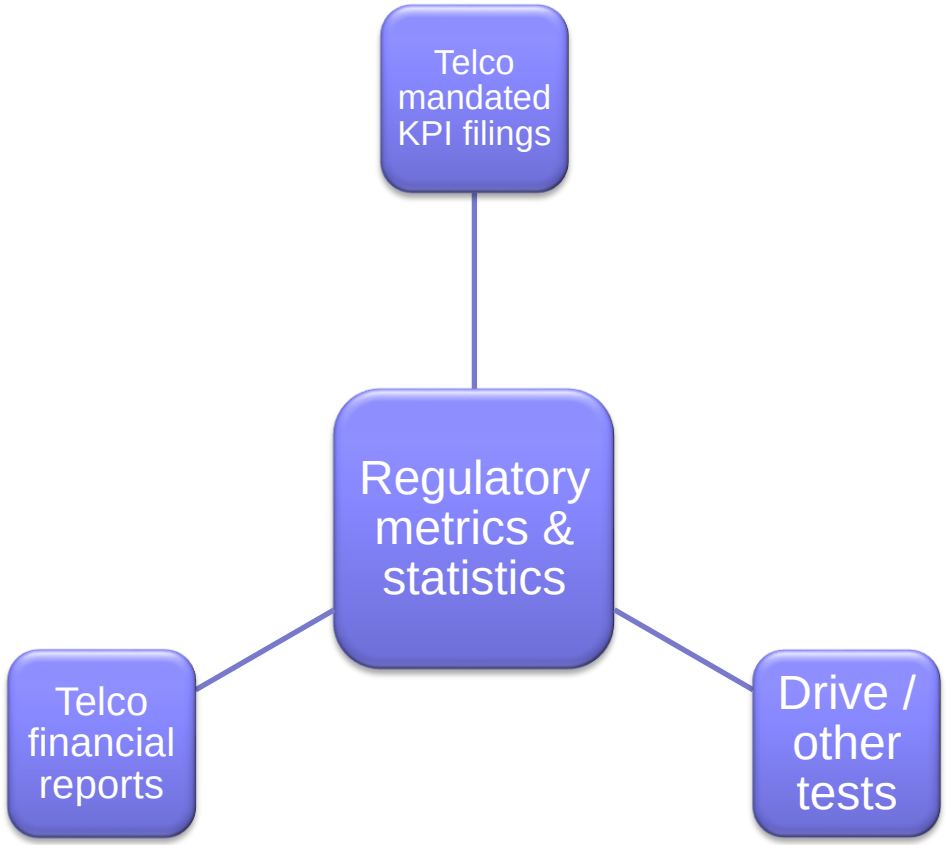
Note: EB = Exabyte
1 EB = 1000 Petabytes, PB
1 EB = 1m Terabytes, TB
1 EB = 1bn Gigabytes, GB

Disruptive Analysis

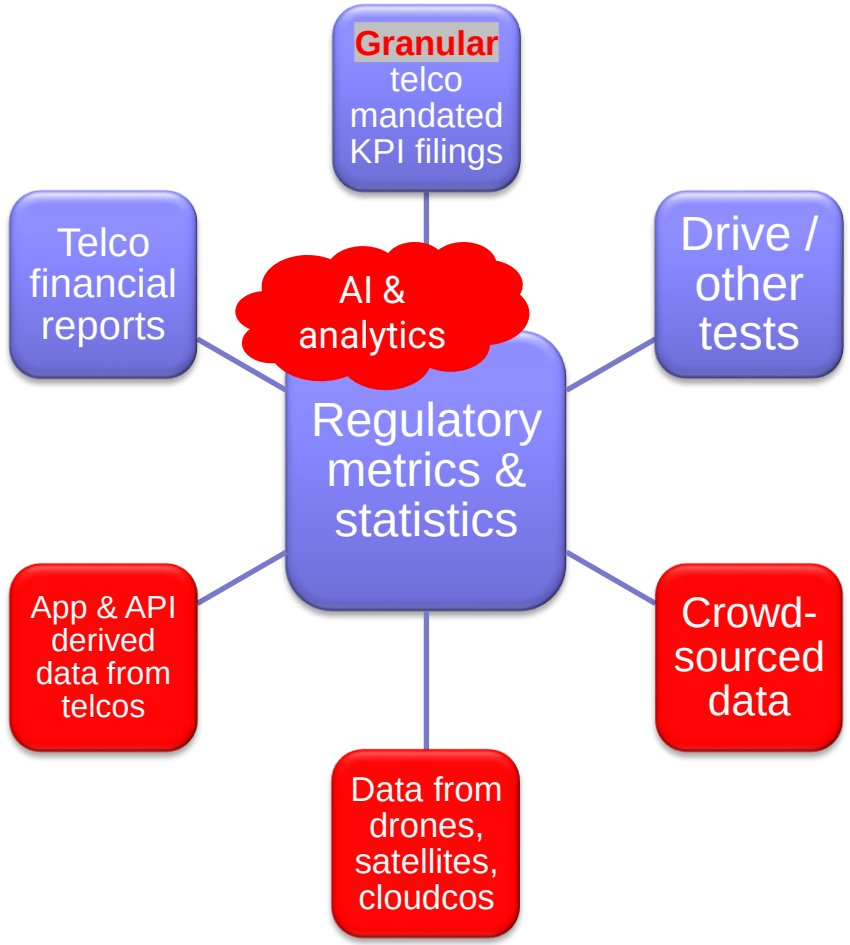
Don't Assume

Policymakers' metrics do not need to rely on telco data

Historic inputs for broad & easy metrics



Diverse inputs for specific & focused metrics



Disruptive Analysis

Don't Assume

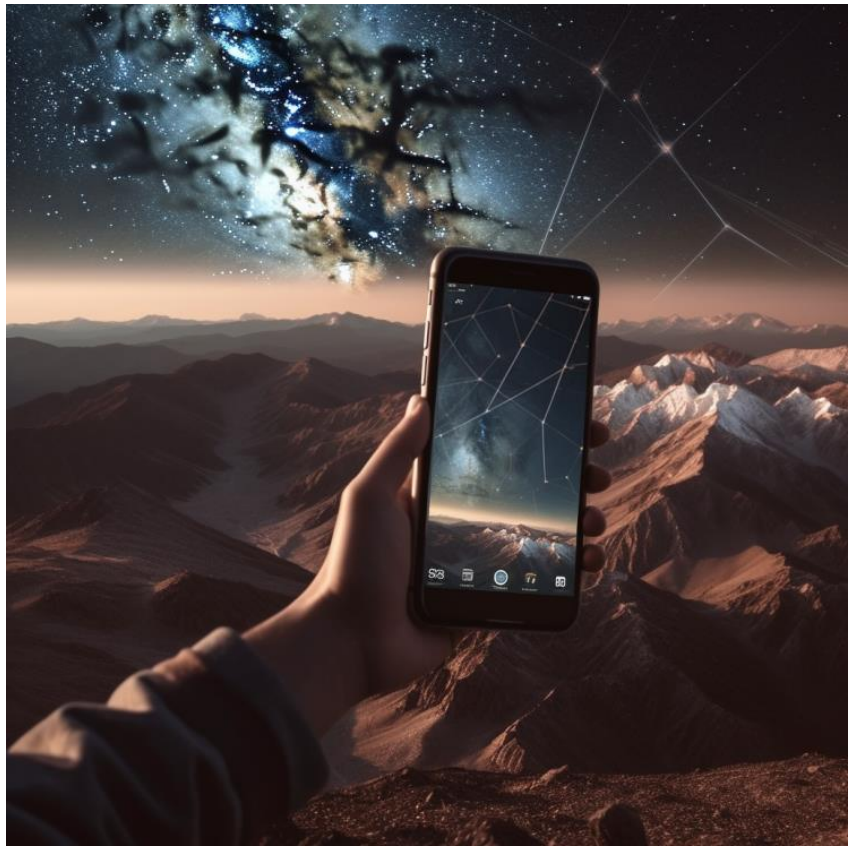
RURAL / REMOTE COVERAGE FOR 6G

February 2024

Disruptive Analysis

Don't Assume

Satellite & 5G/6G NTNs & HAPS – how much can it do?



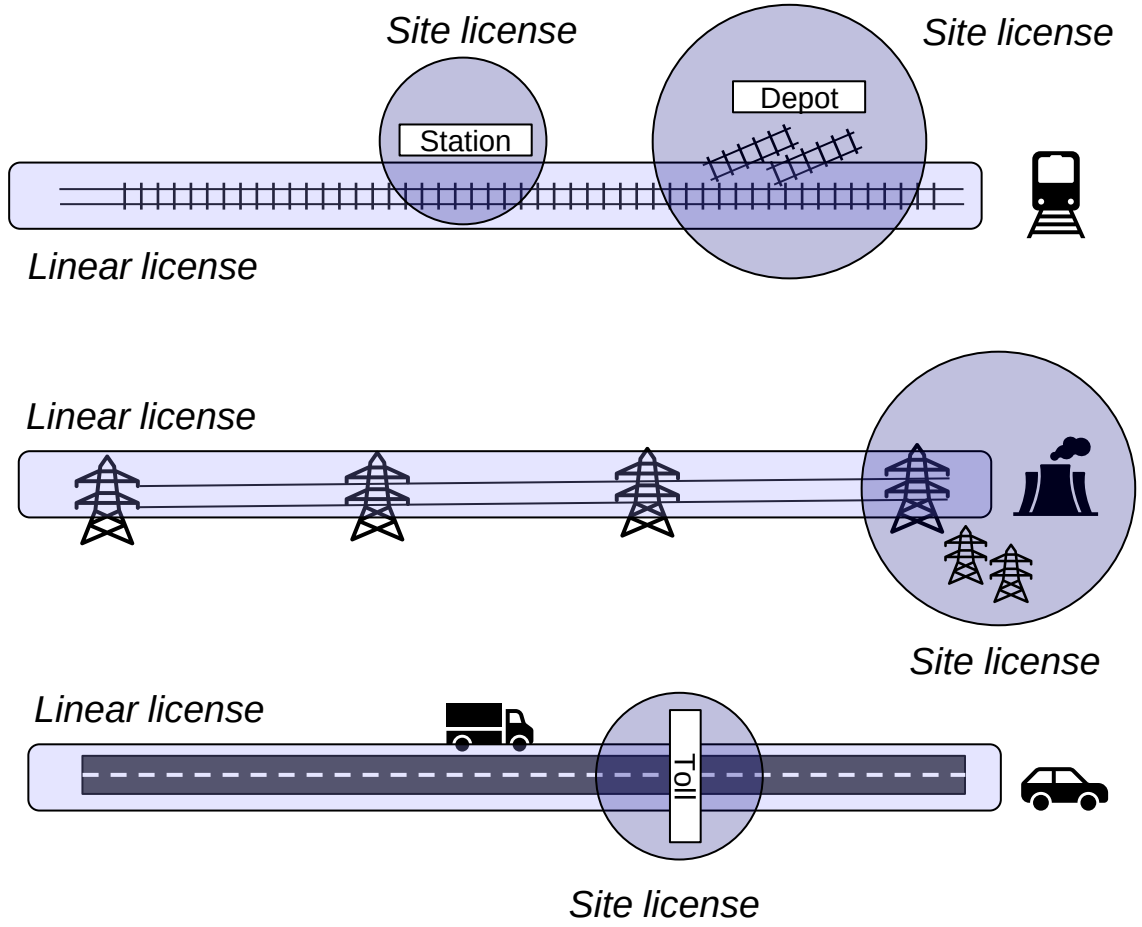
Many regulatory touchpoints for satellite & HAPs – universal coverage, accessibility, reliability, security, spectrum, competition, MVNOs, neutral host, national infrastructure etc

Disruptive Analysis

Don't Assume

Example: Linear networks & shared / infrastr for 6G era

- **6G may link to "infrastructure convergence"**
- Rationale for "long & thin" wireless networks & related spectrum licenses, ideal for / 6G
- Rail, road, power lines, pipelines, drone-routes
- Critical & non-critical applications
  - Train/grid control & signalling, MCPTT etc
  - Operational and passenger connectivity
  - May be integrated with public MNOs / neutral host
- Long duration licenses needed
- Non-critical may have gaps eg to avoid interference with incumbents
- **Same spectrum bands as local private 5G / 6G, or dedicated "infrastructure bands"?**



Disruptive Analysis

Don't Assume

6G & BUSINESS-MODEL NEUTRALITY

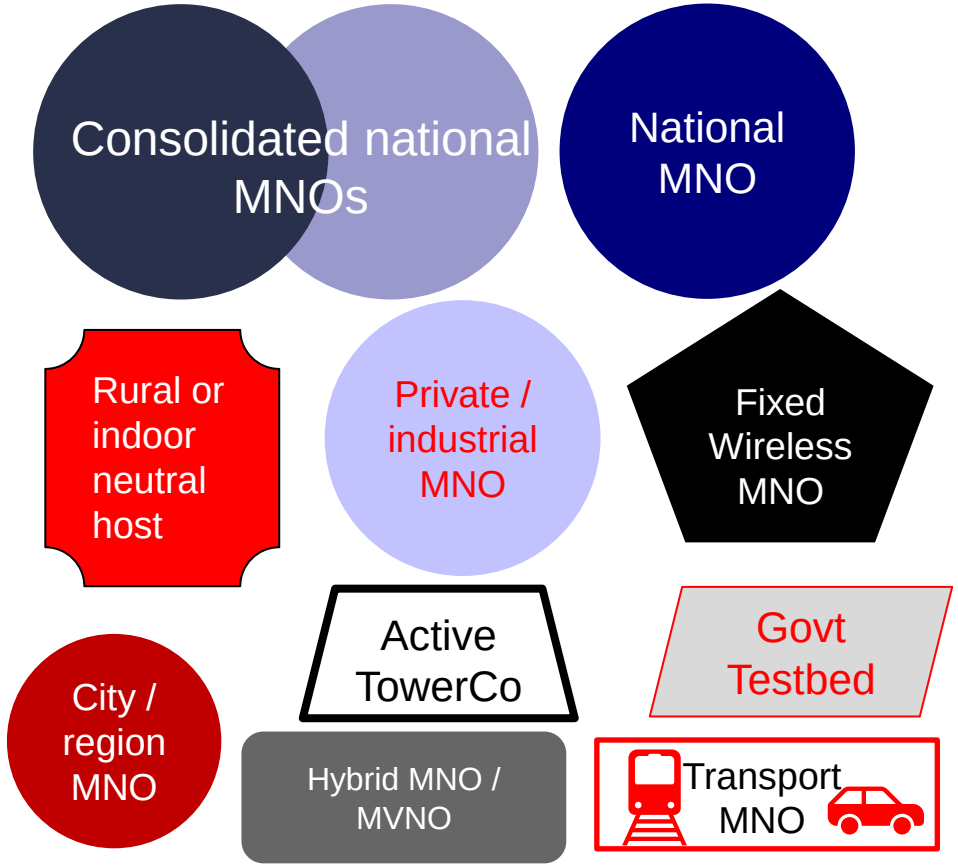
February 2024

Disruptive Analysis

Don't Assume

The first industry transformed by 5G is telecoms itself

4G-Era Mobile Operators



5G / 6G-Era Network Owners

Plus Wi-Fi, satellite, LoRa, FTTX etc

Disruptive Analysis

Don't Assume

6G timelines align with other infra-sharing concepts

Ofcom

Resilience guidance consultation and Call for Input on mobile RAN power back up

Proposal for updated guidance for communications providers on resilience related security duties under the Communications Act 2003.

Telecoms / ICT / spectrum regulatory authorities will need to work collaboratively with other infrastructure & regulatory bodies, in the 6G era

Disruptive Analysis

Don't Assume

6G Internet ecosystem & unintended consequences

- Ongoing regulatory examination of Net Neutrality
- Hype around “cost recovery” or so-called “fair share”
- Flawed grasp / definition of “traffic generation”
- Lack of understanding of peering, transit, CDNs
- Questionable assumptions & demand/cost models
- **Consider implications for 6G**
  - How account for 3rd-party infrastructure (who pays?)
  - What happens to 6G-era MVNOs?
- Many unintended consequences & workarounds
- **6G era & timeframe will exacerbate much of this**
  - Consider AI, AR & VR, cloud, edge, software arch. etc
- **The Internet / network model works. Be wary of those that would like to see it broken.**

Disruptive Analysis

Don't Assume

6G – HOW TO INTERPRET R&D TRENDS?

February 2024

Disruptive Analysis
Don't Assume

Consider 2nd-order regulatory impacts of 6G R&D pipeline

New radio technologies

- What do reconfigurable surfaces mean for regulation? Where will they go? What rules?
- Impacts of distributed or AI-driven MIMO for regulations?
- Open RAN mainstream – is cloud critical infrastructure?
- Network of networks – bidirectional or only 3GPP anchor points?
- How reflect sustainability goals & regulations?

"AI native"

- AI in the RAN: does that fit with new AI regulation?
- AI-powered resource management, slicing, spectrum mgmt etc – what regulatory oversight is needed?
- Device-side AI: implications for network traffic, security, competition
- Demands of AI on network and datacentre infrastructure (& vice versa)

Combined comms + sensing

- Same rules, or changes needed?
- Implications for privacy & security?
- Different models of sensing convergence – same spectrum, same baseband, same site/equipment?
- Sensing types / scenarios very unclear
- Who owns sensor data?

Regulatory touchpoints with all other 6G R&D areas also need to be considered, eg NTNs, edge/cloud compute, IoT etc.

Disruptive Analysis
Don't Assume

Example: Temporal dimension for 6G spectrum sharing

Dynamic demand response
Failovers / resilience
Interference
Opportunistic

Rush hour
Off-peak

PMSE
Govt events
Holidays
Disasters

Seasonality
Construction

Enterprise
Wholesale

MNO RAN
Utilities / rail
Defence
Aviation

Example: Spectrum-sharing is likely to be much more important for 6G. But what framework(s) are needed? How dynamic? How can they be defined & trialled?

Disruptive Analysis

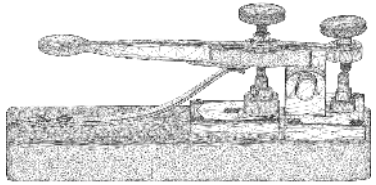
Don't Assume

Wildcard: impact of a post-digital future on 6G networks?

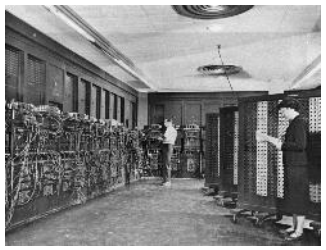
Digital Technologies

4000 years

200 years



180 years



75 years

53 years

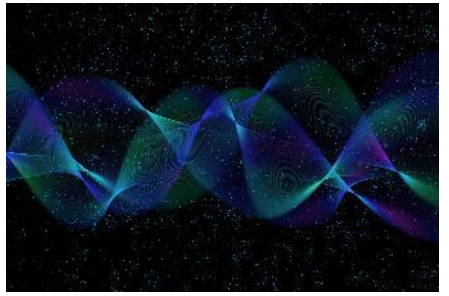
45 years

27 years

15 years

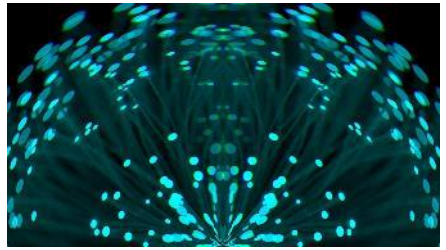
Post-digital Technologies

Neuromorphic computing



Quantum comms / computing

Biological computing



Optical computing

Disruptive Analysis

Don't Assume

Conclusion & action points: 6G for regulators & policy

- 6G is coming
- Still early days for standards…
- … but potential goals becoming clearer
- Multiple possible evolution paths
- Many candidate technologies & stakeholders
- **Regulators need to get "ahead of the game"**
- Think what you WANT to get from 6G
- What decisions have a long lead-time?
- Themes like indoors, NTN, sensing, AI, network / spectrum sharing have *many* regulatory touchpoints
- **Start assessing them now. Don't wait until 6G is nearly here.**

Disruptive Analysis

Don't Assume

dean@disruptive6G.com

https://www.linkedin.com/in/deanbubley/

@disruptivedean

www.deanbubley.com

www.disruptive6G.com