

TOP 3 PREDICTIONS FOR TELECOM IN 2022

TELECOM INDUSTRY FACES NEW CHALLENGES IN THE POST-PANDEMIC ERA

TECHNOLOGY BUSINESS RESEARCH'S *2022 PREDICTIONS* IS A SPECIAL SERIES EXAMINING MARKET TRENDS AND BUSINESS CHANGES IN KEY MARKETS.

COVERED SEGMENTS INCLUDE:

- CLOUD
- ▶ **TELECOM**
- DEVICES
- DATA CENTER
- SERVICES & DIGITAL

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2022 WILL BE A TRANSITION YEAR FOR THE TELECOM INDUSTRY

After emerging from the COVID-19 pandemic relatively unscathed, the telecom industry is entering a new phase and faces a new set of challenges. These challenges include navigating a supply chain left in shambles due to the impact of the pandemic and, representing a separate concern, the inexorable rise and encroachment of hyperscalers in the telecom domain, which threatens to completely disrupt the status quo in the industry.

Incumbent communication service providers (CSPs) and their vendors are navigating these issues, but there is an increased urgency to digitally transform and align with structural changes occurring in the industry, such as the pressure to work with hyperscalers on network transformation and business model co-creation in the cloud.

2022 is poised to be a unique transition year for the telecom industry. While unprecedented government stimulus that originated in the wake of the COVID-19 outbreak continues to be pumped into the global economy, lifting all players in some way across the market landscape, CSPs and their vendors must transition to the fundamentally new network architecture, which is software-based, fully virtualized and cloud-centric. CSPs must also determine where they will play in the new value chains that are being created in the digital economy, most notably in hyperscalers' marketplaces, and in conjunction with new players that are entering the scene in domains such as private networks and satellites.

Meanwhile, supply chain challenges are expected to persist through 2022, with continuing semiconductor and component shortages as well as ongoing skilled labor deficiencies and shipping delays, all of which threaten to delay market development and hinder vendors' ability to recognize revenue and pursue new growth opportunities. Inflation (potentially stagflation) and rising interest rates also pose risks, portending margin pressure and debt refinancing challenges.

Taken together, these circumstances indicate 2022 will be an unusual year for the telecom industry. While government-induced stimulus will provide various benefits to players across the industry, giving off a sense that the industry is functioning normally and is healthy, an acceleration in competitive and technological changes poses a risk to the long-term performance of incumbents. Amid the uncertainty 2022 will bring, one thing is certain: Major changes are coming to the telecom industry in the post-pandemic world, and fast.



PREDICTIONS

SUPPLY-DEMAND IMBALANCE DELAYS PACE OF 5G MARKET DEVELOPMENT



Trend: Supply-side challenges threaten to delay 5G market development.



Driver: Demand environment for 5G infrastructure will remain fertile and robust, thanks to unprecedented government stimulus and increasing competition among telcos.



Result: Demand for 5G infrastructure will remain ahead of supply through at least 2022.

Though most network vendors successfully navigated supply chain headwinds in 2021 and were able to near fully meet demand, 2022 will be a more challenging year as inventories are now thinner and the shortage of chips, components, and labor are catching up to the telecom industry. Chronic shipping delays as well as ongoing waves of lockdowns and energy shortages in key manufacturing hubs and port cities in China are also of significant concern to the supply side. Even if products can be manufactured, there are chronic problems with exporting and importing those products and bringing them to customer sites. This, too, will push out build timelines, delaying market development.

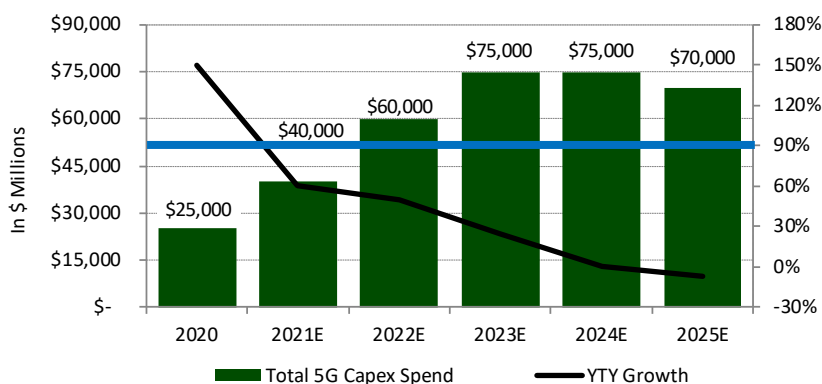
The impact of supply-side challenges began to surface in network vendors' financial results in 3Q21, and evidence suggests the problems are worsening in 4Q21. Due to this gradually weakening picture, and the fact that there is no quick, easy way to normalize the supply chain, TBR now expects the supply environment to become a significant headwind in 2022 and potentially slow the pace of 5G market development.

There are two primary impacts from the supply chain breakdown: the timing of revenue recognition and cash flow for vendors is altered, and the ability of CSPs to meet their build-out timelines and participate in market development is hindered.

TBR sees no easy fix to resolve the supply chain issues; rather, it will be a series of small adjustments over time that will enable the supply side to fully recover and meet demand (e.g., it takes a few years to build new chip factories). This is compounded by a demand environment that is above the historical trendline, which is driven by unprecedented government market support and greater pressure on CSPs to invest in their networks to remain competitive.



CSP 5G CAPEX SPEND






Note: Blue line represents the global, historical annual average capex spend on RAN and core hardware, software and related services for the CSP market.

Note: CSP 5G capex spend includes 3GPP standards-based 5G RAN and 5G core, as well as capitalized services attached to this infrastructure, such as deployment, maintenance and professional services.
SOURCE: TBR ESTIMATES

Technological complexity, standards delays and geopolitical encumbrances also threaten to slow the pace of 5G ecosystem development despite broad interest in the technology. TBR’s CSP 5G capex spend market size estimate and forecast assume some of these supply-side issues will be adequately addressed by 2H22, but the onus will remain on the industry to close the supply-demand gap as demand will remain above the historical trendline.

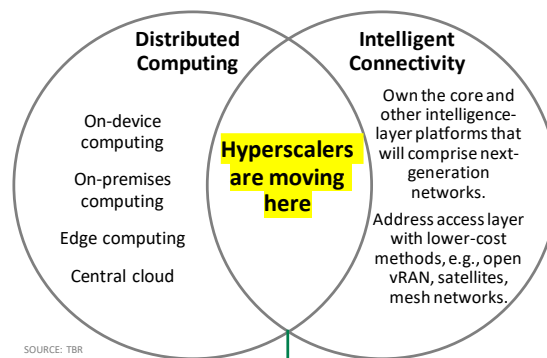
Taken together, these estimates indicate supply-demand disconnect will take a few years to be fully resolved.

HYPERSCALERS SCALE OUT EDGE CLOUD

-  **Trend:** Hyperscalers shift capex from central cloud to edge cloud.
-  **Driver:** Hyperscalers are focused on creating value from the convergence of distributed computing and intelligent connectivity.
-  **Result:** Hyperscalers will capture the majority of economic value from edge computing.

TBR expects hyperscalers to begin broadly scaling out their edge cloud build-outs in 2022. The capex shift from central cloud infrastructure to edge cloud infrastructure began in 2018 with Rakuten's mobile network deployment in Japan and has since spread across all the major hyperscalers as they focus on creating value from the convergence of distributed computing and intelligent connectivity. With hyperscalers' edge-optimized, custom silicon for servers now ready, such as Amazon Web Services' (AWS) Graviton2, and key edge compute-related customer wins announced (e.g., Dish-AWS, AT&T-Microsoft), hyperscalers are now ready to begin proliferating edge site deployments.

Hyperscalers view distributed computing and intelligent connectivity as tightly integrated concepts, and they want to control the entire stack.



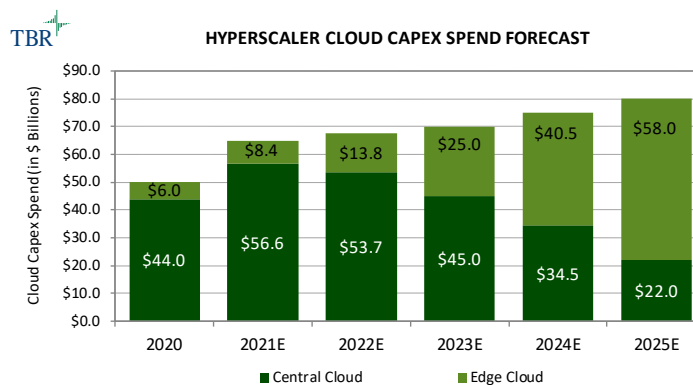
SOURCE: TBR

Trillions of dollars in economic value will be created by the convergence of these megatrends through this decade.

Hyperscalers must pivot from centralized data center build-outs to edge build-outs to achieve the latency and quality of service that new digital use cases will require. TBR believes the world's largest hyperscalers will extend their cloud footprints closer to endpoints through this decade and expects hyperscaler capex will shift significantly from central cloud to edge cloud over the next five years. The Big Nine hyperscalers will drive significant innovation in the edge space, contributing design references, technology standards and best practices to facilitate ecosystem development.

Hyperscalers have been experimenting with ways to make it more economically feasible to deploy distributed edge network resources at scale. The commercial model will likely see hyperscalers partner with ecosystem stakeholders, such as tower companies and data center real estate investment trusts (REITs), to offset the financial burden of deploying, owning and operating edge compute environments. For example, a hyperscaler could partner with tower companies to site micro data centers at the base of cell sites and plug directly into the access and backhaul network. Models such as this would help defray the cost and complexity of building and managing many sites. TBR also believes telco sites, such as central offices and aggregation hubs, are logical locations for edge compute resources because these facilities are usually strategically located, are owned and controlled by the operator, have access to power and cooling, have fiber readily available, offer secure access, and are ruggedized to withstand the elements.

Hyperscalers will utilize the most cost-effective means of deploying edge compute infrastructure, and these companies are building their own standard reference designs for edge compute infrastructure that is intended to be simple to install, employ automation, and use low-cost white-box hardware. The Facebook-led Telecom Infra Project and Open Compute Project initiatives contribute to this trend, where ODMs manufacture ICT gear to hyperscaler-customized specifications to minimize hyperscalers' costs and align with their strategic objectives.






SOURCE: TBR ESTIMATES AND COMPANY DATA
 Notes: Data includes Alibaba, Alphabet, Amazon, Apple, Baidu, Facebook, Microsoft, Rakuten and Tencent.
 Cloud capex includes all capitalized spend on cloud-related hardware, software and services.

All the Big Nine hyperscalers are investing in the edge in some way, ranging from edge-optimized infrastructure (e.g., AWS Outposts) to edge-related devices (e.g., augmented reality [AR]/VR head gear) to low-latency applications (e.g., cloud gaming, autonomous vehicles), to build out their digital ecosystems. Hyperscaler edge infrastructure spend will be dominated by Amazon, Microsoft, Google and Alibaba, with Apple, Baidu, Facebook, Rakuten and Tencent spending a relatively lower amount.

Amazon, Microsoft and Google have global ambitions for edge, and these hyperscalers intend to partner with and compete against telcos and cablecos in the edge space. TBR expects Amazon, Microsoft and Google will ultimately become the largest spenders on edge infrastructure in the world, as their dominance in the central cloud and influence in the economy naturally extend into the edge space.

GOVERNMENT BECOMES LEADER IN 5G SPEND AMONG NONTELECOM VERTICALS

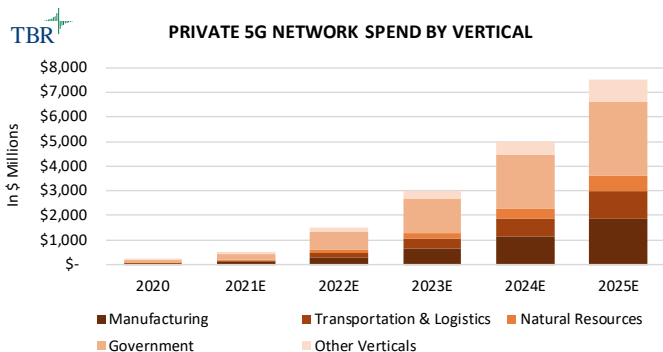
-  **Trend:** Government entities will lead all other nontelecom verticals in spending on 5G.
-  **Driver:** Governments will leverage 5G for a broad range of use cases.
-  **Result:** Government spending on 5G will become a key growth source for CSPs and vendors.

Government entities in key countries worldwide, including the U.S., U.K., South Korea, Japan, Taiwan and China, as well as supranational entities such as NATO are leveraging, or intend to leverage, 5G technology for various use cases spanning domains such as education, smart cities, public safety and defense. Government spend on 5G will initially be driven by the defense and public safety subsectors, with education and smart city growing in the mix over time.

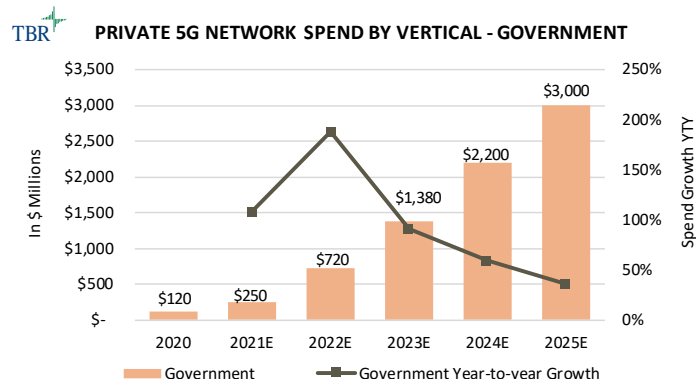
The militaries of the U.S., U.K., South Korea, Taiwan and China have already begun investing in private 5G networks to support various use cases. NATO is also investing in private 5G networks for various defense- and disaster response-related use cases. To date, there have been several high-profile, publicly announced government-related 5G deals, including the Korea Military Academy and the U.S. Army leveraging AR/VR with private 5G networks, and the Department of Defense's (DOD) landmark \$600 million tender covering a broad range of military-related 5G use cases.

The DOD's 5G contract, which was announced in October 2020, is the largest publicly announced 5G contract by a non-CSP entity. This money will be spent over the next few years and is likely to lead to follow-on business for vendors. TBR believes a portion of the DOD's investment will be for private 5G networks (i.e., infrastructure owned by the government) and a portion will be allocated to public 5G networks (i.e., network resources provided via CSP-owned infrastructure).

Governments are expected to utilize a mix of privately owned networks as well as leverage third-party-owned networks, depending on what makes sense.



SOURCE: TBR ESTIMATES



SOURCE: TBR ESTIMATES

Note: TBR’s taxonomy for the government vertical includes national, state/provincial and local government spend on civilian (e.g., education, offices, smart city), public safety, first responder (e.g., police, fire, ambulance), and military use cases for 5G technology.

Note 2: Governments’ need for private 5G networks will be broad (as shown in the graphs above), but this vertical will also leverage CSP-owned 5G infrastructure, evidenced by the DOD’s 5G contract.



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