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Policy brief: techUK's definition of a network of networks

Setting the foundations for economic growth and national security

Introduction

The idea of a network of networks reflects a fundamental shift in how future connectivity must be designed. The next decades will be shaped by cyber-physical systems, robots, drones, autonomous vehicles, precision agriculture tools, and smart manufacturing environments, all of which have very different connectivity requirements.

The future connectivity ecosystem will be a heterogeneous ensemble of public and private mobile networks, enterprise Wi-Fi, neutral-host systems, community networks, low-altitude aviation platforms and satellite links. Connectivity layers should autonomously adapt to changing demand, failures, mobility, energy constraints and security conditions. This shift enables the network to heal itself across domains and to support new classes of applications that depend on consistent, trusted and context-aware connectivity.

To support these emerging systems, four layers of connectivity must interoperate: subsea networks, terrestrial indoor and outdoor networks, low-altitude aerial networks, such as drones or HAPS, and multi-orbit satellite systems across LEO, MEO and GEO. Each contributes different strengths, and the future depends on coordinating them for resilience, security, spectrum management and seamless operation.

This demand for coordination reaches all sides of the telecommunications market: operators, vendors, neutral host providers, satellite companies, optical communications specialists, regulators and policymakers, as well as vertical industries such as healthcare, transport and agriculture. Without this cross-cutting collaboration, innovation will not achieve commercial potential and scale in the real world.

Furthermore, the network of networks should be designed to operate as a secure, AI-native system that self-configures, self-optimises and self-heals across global, multi-layer infrastructure, integrating communications and sensing to deliver resilient, energy-efficient connectivity for future applications.

In summary, a network of networks is a heterogeneous, multilayered approach to connectivity that will define how societies communicate, automate and innovate in the coming decade.

What is a “network of networks”?

- A network of networks is a hybrid connectivity architecture that integrates multi-orbit (LEO, MEO, GEO), multi-domain (subsea, terrestrial, aerial, space), and multi-stakeholder (government, allied, commercial) communications systems.
- It enables seamless coordination across heterogeneous connectivity layers, including subsea networks, terrestrial indoor and outdoor services, low-altitude platforms (drones/HAPS), and satellite/NTN systems.
- It is defined not by a single technology, but by interoperability across all available forms of connectivity, enabling self-configuration, continuous optimisation and autonomous recovery in response to context, environment and mission needs.

Why do we need it?

- It is built to support the next generation of cyber-physical systems, including robots, drones, autonomous vehicles, and sensor networks, which depend on ubiquitous, secure, and resilient data flows across all domains.
- With around 80% of terrestrial connectivity usage occurring indoors, transition between outdoor and indoor networks must deliver seamless, consistent, high-quality performance to ensure reliable access to the wider ecosystem and uptake of new applications across mark.
- Rural and remote parts of the UK remain underserved, with considerable part of the population lacking adequate capacity, constraining economic potential, public service delivery, and digital inclusion.
- Sustained economic growth in enterprise environments, industrial facilities, ports, agricultural sectors and manufacturing sites increasingly relies on the availability and reliability of robust connectivity.
- National resilience depends on a diversified and sovereign technology base, leveraging UK strengths in areas such as photonics, optical wireless, and advanced communications research.

Recommendations

Interoperability & seamlessness

Seamlessness is quickly moving from aspiration to reality, as growing work on enhancing connectivity along rail corridors and refining transitions between networks sets the foundation for a unified, cross-domain experience.

Action: Establish cross-sector vertical task forces mapping real-world needs to R&D potential.

Spectrum coordination

As terrestrial, NTN, and low-altitude platforms increasingly operate in overlapping bands, new multi-layer coordination frameworks are essential to manage interference and enable reliable, efficient spectrum sharing across all services.

Action: Structure a long-term spectrum strategy to support multi-layered architectures.

Indoor performance

Indoor environments present a major opportunity for connectivity improvement, with new generations of services well positioned to evolve into a highly reliable, mission-critical platforms that complements and enhances current capabilities.

Action: Create national indoor connectivity and security standards for critical environments.

Technical limits & scaling research

Ultra-reliable low-latency communications (URLLC) remain difficult to achieve outside laboratory conditions, and many of the innovations that could enable it, such as optical wireless, neuromorphic computing, and reversible computing, are still challenging to scale from research environments into real-world deployment.

Action: Facilitate testing to develop UK strategic strengths in wireless technologies.

Data governance, security, and AI risks

A secure network of networks depends on well-defined data rights, transparent AI training processes, and robust mechanisms for observability, rollback, and safe automated decision-making.

Action: Reinforce a national framework for AI-driven network management.

From research to market

Patent pooling and joint innovation frameworks between academia and industry, pre-competitive collaboration, and structured routes for SMEs and startups to access national-scale testbeds and infrastructure are mechanisms that the UK should develop with greater urgency.

Action: Adopt an institutional design that translates research into deployable technology.

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The building blocks of the network of networks[1]

Advancing connectivity through AI-driven growth

Edge computing and network orchestration

AI native and AIaaS for network and applications

Spectrum monitoring and management

AI-driven control layers are moving networks from static configuration towards intent-based operation, where dynamic service configuration and inter-network orchestration happen autonomously in response to defined outcomes

Ensuring resilience with frontier technologies

Terrestrial and non-terrestrial integration

Secure and resilient communications

New hardware integration and testing

Quantum communications and networks

Several enabling technologies cut across these layers and represent areas where the translation from academic research to commercial deployment is both urgent and currently underdeveloped. With this in mind, growth and security become interdependent objectives, avoiding over reliance in foreign suppliers, at the same rate it prevents fragmentation

Defining a sustainable commercial strategy

Rural connectivity and digital inclusion

Smart cities and urban IoT

Infrastructure evolution and sensing

Industrial IoT

Immersive media and holographic communications

Energy management and sustainability

Wearables and health

Digital skills and SME enablement

Digital inclusion, rural connectivity, and accessibility are requirements that policymakers and industry must hold together from the outset. In that context, energy efficiency must be treated not only as an application outcome, but as a network-level optimisation objective. As compute, communications and sensing converge, AI-driven orchestration will play a critical role in minimising energy consumption while maintaining resilience and performance across all layers.

[1] List of technologies and applications was retrieved from JOINER's presentation at techUK's Future Telecoms Conference 2026, on 10 February 2026.

Conclusion

The UK stands at an inflection point in telecommunications. The convergence of new wireless generations, AI-driven networks, and a diversified infrastructure creates both extraordinary opportunity and complex risk. Realising the growth and security potential of this moment requires collaboration across policymakers, academia, testing facilities, industry, and the communities that ultimately depend on connectivity.

Delivering a true network of networks will require close collaboration across the national research landscape. Universities, the Federated Connectivity Hubs, standards bodies, and the organisations responsible for patent-pool governance all play a foundational role. They form the engine that drives innovation, develops sovereign capabilities, and helps translate the UK's world-leading research output into deployable technologies. These institutions also provide the neutral scientific and technical ground needed to test, validate and scale new concepts such as AI-driven orchestration, optical wireless, and neuromorphic computing.

Alongside the research ecosystem, a broad set of industry stakeholders must be engaged. Mobile network operators, satellite providers, neutral hosts, Wi-Fi and advanced in optical wireless systems, each contribute critical layers of connectivity. Cloud and edge-infrastructure providers will be equally essential, as compute power becomes deeply intertwined with communications.

Semiconductor and photonics companies add another key dimension, enabling the high-performance processing and interconnects that future autonomous systems and distributed networks will rely on. None of these actors can achieve future connectivity alone, as each layer of the ecosystem fills a different technical and commercial niche.

Also important are the vertical industries that depend on reliable connectivity to operate and innovate. Transport networks, particularly rail and advances in drone deployment, require far better coverage and continuity. Manufacturing and industrial automation need deterministic, low-latency networking to support robotics and cyber-physical systems.

Precision agriculture, very hard to reach areas and industries in remote and offshore areas depend on NTN, drones and extended-range terrestrial networks to unlock productivity. Healthcare and emergency services will rely more on resilience, security and mission-critical performance. Even indoor-dominated sectors such as education, enterprise environments and hospitality will require consistent, high-quality indoor coverage to support digital services, automation and emerging applications like AR/VR. These sectors are not just end users, they are co-designers of future requirements and must be accounted for in shaping what good connectivity looks like.

Regulation will then shape how these technologies coexist, whether through spectrum-sharing arrangements, AI-driven network management, or edge devices designed to prioritise best connectivity input. Without regulatory leadership and the right incentives, the network of networks risks emerging as a fragmented patchwork rather than a coherent, interoperable system.

Building on this, government and regulators have a central role in convening, aligning and enabling the entire multi-layer ecosystem. They will need to coordinate policy frameworks, spectrum strategies, security and resilience requirements, directing targeted investment of funds and skills from the wider ecosystem.