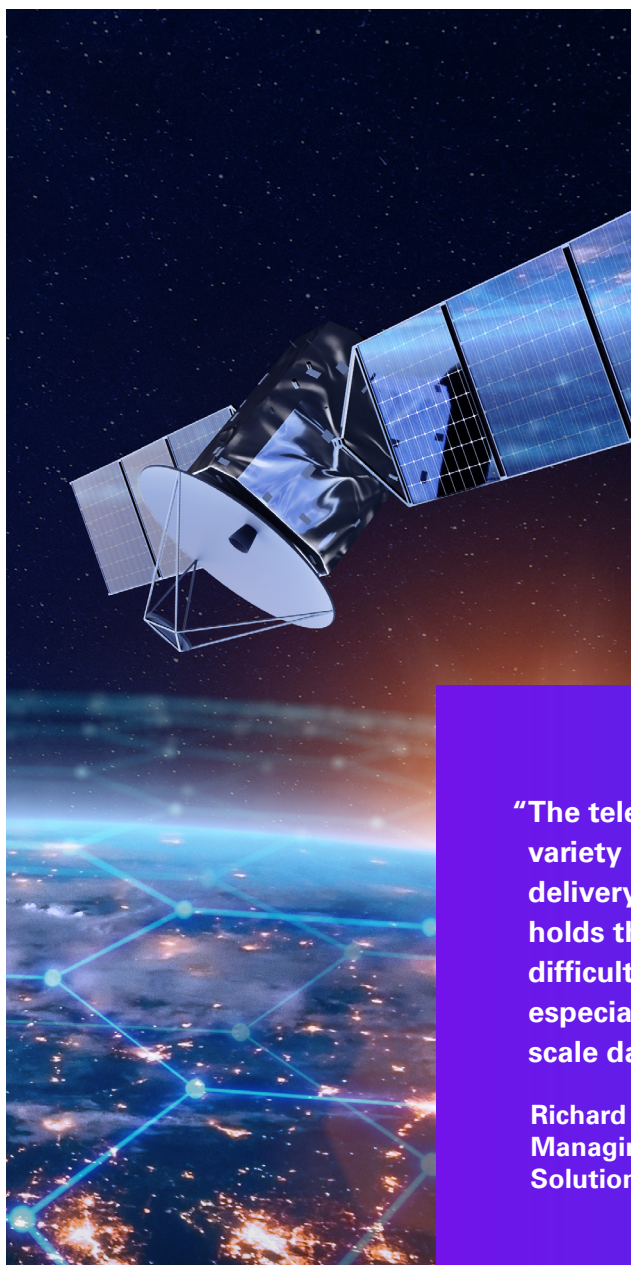
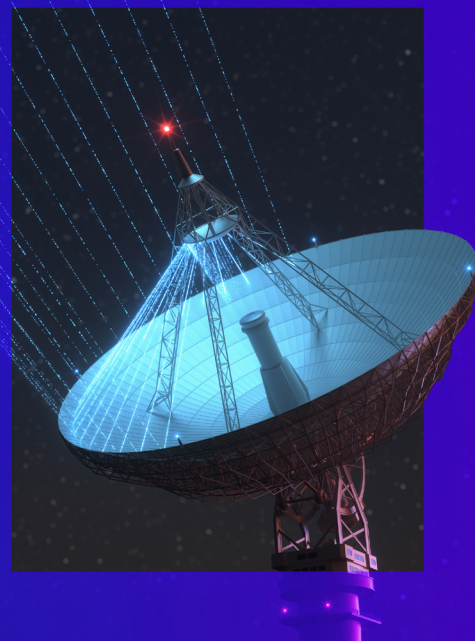




Quantum sensing in action

Elevating positioning, timing, and
communication networks

Dr. Aaron Kemp and Brian Miske



Quantum sensing for commercial applications

Imagine a world where technology not only meets our expectations but exceeds them, where the limits of what we thought possible are shattered by the profound capabilities of quantum sensing. Welcome to “Quantum Sensing for Commercial Applications,” an article that will take you on an inspiring journey through the transformative potential of this groundbreaking technology in the telecommunications sector.

We will explore specific use cases that illuminate how quantum sensors can enhance our understanding and interaction with the world around us. We will

“The telecom industry can leverage quantum computing in a variety of ways to enhance its operations, improve service delivery, and unlock new capabilities. Quantum computing holds the potential to solve problems that are currently difficult or impossible for classical computers to address, especially in areas such as optimization, security, and large-scale data processing.”

**Richard Entrup,
Managing Director, Enterprise Innovation, Head of Emerging
Solutions, KPMG LLP**

also confront the challenges that accompany these innovations, examining how businesses can navigate the complexities of implementation while considering the broader implications for society.

As we embark on this exploration, our goal is to provide you with insights that are not just informative but also actionable. Quantum sensing is not merely a technological advancement—it is a catalyst for innovation and growth. Together, let's unlock new opportunities and reimagine what's possible in the commercial landscape.

Quantum sensing is set to revolutionize the telecommunications industry by leveraging quantum mechanics to provide unprecedented accuracy in position, navigation, and timing (PNT) systems. This technology enhances data synchronization across networks, which is crucial for maintaining efficient operations, especially in challenging environments where traditional systems falter. By overcoming GPS limitations and improving communication security through quantum key distribution, quantum sensing opens new financial opportunities and supports advanced applications such as autonomous vehicles. As these sensors become more scalable, they promise transformative advancements, positioning early adopters for significant competitive advantages.

Defining quantum sensing

Quantum sensing leverages the principles of quantum mechanics, such as entanglement and superposition, to achieve unprecedented precision in measuring physical quantities. This technology holds transformative potential across various sectors, particularly in telecommunications, by enhancing the accuracy and reliability of PNT systems. Quantum sensors can operate effectively even when traditional systems such as GPS are unavailable or unreliable due to interference. This capability opens new financial opportunities by enabling more resilient communication networks, improving synchronization for financial transactions, and supporting advanced applications such as autonomous vehicles and smart infrastructure management. As these sensors become more affordable and scalable, they promise to drive significant advancements in both commercial and strategic areas.



Quantum key distribution, enabled by quantum sensing, offers a new level of security for telecommunications, protecting sensitive data with theoretically unbreakable encryption.”

**Dr. Aaron Kemp,
Director, Enterprise Innovation, US Quantum
Leader, Emerging Solutions, KPMG LLP**



Early adopters of quantum sensing in telecommunications will gain a critical edge, offering innovative services and achieving superior operational efficiency.”

Dr. Aaron Kemp ,
Director, Enterprise Innovation, US Quantum Leader,
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Revolutionizing PNT systems

Quantum sensors are poised to revolutionize PNT systems within the telecommunications and satellite industries. These sensors leverage the principles of quantum mechanics to provide unprecedented levels of accuracy and reliability. In telecommunications, precise timing is crucial for data synchronization across networks. Quantum sensors enhance this precision by offering more accurate measurements of time and space, which are essential for maintaining the integrity and efficiency of network operations. This capability is particularly beneficial in environments where traditional systems face challenges, such as urban canyons or areas with signal interference. By integrating quantum sensors, telecommunications companies can achieve superior navigation and timing services, enhancing overall network performance.

Overcoming GPS limitations

Traditional GPS systems, while widely used, have inherent limitations such as signal degradation in densely built environments or under heavy foliage. Quantum sensing addresses these shortcomings by providing more robust and accurate positioning data. Quantum sensors can operate effectively in environments where GPS signals are weak or obstructed, providing continuous and reliable service. This advancement is critical for applications that require high precision, such as autonomous vehicles or drones operating in complex terrains. By overcoming these limitations, quantum sensing

not only improves navigation accuracy but also expands the potential applications of PNT systems beyond current capabilities.

Quantum communication advances

Quantum sensing also plays a pivotal role in enhancing communication security and efficiency. One of the most promising applications is quantum key distribution (QKD), which uses quantum mechanics to create encryption keys that are theoretically unbreakable. This technology provides secure data transmission across networks, protecting sensitive information from cyber threats. Additionally, quantum sensing can improve the efficiency of data transfer by optimizing signal processing techniques. This dual benefit of enhanced security and efficiency makes quantum sensing a valuable asset in the telecommunications industry, where data protection and rapid communication are paramount.



Precision timing in telecom

The introduction of quantum clocks into telecommunications networks marks a significant advancement in precision timing. Quantum clocks offer unparalleled accuracy, which is essential for synchronizing complex network operations. In telecommunications, precise timing reduces latency and ensures seamless data transfer across different nodes in the network. This capability is particularly important for high-frequency trading platforms, global positioning systems, and other applications where even microsecond discrepancies can have significant impacts. By integrating quantum clocks, telecom companies can enhance their service quality and operational efficiency, providing a competitive edge in a fast-paced digital landscape.

Opportunities and challenges in implementation

Despite the promising benefits of quantum sensing, integrating these technologies into existing telecom infrastructure presents several challenges. The high cost of quantum equipment and the complexity of these technologies can be significant barriers to adoption. Additionally, there is a need for specialized knowledge and expertise to effectively implement and maintain quantum systems within traditional networks. Overcoming these challenges requires strategic investments in research and development, as well as collaboration between industry stakeholders to develop standards and best practices for integration.

Quantum sensing offers a range of applications within the telecommunications industry. One notable use case is in signal processing, where quantum sensors can enhance the clarity and quality of transmitted signals. Additionally, they can be used to develop advanced navigation systems that provide real-time positioning data with high accuracy. These applications not only improve existing services but also open up new opportunities for innovation in telecommunications.



By leveraging quantum sensing technologies, the telecom industry can unlock new financial opportunities through more resilient and secure communication infrastructures.”

Dr. Aaron Kemp,
Director, Enterprise Innovation, US Quantum
Leader, Emerging Solutions, KPMG LLP

“Quantum sensing is set to revolutionize telecommunications by providing a new level of security and efficiency. As we move toward a more connected world, the ability to create virtually unbreakable networks and process data with unmatched speed will be crucial. Through our relationships at the Chicago Quantum Exchange, we are helping clients stay at the forefront of these developments.”

Jeff King
Chicago Managing Partner, KPMG LLP
jbking@kpmg.com



Quantum sensing stands as a beacon of innovation, poised to revolutionize telecommunications by offering unmatched accuracy, resilience, and security, thus unlocking new financial opportunities and transforming commercial landscapes.”

**Brian Miske ,
US Ignition Leader, Americas
Space Leader, KPMG LLP**

Future of quantum sensing

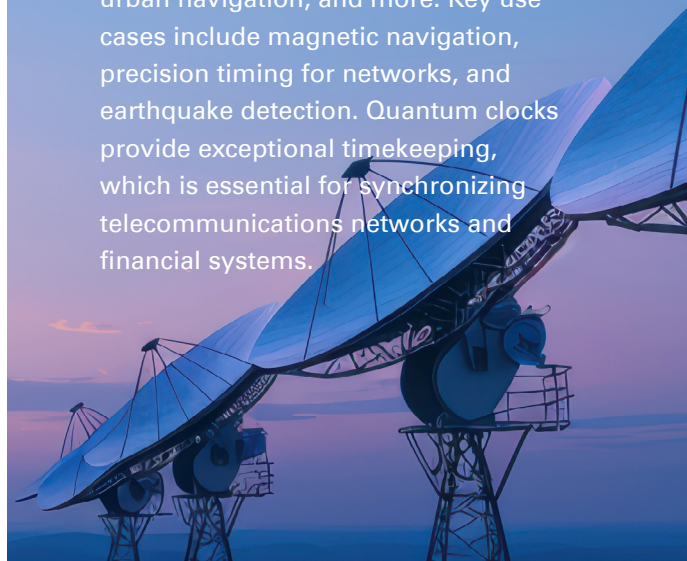
Looking ahead, the future of quantum sensing in telecommunications holds immense potential for transformative developments. As technology matures, we can expect more widespread adoption of quantum technologies across various sectors within telecommunications. This could lead to ultra-secure communication networks that leverage quantum encryption methods and more efficient data processing capabilities that enhance network performance.

Industry implications

The integration of quantum sensing technologies will likely reshape business strategies within the telecommunications sector. Companies adopting these technologies early may gain significant competitive advantages through enhanced security measures and improved operational efficiencies. Furthermore, the ability to offer new services enabled by quantum technologies could drive revenue growth and market expansion.

Quantum sensing represents a frontier of innovation for the telecommunications and satellite industries. By addressing current limitations and opening new avenues for technological advancement, it promises to redefine how we connect and communicate on a global scale.

Arlington, Virginia, October 28, 2024 – A recent report by the Quantum Economic Development Consortium highlights significant financial opportunities in telecommunications through the use of quantum sensors. These sensors enhance the precision and reliability of PNT devices, critical for industries such as defense, transportation, and energy. Quantum sensors offer unparalleled accuracy compared to traditional methods, providing functionality even when GPS is compromised by poor signals or interference. This advancement is crucial for applications such as underground operations, urban navigation, and more. Key use cases include magnetic navigation, precision timing for networks, and earthquake detection. Quantum clocks provide exceptional timekeeping, which is essential for synchronizing telecommunications networks and financial systems.



According to the latest *KPMG Futures Report*, quantum computing is positioned as a horizon disruption.* With postquantum encryption standards set to emerge this year, quantum encryption is expected to be the most immediate priority in this space. While general-purpose quantum computers may still be years away, experimenting with quantum use cases today offers companies a strategic advantage in preparing for the opportunities this technology will unlock.

At **KPMG Enterprise Innovation**, we have been closely tracking the quantum computing frontier. Through strategic partnerships with organizations such as the *Chicago Quantum Exchange* and *IBM*, we are exploring how quantum can accelerate real-world solutions.

**Horizon disruption is change that is poised to happen for a time, and then finally does.*



Quantum computing could allow telecom companies to analyze massive data sets with greater efficiency, uncovering insights that would otherwise take too long or be computationally infeasible. This could help with improving customer insights, including network usage patterns, satisfaction metrics, and behavior prediction and also enhance resource allocation by identifying inefficiencies in network usage or infrastructure."

Richard Entrup,
Managing Director, Enterprise Innovation, Head of
Emerging Solutions, KPMG LLP

Experience and learn more — KPMG Ignition Discovery Session

Unlock the transformative potential of quantum sensing for your business. Join us at **KPMG Ignition** for a Discovery Session and elevate your team's knowledge and opportunities in this groundbreaking field. Together, let's turn innovation into reality and lead the charge in commercial applications.

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