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# Open RAN Market Opportunity and Risks

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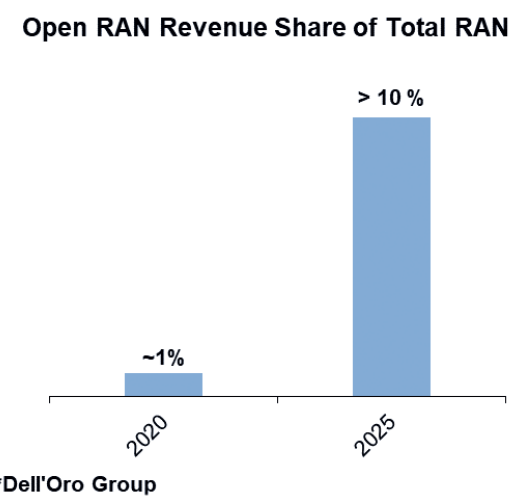
# Executive Summary

The entire mobile infrastructure ecosystem has delivered beyond expectations, managing diverging supply and demand trends, with mobile data traffic growing at a 70% CAGR and RAN and wireless carrier revenues advancing at a 1% CAGR, respectively, since the first 3G iPhone was introduced in 2008.

While no one is questioning whether the current model is working, the industry is exploring the possibility as to whether anything can be done to improve the existing model and accelerate innovation, as this would ultimately provide service providers and enterprise with the best foundation to proliferate connectivity securely across society and support another 20x to 100x of data traffic growth over the next decade.




As the telecom industry as a whole is moving away from hardware-driven models toward more virtualization and software, Open RAN and virtualized RAN (vRAN) are increasingly viewed as architectures that could potentially help address some of the underlying supply-and-demand-related challenges that characterize this market.

The Open RAN movement has come a long way in just a few years, surprising even the most ardent skeptics. The shift from proprietary RAN toward Open RAN became significant in 2020 and the momentum with both commercial deployments and the broader movement continued to improve during the first half of 2021, bolstering the idea that Open RAN is here to stay.

With Open RAN now projected to account for more than 10% of the overall RAN market by 2025, we also need to keep in mind that we are still in the early days of the broader Open RAN transition, especially with regard to brownfield networks.

Risks surrounding the growth projections remain significant and broadly balanced. The improved momentum combined with positive performance and TCO Open RAN developments could foster stronger market adoption than had originally been expected. Similarly, government funding focused on improving RU/DU/CU (silicon and software) technologies, accelerating interoperability testing, and incentivizing operators that embrace the Open RAN architecture could result in a more favorable outcome.

At the same time, technology readiness on the part of new RAN suppliers, weaker-than-expected performance and TCO with Open RAN in high-traffic areas, cost/energy challenges with vRAN, asynchronous progress with the radio and baseband ecosystem, and excessive fragmentation could together act as a drag on the development of the Open RAN market.

Understanding the upside and downside risks will be important for suppliers, operators, investors, and governments seeking to capitalize on this opportunity.

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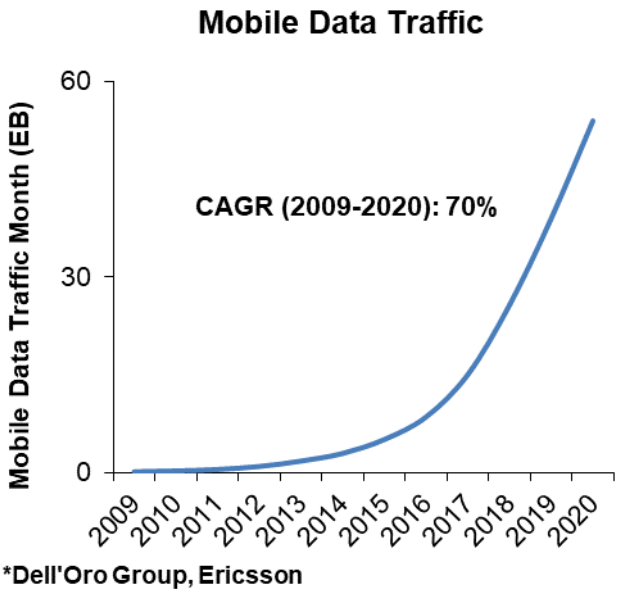
## INTRODUCTION

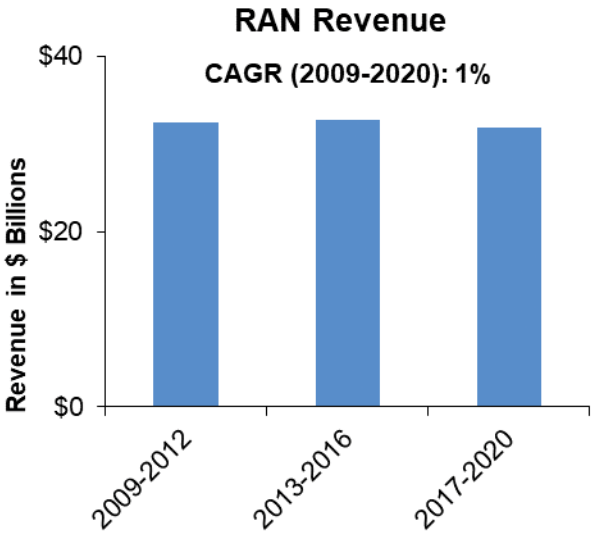
In recent decades, mobile communications have completely transformed the way that humans and machines communicate and interact with one another. New technology generations introduced on average every ten years have consistently and fundamentally improved the overall user experience, paving the way for innovation beyond anyone's wildest imagination.

The mobile communications networks have transformed profoundly from the initial voice-centric models to today's data-driven environment, with 2G to 5G mobile data traffic increasing nearly 1000-fold since Apple introduced its first 3G smartphone in 2008.

Meanwhile, the innovation on the supply side to manage the 70% compounded annual growth rate (CAGR) in mobile data traffic has not translated into any significant revenue upside for the suppliers. The Dell'Oro Group estimates that the worldwide Radio Access Network (RAN) market—an important subset of the overall mobile infrastructure market —increased at a 1% CAGR in nominal US Dollar (USD) terms between 2009 and 2020.

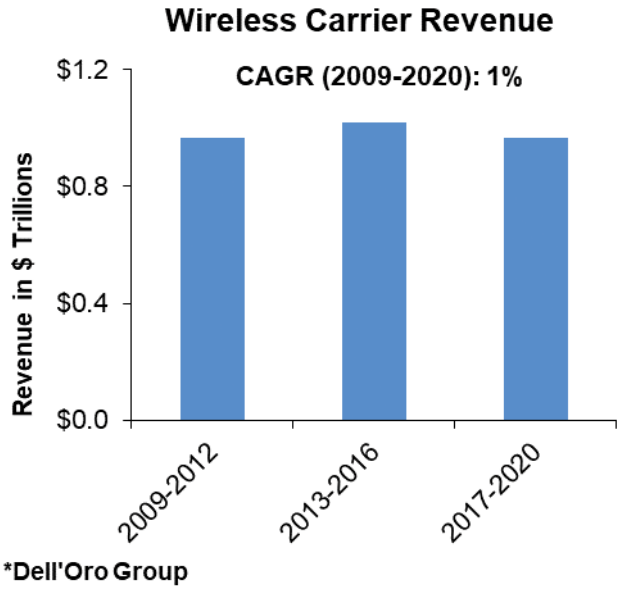



Operators have also struggled to extract more revenue from their customers. Per the Dell'Oro Group Capex Report, worldwide wireless carrier revenues increased at a CAGR of 1% between 2009 and 2020, reflecting slowing subscription growth and lack of revenue upside from new sources.




The strong relationship between wireless carrier revenue and RAN revenue growth reflects the limited wiggle room operators have to expand capital intensity (capex/revenue), as limited operator revenue growth will remain one of the primary inhibitors of further telco capex acceleration.

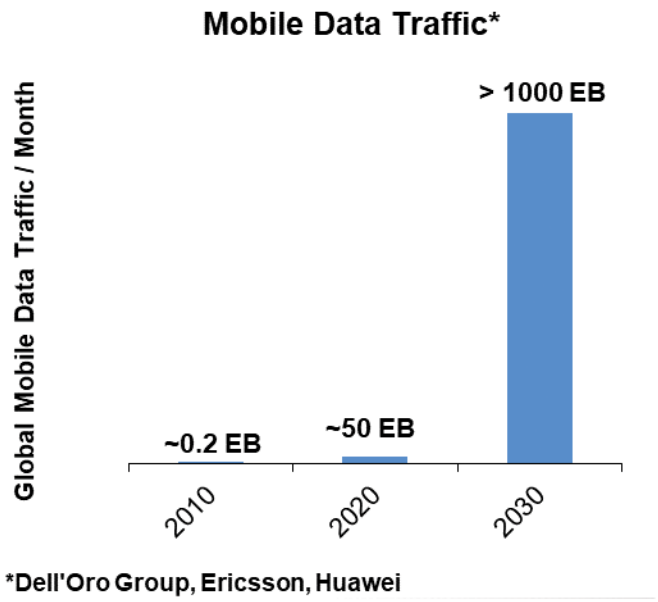
With around 5.3 B unique mobile subscribers globally consuming nearly 10 GB of mobile data per month per person (GSA, Ericsson), no one is questioning whether the current model is working.



But we are also in the very early phases of this digital journey. Giving everyone a computer with mobile broadband access in the palm of their hand is just the beginning. In the next phase, connectivity will proliferate across society and deliver innovation to an extent that we cannot yet imagine.

Can anything be done to improve the existing model and accelerate innovation, ultimately providing operators and enterprises with the best foundation to proliferate connectivity securely across society, while supporting another 20– 100x of data traffic growth over the next decade?

As the telecom industry as a whole is moving away from hardware-driven models toward more virtualization and software, Open RAN and virtualized RAN (vRAN) are increasingly viewed as architectures that could potentially help address some of the underlying supply-and-demand-related challenges that characterize this market.



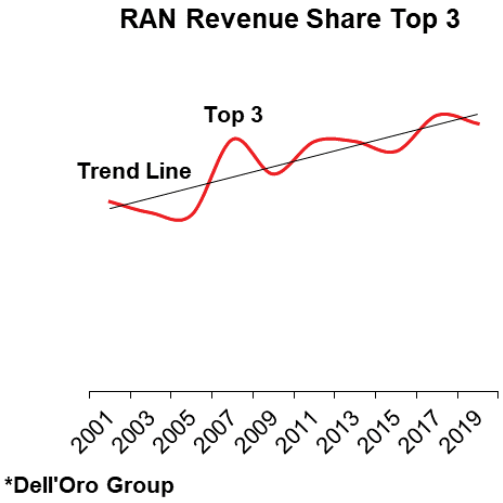

While Open RAN is accelerating at a faster pace than initially expected, Open vRAN's progress is behind schedule. In this paper, we explore the benefits with Open vRAN, the potential market upside, and the risks.

## WHY USE OPEN RAN AND vRAN?

Initially the value proposition of vRAN was heavily weighted toward the TCO benefits of using more general-purpose processors (GPPs). But this vision is evolving, as operators and vendors are realizing that the performance-per-watt per-dollar gap between hybrid solutions relying on GPPs/accelerator cards and ASICs is perhaps not converging as much as had originally been expected, resulting in an increased emphasis on other benefits, including:

- scaling efficiencies (vRAN)
- flexible network architecture (vRAN)
- conduciveness to automation and orchestration (vRAN)
- hardware consolidation between RAN and Core (vRAN)
- simplification of swaps (Open RAN)
- supply chain visibility improvements (Open RAN)
- acceleration of innovation (vRAN and Open RAN)
- faster time-to-market (vRAN and Open RAN)

And the importance of these benefits will vary. The regulator in one country might be attracted to the potential cost savings, while some governments might see Open RAN as an opportunity to improve the competitiveness of local suppliers. The incumbent equipment supplier might be more enthusiastic about the Radio Interface (RIC) controller and the benefits with vRAN, while new RAN entrants are likely more optimistic about the reduced barrier to entry.



When it comes to the broader movement behind Open RAN, one of the leading drivers from an operator perspective is the overall RAN market concentration trends and the fact that three suppliers control around 80% of the market globally. And per the Herfindahl Hirschman Index (HHI), the RAN market is highly concentrated in both China and the US.

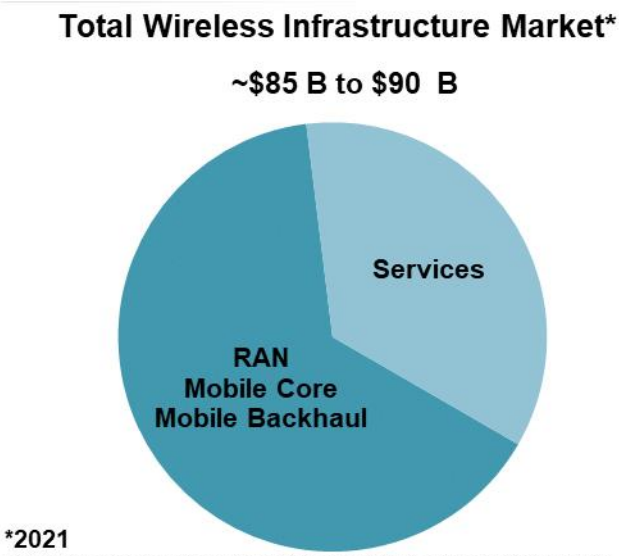
While there are some initial signs that the efforts by the US government to curb the rise of Huawei is starting to show in the numbers outside of China, concerns remain about the competitive dynamics in the mobile infrastructure industry and the implications for prices, innovation, and security.

## MARKET OPPORTUNITY

Operators invest around $160–180 B in capex annually to improve their wireless networks. With around a third of the overall wireless capex allocated for equipment, we estimate the overall wireless equipment plus services opportunity to be in the range of $85–90 B.

The broader Open RAN movement is not confined to the RAN market. TIP—an initiative to accelerate the deployment of Open architectures—has project groups for Open Transport, Open Core, Open WiFi, and Open Cell Site Gateways. This means that the overall opportunity could over time be even greater than what we have outlined here. Initially, however, the focus is more concentrated on the RAN.

As we assess the near-term market opportunity with Open RAN, we need to factor in a wide range of variables—including the timing, radio requirements, RF output power, the regional landscape, geopolitical uncertainty, and expected reliance on the existing network and legacy technologies—to translate the overall market opportunity into a forecast for all the various RAN segments.



## MARKET STATUS AND FORECAST

The Open RAN movement has come a long way in just a few years, surprising even the most diehard skeptics. The shift from proprietary RAN toward Open RAN began in 2020 and the momentum with both commercial deployments and the broader movement continued to improve during the first half of 2021, bolstering the premise that Open RAN is here to stay.

Preliminary estimates suggest that total Open RAN revenues—including O-RAN and OpenRAN compatible macro and small cell radios plus baseband hardware and software—surprised on the upside both in 2020 and during 1H21. Our estimates suggest that total Open RAN revenue increased around 5-fold Y/Y, though it is worth noting that there was a bit of a slowdown sequentially between 1Q21 and 2Q21.

At the same time, not all Open RAN is the same. Open RAN adoption remains mixed from a regional perspective, underpinned by a fairly synchronized transition toward Open RAN in Japan. Although more than 80% of the top 20 wireless operators are investing in or exploring this new architecture—and greenfield operators in Germany, Japan, and the US (1&1, Rakuten, Dish) are embracing Open vRAN—one of the fundamental questions is how long it will take for this concept to resonate more broadly with brownfield (existing network) deployments.

The RAN market, including proprietary RAN and Open RAN, which averaged around $32 B annually between 2009 and 2020, is projected to grow at a 1% CAGR between 2020 and 2025. And Dell'Oro recently adjusted the Open RAN outlook upward to reflect the higher baseline, the improved pipeline, and the progress with regard to Massive MIMO systems. This forecast rests heavily on the assumption that large-scale Open vRAN deployments will be a reality by 2025.

Risks are broadly balanced. On the upside, operator commitments are improving, with multiple operators in the US, Asia Pacific, and Europe planning to use the Open RAN architecture in high-traffic areas by the outer part of the forecast period. The impact of operators successfully integrating Open RAN on a larger scale, not just in rural but also high-traffic areas, could foster stronger acceleration than in the baseline scenario.

The recent uptick in the formation of various groups to promote policies to advance the adoption of Open RAN-based architectures globally could trigger broad-based policies and funding.

More specifically, if governments allocate funding to improve RU/DU/CU (silicon and software) technologies, accelerate interoperability testing, and incentivize operators that embrace the Open RAN architecture, adoption could accelerate at a faster pace than outlined in the baseline scenario.

At the same time, Open RAN is more of an architecture than a technology. And it is not a magic architecture that somehow changes the underlying supply-and-demand challenges that have characterized this market over the past 30 years. RAN is still a scale game that requires a massive amount of investments in new technologies to address all the various RAN segments. At the end of the day, operators need to optimize TCO/energy

consumption/spectral efficiency and work with suppliers that can help them tackle new opportunities while also supporting existing legacy networks.

In terms of comparing the TCO and the overall spectral efficiencies between Open RAN and proprietary RAN, it is important to keep in mind that we are still in the early days. Some component suppliers believe Massive MIMO Open vRAN will result in an improved link budget compared with proprietary RAN. In this case, Open RAN adoption could accelerate at a faster-than-expected pace.

With RAN accounting for less than a fifth of the overall wireless capex and site opex, stronger- than-expected non-RAN related capex and opex gains could accelerate the transition at a faster pace than originally envisioned.

**RAN Segmentation**

**RF Output Power:** Macro, Small Cell
**Frequency:** Sub 6 GHz & mmW
**Radio Interface:** 2G, 3G, 4G, 5G
**Antenna System:** Conventional, Advanced
**Baseband Architecture:** C-RAN, D-RAN
**Baseband Hardware:** V-RAN, Non V-RAN
**Openness:** Open RAN, Proprietary RAN
**Performance:** Mission Critical, Non Mission Critical
**Product Mix:** Hardware, Software
**Region:** North America, Europe, MEA, APAC, CALA
**Location:** Indoor, Outdoor
**Buyer:** Service Provider, Enterprise/Other
**Access:** Public, Private
**User:** Human, Machine (IoT)

*Dell'Oro Group

There are also downside risks to the forecast. Open RAN revenues are tracking ahead of schedule but the technology progress with some of the non-traditional RAN suppliers is also developing at a slower pace than had initially been expected. Meanwhile, the leading RAN vendors are constantly raising the bar, widening the gap between them and the "new" RAN suppliers. If these trends are not reversed, it could be challenging for operators to reduce their reliance on the traditional RAN suppliers.

Massive MIMO Open RAN has not been proven in the field yet to the same extent as basic 4T4R radios. There could be downside risks if the balance between complexity and performance with O-RAN Massive MIMO results in a greater-than-expected performance gap in high-traffic areas. While some component suppliers believe Open RAN Massive MIMO will be more efficient than proprietary RAN, simulations performed by the leading RAN suppliers suggest that proprietary RAN will be more efficient, meaning that if correct, O-RAN would require incremental sites, thereby driving up the TCO.

More broadly, there are downside risks to the forecast if the non-traditional suppliers fail to capture this opportunity to ensure a competitive RAN portfolio for both basic and advanced radios. It will not be enough to simply focus on LTE and 5G NR niche cases.

Virtualization in the telecom world is far from new. We estimate that Network Function Virtualization (NFV) comprised around half of total Mobile Core Network revenues in 2020 (Dell'Oro Group MCN Report). RAN virtualization has not accelerated at the same pace as in the core, partly because signal processing comprises more than 90% of the base transceiver stations. Furthermore, power consumption and BOM-related cost benefits with ASIC-enabled platforms have so far outweighed the reduced introduction costs and improved

flexibility with standard signal processors. There could be risks to the forecast if the cost differential between custom silicon and COTS hardware combined with accelerator cards remains significant.

The Open RAN ecosystem is expanding at a relatively healthy pace, with multiple suppliers announcing basic and advanced O-RAN compatible radios. Meanwhile, activity has been more muted when it comes to the macro vDU, with a handful of suppliers driving this market. This asynchronous progress between the radio and the DU could have a negative impact on the overall Open RAN ecosystem.

While a more diversified supplier landscape is one of the tenets of the Open RAN movement, too much fragmentation and lack of interoperability could have a negative impact on the broader market if ongoing efforts, such as NTT DoCoMo's 5G Open RAN ecosystem (OREC), fail to deliver.

## CONCLUSION

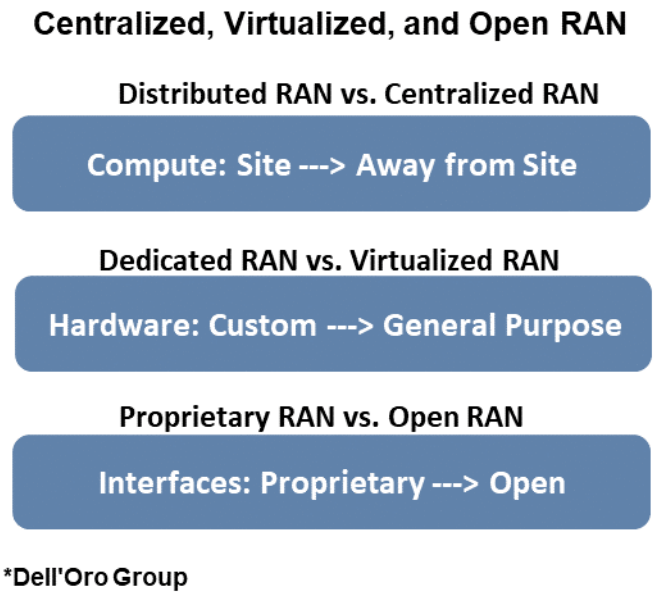
In summary, Open RAN represents a new architecture that aims to lower barriers to entry, reduce vendor lock-in, improve vendor swap costs, and accelerate innovation, ultimately providing operators with more supplier options, so they can continue to seize new opportunities and operate profitably in an environment with constrained topline growth.

However, as we are still in the early days, risks remain in both directions, as the benefits of Open RAN are not guaranteed. Understanding the upside and downside risks will be important for suppliers, operators, investors, and governments seeking to capitalize on this opportunity.

## APPENDIX: OPEN RAN, vRAN, C-RAN, CLOUD-RAN

The telecom industry as a whole is moving away from hardware-driven models, toward more virtualization and software. In the RAN domain, there are now three broad parallel tracks aimed at addressing on-going challenges relating to supply and demand: (1) Centralized-RAN (C-RAN), (2) Virtualized RAN (vRAN), and (3) Open RAN.

The majority of compute processing done for ~8 M macro cells sites globally is currently addressed at the cell site (Distributed RAN). The purpose of C-RAN is to move the processing to a central location (baseband hotel, telco cloud, or public cloud) and ultimately improve efficiency and performance by sharing resources across sites with different utilization levels.




Virtualization, which disaggregates software from hardware, enables software to run on vendor-agnostic commercial off-the-shelf (COTS) hardware.

Virtualization in the RAN is not confined to a specific location and can be deployed both with D-RAN and C-RAN topologies. C-RAN in combination with vRAN is sometimes also referred to as Cloud-RAN.

With complete vRAN, the RAN becomes software-defined and programmable, providing more flexibility for various architectures.

Open RAN is a generic term, reflecting the movement of multiple initiatives (e.g., O-RAN, TIP, and OpenRAN*) to first and foremost disaggregate the RAN from one system with proprietary interfaces into multiple building blocks , including the Radio Unit (RU), Distributed Unit (DU), and Centralized Unit (CU).

In addition to leading the industry toward open and interoperable interfaces, the long-term roadmap maximizes the use of COTS hardware and minimizes the reliance on proprietary hardware.

Although the terms C-RAN, vRAN, Cloud RAN, and Open RAN are sometimes used interchangeably, they are not completely equivalent. Unique drivers and benefits accompany each of these architectures, which more often than not are deployed separately. But the long-term vision is that the overlap will improve over time, so that operators can maximize the combined benefits with these architectures.

**Open RAN –** Generic term reflecting the broader movement to disaggregate the RAN
**OpenRAN –** Disaggregated RAN using open interface specifications
**O-RAN –** Disaggregated RAN using O-RAN Alliance specification
**vRAN –** Disaggregates the software from the hardware
**C-RAN –** Moves processing from the site to central location
**Open vRAN –** vRAN plus Open RAN
**Cloud RAN –** vRAN plus C-RAN

## About Author:

**Stefan Pongratz** joined Dell'Oro Group in 2010 and is responsible for the firm's Mobile RAN market and Telecom Capex research programs. While at the firm, Mr. Pongratz has expanded the RAN research and authored multiple Advanced Research Reports to ensure the program is evolving to address new RAN technologies and opportunities including small cells, 5G, Open RAN, Massive MIMO, mmWave, IoT, private wireless, and CBRS. He built the Telecom Capex coverage detailing revenues and investments of over 50 carriers worldwide.

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