TOP MARK CAPITAL MANAGEMENT LLC

416 13th Street
Suite 200
San Diego, CA 92101
E: contact@topmarkcapital.com
T: +1 (646) 470-3016

TOP MARK CAPITAL PARTNERS LP

QUARTERLY LETTER

For the period ended June 30, 2022

PERFORMANCE

To 6/30/2022, From:	TMCP % Return[1]	S&P % Return[2]
12/31/2021	**-30%**	-20%
12/31/2020	**-2%**	3%
12/31/2019	**58%**	22%
12/31/2018	**180%**	60%
12/31/2017	**220%**	53%
12/31/2016	**403%**	87%
Since Inception[3]	**994%**	222%
Annualized Since Inception	**28%**	15%

For the first half of 2022, limited partnership interests in Top Mark Capital Partners have declined 30% in price. This compares with an index return of -20% for the S&P 500 and -29% for the Nasdaq 100. So there is no confusion, the index is not our

[1] Performance is gross (i.e., net of management fees and costs, but before performance fees) and rounded to the nearest whole percentage. *Past performance does not guarantee future results and current performance may be lower or higher than the performance quoted.*

[2] S&P 500 total return, i.e. dividends reinvested.

[3] December 1, 2012

benchmark. Jason and I spend no time thinking about the index, but it does put our returns in context. However, in order to properly put returns in context, we suggest that you assess performance (of our partnership and others) on a cumulative basis rather than in discrete annual increments. We will, from time to time, find ourselves on the "wrong side" of the indexes, and that's OK because we are investing for the long term. To drive the point home, a dollar invested at the inception of our partnership would now be valued at around $9.94[4] as compared with $2.22 for the S&P 500. For those that like to see the annual returns data, the table below is provided for your review.

Year	TMCP % Return[5]	S&P % Return[6]
2021	**40%**	29%
2020	**62%**	18%
2019	**77%**	31%
2018	**14%**	-4%
2017	**57%**	22%
2016	**131%**	12%
2015	**-6%**	1%
2014	**8%**	14%
2013	**-7%**	32%

[4] Note, this is after management fees and expenses but before performance fees.

[5] Performance is gross (i.e., net of management fees and costs, but before performance fees) and rounded to the nearest whole percentage. *Past performance does not guarantee future results and current performance may be lower or higher than the performance quoted.*

[6] S&P 500 total return, i.e. dividends reinvested.

INVESTMENT OUTLOOK

Meaningful inflation and global conflict combined with a late start to tightening monetary policy and foolish fiscal policy are a recipe for stress, anxiety, and depression. However, you can relax, your managers are in good spirits, and most importantly, awash with investment opportunities.

Current performance notwithstanding, our partnership is in good health. The biggest lesson we learned through this cycle is in regards to selling discipline. We prefer to be the type of investor that 'holds too long' rather than the 'sells too soon'. That being said, with 20/20 hindsight, we ought to have hedged and/or sold more than we did over the past 12 months. That realization has caused us to implement a more robust, IRR-based approach to selling discipline.

For a view into how we are thinking about investments in the current environment, we encourage you to read the appended 'theme document' entitled *Open RAN, 5G, and the future infrastructure of cellular networks*. As described in our 2021 annual letter, we organize our research around 'themes'. Those 'themes' manifest in the form of a 'theme document'. The format and structure of our 'themes documents' are inspired by the Amazon 6-pager, which Jeff Bezos described in his 2017 letter to shareholders[7]...

> *We don't do PowerPoint (or any other slide-oriented) presentations at Amazon. Instead, we write narratively structured six-page memos. We silently read one at the beginning of each meeting in a kind of "study hall." Not surprisingly, the quality of these memos varies widely. Some have the*

[7] Bezos, "Amazon Letter to Shareholders - 2017."

clarity of angels singing. They are brilliant and thoughtful and set up the meeting for high-quality discussion. Sometimes they come in at the other end of the spectrum.

...

Here's what we've figured out. Often, when a memo isn't great, it's not the writer's inability to recognize the high standard, but instead a wrong expectation on scope: they mistakenly believe a high-standards, six-page memo can be written in one or two days or even a few hours, when really it might take a week or more! They're trying to perfect a handstand in just two weeks, and we're not coaching them right. The great memos are written and re-written, shared with colleagues who are asked to improve the work, set aside for a couple of days, and then edited again with a fresh mind. They simply can't be done in a day or two. The key point here is that you can improve results through the simple act of teaching scope – that a great memo probably should take a week or more.

We hope this theme, and others to come alongside future letters, will intrigue you and potentially spurr some conversations on the topic. Similar to Amazon, our theme documents are revised and re-written over time as we come to understand the theme better. We, like you, are here to learn and we welcome your feedback (both confirming and especially disconfirming).

OUTLOOK FOR NEW PARTNERS

T*he average stock goes up and down by ~80% every year*. How can underlying value vary by 80% over a given year? Simply, it doesn't. This creates enormous opportunities for investors like us who are willing to put in the work, understand the underlying business, and wait patiently. The strategy requires owning fewer stocks than the indices, and therefore we expect to underperform the market from time to time (as we have in 3 of the last 9 years, or 33⅓% of the time, see table above[8]). This is not the first time our partnership experienced a major drawdown - though not visible in the discrete return figure on page 2, we experienced a 52% drawdown in Q4 2018. Charlie Munger said it best...

> *If you're going to be in this game for the long pull, which is the way to do it, you better be able to handle a 50% decline without fussing too much about it.*

Admittedly, handling a 50% drawdown is easier said than done. Our reptilian brains are programmed to treat investments as giffen goods (i.e. we want more when prices rise and less when prices fall). The rational brain treats investments as Warren Buffett treats hamburgers...

> *When hamburgers go down in price, we sing "Hallelujah Chorus" in the Buffett household. When hamburgers go up, we weep. For most people, it's the same way with everything in life they will be buying – except stocks.*

[8] Warren Buffet and other investors that follow a similar strategy tend to underperform the major indices 30-40% of the time.

> *When stocks go down and you can get more for your money, people don't like them anymore.*

Jason and I will continue to do what we do: ignore the noise and focus on what we can control - our research and analysis (and the price of hamburgers!). And **price is key**. There are many businesses we wish we could own if not for the price.

Before I leave you, I want to make a key point related to our investment process and the theme document attached to this memo. Investing in themes by simply buying all the companies exposed to those themes can lead to disastrous outcomes. For example, technological innovation often creates ruinous competition. Funds that don't consider price and don't have the luxury of being patient capital will struggle to implement a themes based approach (I'm looking at you ARK Invest). With this in mind, our investments may be unconventional, non-obvious, counter-intuitive, and/or contrarian. Howard Marks, initially wrote about this concept of investment behavior in a memo called *Dare to Be Great*...

> *If your behavior and that of your managers is conventional, you're likely to get conventional results – either good or bad. Only if the behavior is unconventional is your performance likely to be unconventional ...and only if the judgments are superior is your performance likely to be above average.*
>
> *The consensus opinion of market participants is baked into market prices. Thus, if investors lack the insight that is superior to the average of the people who make up the consensus, they should expect average risk-adjusted performance.*

Jason and I do not control the annual performance figures, though it would be nice if we did. Rather, we control our analysis and we aim to maximize our effort in this area

in an attempt to make superior judgments about our investments. Over the long term, we expect this will result in satisfactory investment results.

Thank you for entrusting us with your capital. ***If you are not yet a partner and resonate with our approach, do not hesitate to contact us directly to learn more about the partnership.***

Sincerely,

Michael Nicoletti

Open RAN, 5G, and the future infrastructure of cellular networks

Table of Contents

INTRODUCTION

Open RAN is an open technology standard for radio access networks. A RAN is the backbone of a mobile cellular network, connecting end user devices through base stations to the carrier's core network. The ability for your mobile phone to connect to the internet today requires custom software to run on proprietary hardware modems, base stations, and networking equipment. Open RAN seeks to decouple the software and hardware by creating specifications to which each should be built, and the protocols to communicate between them. The result is interoperability across equipment vendors and a standard to which software can be written in order to plug into those networks. *This should drive down hardware costs and spur innovation in the software layer of mobile networks.*

The O-RAN Alliance is comprised of 30 telco operators and more than 200 technology vendors, having broad industry interest. The introduction of Open RAN has coincided with the ongoing buildout of 5G networks.

STATE OF THE TREND

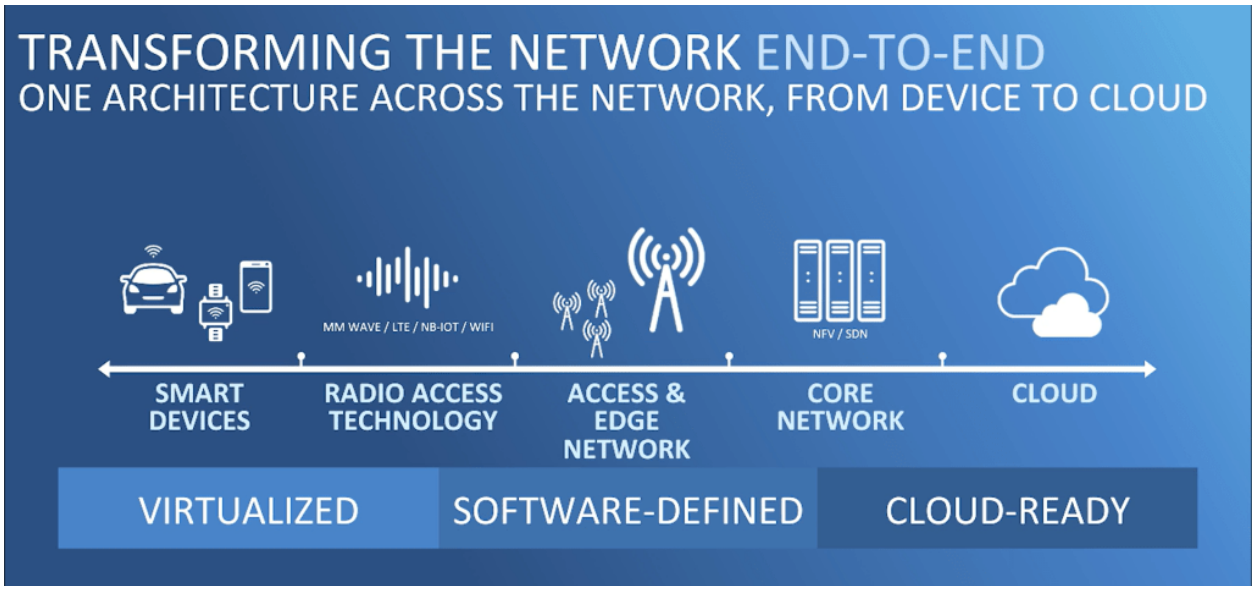
The Case for Cloud RAN

One of the most interesting and impactful goals of the O-RAN Alliance is the call to build wireless networks natively on the cloud. There are numerous advantages to this, most of them well known talking points we've been hearing for years and the reason the cloud migration is so powerful. Some highlights are:

- Reduce costs and shift a lumpy capital expenditure to a predictable operating expenditure. No longer necessary to build and maintain a network of data centers across the nation.
  A Deloitte study estimates that up to 70% of the total cost of ownership of a cellular network is in the RAN. They also estimate that a virtualized Open RAN would achieve a 40 - 50% reduction in capex, and a 30 - 40% reduction in opex[1].
- The cloud provides elasticity of network compute resources. Automatically scale up resources to provide better service during localized high demand events. Similarly, scale down active resources nightly to reduce server costs.
- Shared responsibility of data center security with the cloud provider. Cloud computing systems are widely recognized as more up-to-date and better secured than on-premises data centers. This reduces the chances of a costly data breach and impacts to consumer image. Additional security enhancements are gained from virtualized machines, as software defined networks can quickly shut down in the event of a compromise and restart fresh with minimal impact.
- The ability to provision virtualized server resources in any of the cloud provider's data centers quickly allows for much easier expansion into new regions.

[1] Telecom Engineering Centre of Excellence (TEE), “The Open Future of Radio Access Networks.”

- Requires a much smaller tower footprint. Rather than hosting small buildings to house networking equipment at each tower, most of this functionality has been moved into the cloud datacenter. Now the equipment at each tower can be distilled down into a refrigerator sized cabinet at the base of the tower. This saves equipment costs, installation and maintenance costs, as well as recurring tower leasing fees.
- The benefit most O-RAN Alliance members will cite is the speed to bring new features to market. By utilizing the cloud, new features within the network can be distilled to a software only solution. This removes the need to test and certify new equipment, coordinate production or updates, and mobilize a workforce for rollout. This is a process that one industry insider says takes 18 to 24 months.
- Artificial intelligence tools now become available to analyze and aid in the operation of wireless network infrastructure. This will give the operator of a cloud based RAN a strategic advantage.



If a carrier were to build a new network from scratch, they would undoubtedly utilize cloud computing resources. In addition, the Open RAN standard calls for the use of software to perform time-sensitive tasks previously reserved for specialized hardware such as traffic load balancing and handoff control. However, established carriers are constrained by upgrading existing networks rather than building a fully modernized network. One of the biggest proponents of Cloud RAN is Amazon Web Services, who for obvious reasons is encouraging carriers to partner with them for network buildout. Realizing the inevitability of Cloud RAN, they are aggressively building the capabilities to host 5G networks to capture this large market before the competition.

A huge benefit of cloud hosting a RAN is the ability to virtualize the network as specified by the Open RAN standards. This entails using software services alone to perform actions previously handled by specialized hardware. At this point all of the benefits of cloud hosted software become available to what was previously a network-wide hardware infrastructure. In addition,

these virtualized software services can leverage all of the innovations taking place on the cloud platforms at a rapid pace. Much of this innovation is provided by third-party vendors alongside the cloud platforms. A Cloud RAN solution would no doubt take advantage of the cutting edge monitoring, interservice messaging, and orchestration solutions (to name a few examples) widely used by highly scalable software companies.

5G's Offer

Simply put: faster, denser networks. Network speeds should improve by the traditional order of magnitude between generations. This means download speeds in the 10 gigabit range and connection latency of under 1 millisecond.[2] A larger step-change occurs in the connection density of the network. Where 4G could service 60k simultaneous devices per square kilometer, 5G may handle 1 million devices per square kilometer, a 17x improvement.[3]

The throughput and connection speeds afforded by a 5G network will offer disruptive impacts in many ways, some of which innovators have not dreamt up yet. Some trends that we see on the horizon are:

- Virtual reality and augmented reality applications are in the early stages of commercialization and both have very high bandwidth requirements. Apple is rumored to be releasing a consumer device in late 2022 while the rest of big tech continues to push research in this area. Meta/Facebook in particular is staking its future on the prospects of a VR metaverse, renaming the company itself.
- IoT has perpetually been on the horizon. 5G and Open RAN may offer the tipping point to adoption. 5G networks can handle an exponentially larger number of concurrent connections and provide much reduced connection latency. The network capacity increases from 60k devices per square kilometer to 1 million per square kilometer with 5G. Whereas the connection latency is reduced from 20ms to 1ms. As Amazon pushes into the 5G / Open RAN space, they have launched the AWS Wavelength service. The promise of this service is to offer extremely low latency connections by allowing IoT traffic to reach application servers directly within a 5G RAN network.
- Autonomous vehicles may end up a big user of 5G connectivity, this includes both on-road vehicles and drones. As these technologies continue to be developed, it is likely that they will depend on reliable, low-latency, high-speed network connectivity.
- 5G cellular speeds now match the average home broadband connection speed. Today 54% of US households already access the internet solely through mobile connections. Although our intuition says that this cohort is majority lower income households, the trend is increasing.
  Carriers have recently introduced 5G home wifi routers in select markets. They are in the early stages of testing this product line. We see it likely that carriers strategically use these fixed connections to fill in underutilized portions of their network, but the potential for wider use is there.

[2] “What Is 5G Base Station Architecture?”
[3] “5G – Connection Density — Massive IoT and So Much More.”

With relation to the last point above, while 5G home wifi will capture some portion of the fixed internet market, it is likely to never be the dominant method. Wireless executives believe it is important to conserve the scarcity of spectrum for mobile applications (not just mobile phones, but mobile cars, sensors, etc.) rather than dedicate a significant portion to fixed wireless internet.

A downside risk to 5G networks is in the energy consumption due to the frequency ranges used in the spec. In general, higher speeds are achieved through higher frequencies. The tradeoff is that higher frequencies have higher signal attenuation rates. Due to this, the density of base stations increases from 8 to 10 per square kilometer in 4G networks to 40 to 50 in a 5G network at millimeter wave frequencies. Power consumption within the network increases at an even higher rate. Besides having 5x the number of base stations, each one will use between 2 to 3 times the energy of the previous generation. This can partly be attributed to the higher frequencies used, as more power is required to penetrate obstructions such as buildings / walls in a populated area. Today energy costs of operating a network are roughly 5% of opex, and this is set to rise dramatically. This poses a significant risk to the operating margins of running a 5G network.

There are mitigations to this substantial rise in energy consumption. The low-band 5G spectrum is capable of covering an area roughly equivalent to the footprint of a 4G base station. Deploying a network that covers both low and high bands of 5G will allow the high frequency, high bandwidth portions of the network to be turned off when the demand is low. A RAN is an example of another case where the 80/20 principle still applies; only 20% of base stations in the denser populated areas carry 80% of the network traffic. Additionally, artificial intelligence learning algorithms will be employed to cycle 5G equipment on and off to save energy when not in use. An anecdote from China, being one of the first nations to roll out 5G, is that they power down portions of the 5G network between the hours 21:00 and 09:00 to save on energy consumption.

Why is now the time we may start to see the adoption of cloud computing and/or Open RAN by carriers? The last generation (4G) of cellular networks were deployed in the US in 2010 whereas the planning and buildout occurred years prior. At this time cloud infrastructures were unproven and not capable of hosting the necessary computing. Today's cloud providers have many data centers coast to coast and are building out edge computing capabilities, bringing servers in close proximity to most base stations.

Additionally, the O-RAN Alliance is finally enjoying broad industry interest. As more network providers are adopting the standard, more component makers are building products to suit. These components can more-or-less operate interchangeably, thus the vendors are now in competition and driving down the prices. The previous industry norm was for a network operator to be locked into a single vendor and their proprietary interfaces. This competition is good for the industry and consumers as a whole.

Image 1 – A 5G tower site in Las Vegas

Dish Network's 5G equipment is in the silver refrigerator size cabinet to the left of the tower with most functionality now handled in the cloud. Verizon's 5G equipment is in the much larger brown concrete shed to the right.[4]

Another benefit to virtualization is the ability to elastically scale the components (formerly hardware and now software) to meet the demand. You can think of this at a local level if you've been to a large sporting event. When there is an unusual concentration of devices in a locality, the hardware today is not sufficient to meet the network demand. By virtualizing, additional capacity may be allocated to the network on demand providing a much better customer experience.

In the future, it is inevitable that cellular networks will reside on the cloud. Whether this happens with any 5G buildouts is yet to be seen. The wireless network industry, through the O-RAN Alliance, realizes this along with at least one of the cloud providers who is actively working towards this end state.

Fixed Wireless Access (FWA)

Fixed wireless internet access has a lot of technical challenges and physical limitations that previous RAN generations were unable to surmount, with the question now being "does this

[4] DANO et al., "The Time I Visited a Dish 5G Cell Site."

change with 5G?". Network usage patterns between mobile and home internet present a challenge for the wireless network. Home connections typically use a much greater amount of bandwidth with streaming HD video being a large consumer. That data can be delivered at a much lower cost per byte over a wired home connection versus a wireless network.

T-Mobile has started offering fixed wireless 5G access points in select areas. The addresses where they will provide an access point are localized to specific 5G base stations that they feel have capacity available. It is our belief that they use this offering to monetize the extra space on the network at little marginal cost, rather than launching it as a core product offering.

As part of Amazon's push into 5G infrastructure, they now offer an out of the box solution for a RAN cloud backbone called AWS Private 5G. There are also other providers offering similar solutions in the AWS marketplace[5]. This is enabling regional players to stand up fixed wireless internet services, initially in more rural or suburban areas, at a lower initial cost than laying fiber or cable over long distances to single homes[6]. India's largest telecom operator may well prove out if 5G can provide fixed wireless internet at scale. Jio is planning on bringing FWA to every town in India and expects to connect 100 million households[7]. We will certainly be interested in watching how this network develops.

INDUSTRIES & SECTORS

Operators

We believe greenfield Open RAN operators will have a disruptive cost advantage over existing operators. Operators of existing wireless network infrastructures will find it difficult to cut over to a virtualized Open RAN cleanly. For years to come they will be saddled with operating two distinct radio access networks, thereby weakening potential cost advantages. The Open RAN standard does not account for the support of older 2G and 3G networks. Top Mark believes that the existing carriers will ease into Open RAN by only adopting the interoperability standards on equipment and protocols, and not adopt the full cloud virtualization.

There are several startups building smaller scale RANs available for lease around the world. Only two large operators are taking the proactive approach of building a pure greenfield Open RAN infrastructure, Dish Network (US) and Rakuten Mobile (Japan). Construction of several other test networks is occurring around the world: 1&1 is building a network within Germany, Vodafone is partnering with Parallel Wireless to build test networks in the UK and Turkey, and Telefonica is building a test network in Peru.

There will be cost advantages to running a fully virtualized network (Rakuten is the only sample today with a 40% capex reduction) and it will be interesting how those players position

[5] Hardesty, "Federated Creates a Turnkey Private Wireless Offering Sold through AWS Marketplace."
[6] Hardesty, "Tarana Provides 1 Gig+ Speeds on Its Fixed Wireless Access."
[7] Singh, "Reliance Jio to Spend $25B on 5G Rollout, Debut in October."

themselves in the market. Initial pricing from Dish Network indicates a $30 price point for unlimited talk, text, and data, dramatically undercutting the competition on price.

Picks & Shovels

Mobile Tower REITs

These businesses own the real estate that cell tower or antenna sites sit on. They lease out space for antennas to each of the carriers / RAN operators. As we've shown, the number of base station sites will need to increase with this generation by up to a factor of 5. Some names in this space are American Tower (AMT), Crown Castle International (CCI), and SBA Communications (SBAC).

Communication Equipment Manufacturers

This is another group that stands to benefit from the increase in number of base stations required to create a 5G network. These will be the manufacturers of the antenna equipment, cabling, network switching, etc. A caveat here is the potential for some of the formerly hardware solutions to be virtualized in a cloud RAN infrastructure.

Note: Other connected businesses in this segment crossover into our Semiconductor Advanced Nodes & Advanced Packaging theme is with Onsemi (formerly On Semiconductor) and Marvell Technology. Their ASICs utilize the cutting edge semiconductor technology for 5G applications.

Cloud Providers

Moving entire cellular networks into the cloud is a big win for the cloud providers that capture this business. AWS, Azure, and Google Cloud have all announced plans for supporting 5G core networks. AWS has announced partnership plans with Dish Network, while Azure has partnered with AT&T and announced a partnership with CommScope to build their private wireless network[8]. AWS may be the first to offer "5G as a Service", having recently announced a non-public preview of a Private 5G service to be offered.

Note: Verizon has explicitly stated they will deploy their 5G network in their own private cloud.

Traditional ISPs

This industry historically scores lowest on consumer satisfaction surveys and should garner little brand loyalty. We don't anticipate fixed wireless access (FWA) to supplant the existing wired ISPs, however they may take a percentage of growth away from these companies.

T-Mobile is the first carrier to aggressively go after the home internet market. They have a few offerings currently:

- Home internet for $50/mo, with up to a $500 termination credit for breaking your existing home internet service contract.

[8] "CommScope Collaborates with Microsoft to Advance Industrial Manufactur."

- A family plan with four mobile lines and one home internet connection for $200/mo.
- A traditional “phone / tv / internet” bundle launching on 10 May 2022 with pricing details to come. This plan is a mobile line, 5G home internet, and a YouTube TV subscription under a single plan.

We expect at a minimum, carriers will selectively offer 5G home internet in locations where base stations are underutilized. This allows the wireless carrier to optimize the traffic over each tower without overloading any one base station.

If FWA does prove to be the preferred method of connectivity in rural or lightly populated areas, Amazon and Dish Network stand to benefit. Amazon offers the AWS Private 5G service and Dish has intentions on being the top MVNO provider in the industry. These two, and possibly others, could make for good pick & shovel infrastructure plays for the consumer facing internet providers. The competitiveness of a FWA product from a cost to deliver a unit of data perspective will be a key piece of the puzzle to track. Virtualized networks can be scaled up and down based on demand because significantly more of the costs are variable in nature. Contrast that with your typical wireless and fixed line operator where their costs are ‘incremental fixed’ - meaning, require a large capex investment in order to expand capacity. Therefore, FWA operators on virtualized networks will only deploy where gross margin per bit is greater than the marginal cost per bit. Depending on where this marginal cost per bit lands, virtualized networks may or may not compete with existing traditional FWA and fixed line solutions.

Software Providers

Another group of companies that stand to benefit are software providers with solutions in the distributed computing / network management or monitoring verticals. A national network that requires constant uptime will need robust monitoring solutions, and in an Open RAN environment, these providers will look more like Cloud SaaS solutions than the traditional self-managed software vendor applications.

BIBLIOGRAPHY

CIO. “5G – Connection Density — Massive IoT and So Much More.” Accessed May 2, 2022. https://www.cio.com/article/230940/5g-connection-density-massive-iot-and-so-much-more.html.

CommScope. “CommScope Collaborates with Microsoft to Advance Industrial Manufactur.” Accessed August 1, 2022. https://www.commscope.com/press-releases/2022/commscope-collaborates-with-microsoft-to-advance-industrial-manufacturing-with-private-wireless-network-solution/.

DANO, DanoVision MIKE, Editorial Director, 5G, and Mobile Strategies 2/25/2022. “The Time I Visited a Dish 5G Cell Site.” Light Reading. Accessed April 8, 2022. https://www.lightreading.com/the-edge/the-time-i-visited-dish-5g-cell-site/a/d-id/775576.

Hardesty, Linda. “Federated Creates a Turnkey Private Wireless Offering Sold through AWS Marketplace.” Fierce Wireless, September 27, 2022. https://www.fiercewireless.com/private-wireless/federated-creates-turnkey-private-wireless-offering-sold-through-aws-marketplace.

———. “Tarana Provides 1 Gig+ Speeds on Its Fixed Wireless Access.” Fierce Wireless, September 27, 2022. https://www.fiercewireless.com/tech/tarana-provides-1-gig-speeds-its-fixed-wireless-access.

Singh, Manish. “Reliance Jio to Spend $25B on 5G Rollout, Debut in October.” *TechCrunch* (blog), August 29, 2022. https://techcrunch.com/2022/08/29/reliance-jio-to-debut-5g-in-october-reach-all-by-2023-end/.

Telecom Engineering Centre of Excellence (TEE). “The Open Future of Radio Access Networks.” Deloitte, 2022.

“What Is 5G Base Station Architecture? | Global Manufacturer & Distributor of Component Solutions — Essentra Components.” Accessed May 2, 2022. https://www.essentracomponents.com/en-us/news/guides/what-is-5g-base-station-architecture.