Vanguard

Fixed Income Group research

5G and the opportunity set for global credit markets

March 2022

- The advent of fourth-generation (4G) wireless mobile networks enabled a lot of value creation, but most was captured by adjacent technology and digital media companies rather than the wireless network operators themselves.
- As fifth-generation (5G) networks roll out in the U.S. this year, we are likely to see a continuation of those trends.
- As fixed income investors, we are cautious about technology and digital media companies. Although they may well continue to capture most of the value from 5G, their debt already tends to be high-quality and is trading at high valuations. We see more value in wireless telecoms and cell tower operators; their credit profiles should improve as carriers expand 5G coverage and monetize this service.

Authors: Scott Miles, senior credit analyst, based in the United States | Alicia Low, head of credit research for the Asia-Pacific region, based in Australia | Andreas Nagstrup, credit analyst based in the U.K

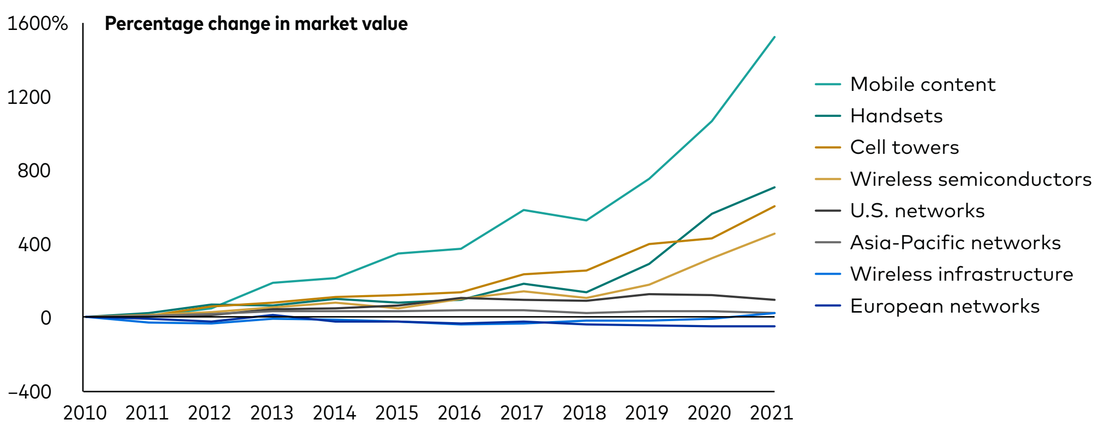
Lessons learned from 4G

It has been 11 years since Verizon rolled out the world's first large-scale 4G wireless network.

4G networks brought about a tremendous amount of change. Social media and video consumption migrated to mobile, and gig economy platforms emerged, all with tremendous social, political, and investment implications.

4G networks enabled value creation, but, as the chart illustrates, wireless carriers and infrastructure manufacturers captured comparatively little of that value. Other parts of the wireless value chain, including semiconductors, handsets, and especially mobile content, received the lion's share.

Stock market increases in the 4G era for parts of the wireless value chain



Note: Data are year-end figures from 2010 through 2021.
Sources: S&P Capital IQ and Vanguard.

Emerging themes in U.S. 5G

As 5G lights up across the U.S., we have been weighing whether this generation of wireless networks will be as significant as the former and what the investment implications could be.

Here are some of the themes we see materializing:

- 5G has kicked off a generational investment cycle in fiber, cell towers, network infrastructure, and data center capacity.
- Higher speeds will create new market opportunities for mobile content, such as cloud gaming, augmented reality, and embedded artificial intelligence.
- This will grow new markets for hardware (such as wearables), drive higher semiconductor content in devices, and spur large investments in semiconductor manufacturing capacity, especially in the west.
- 5G fixed wireless broadband will drive more competition and consumer choice in residential broadband markets.

As in the last cycle, wireless carriers likely won't capture much of the value from 5G networks.

Wireless markets were competitive during the 4G era, and we expect them to become increasingly so because of the blurring of distinctions between wireless and cable providers. Wireless will increasingly compete with cable for home broadband service, especially in underserved areas.

5G makes it more feasible for governments to pursue rural broadband goals through subsidies. These subsidies will boost growth opportunities for wireless but may come at the expense of greater regulatory oversight and lower long-term margins.

Cautious on about tech and digital media

Technology and digital content will continue to capture most of the value from 5G. However, we don't think this implies opportunities for credit investors, for a number of reasons. These high-quality sectors already trade at elevated valuations, leading to an asymmetric risk-return profile (that is, limited upside and comparatively greater downside risk).

Tech companies may use their fortress balance sheets to pursue new market opportunities through mergers and acquisitions (M&A), to the detriment of creditors. The recently announced Oracle-Cerner transaction is a good example.

5G is contributing to high demand for semiconductors today, but we are concerned that the massive supply response will overshoot demand and lead to an inventory-led correction.

Today's dominant technology companies won't necessarily be the winners in 5G applications. Asian markets have a head start and will be more competitive during this cycle.

Regulatory scrutiny is elevated. In the 5G era, tech incumbents will have less latitude to buy rising threats (such as Facebook/Instagram and Alphabet/YouTube).

If regulatory curbs, global competition, and excess capacity slow growth, firms may resort to using their balance sheets to drive earnings-per-share growth, which would entail moving down in credit quality.

Bullish on wireless networks and cell tower operators

We see better fixed income value in wireless telecoms such as Verizon and T-Mobile US and towers including Crown Castle and American Tower. Driven by M&A, the U.S. wireless sector dropped in credit quality during the 4G era. "In the U.S., wireless telecoms migrated from single-A to triple-B credit ratings," said Scott Miles, senior credit analyst. "That wasn't a great outcome for fixed income investors, but, as a result, they offer more value today." Additionally, North American wireless networks have invested heavily recently in capital equipment and wireless spectrum. Balance sheets are stretched, but we expect credit profiles to improve as carriers expand 5G coverage and monetize this service. Carriers should use the current inflationary environment to push up pricing while touting increased network capability.

Wireless earnings growth should shift from low single digits today to mid-single digits or better, accelerating the recovery of credit profiles.

Although the mobile market is saturated, we see major growth opportunities opening for fixed wireless. The drivers will be population growth, pricing, and fixed wireless expansion.

Regulatory oversight will increase as wireless networks displace landlines in some underserved areas, limiting margin growth but also suppressing volatility.

In Europe, expect a slow 5G rollout, greater competition, and limited revenue growth

The themes we see emerging with 5G in Europe are similar to those in the U.S., with some noteworthy differences and nuances:

The European telecom market is more fragmented, with many more operators than in the U.S., where three large, nationwide players dominate. This leads to an intensely competitive market environment, which in turn means revenue growth is likely to be anemic, with limited near-term catalysts for improvement.

The pandemic has highlighted the need for governments, companies, and consumers to have robust broadband connectivity. This is a political priority, and the European Commission has laid out ambitious targets for 5G rollout. These include ensuring uninterrupted 5G coverage in urban areas and along main transport routes by 2025. In March 2021, the commission extended the objective to include universal 5G coverage in all populated areas by 2030.

The rollout of fiber-to-the-home (FttH) has been very fragmented in Europe, and countries including the U.K. and Germany need to make significant investments to catch up. Investment spend is likely to focus on FttH in the near term before gradually shifting to 5G. After a period of significant acquisition activity, telecoms are facing a balancing act to keep leverage in check while investing in network expansion. Consequently, we expect Europe to roll out 5G more slowly than the U.S. and developed Asia.

"The credit profiles in the European telecom sector should hold fairly steady, with network investment remaining elevated in the short-to-medium term and revenue and earnings growth likely to be modest," said Andreas Nagstrup, a European credit analyst based in London. "There are, however, differences among telecom credits even in this somewhat challenging environment, which gives active managers scope to add value."

In the Asia-Pacific region, emerging trends look set to support both the equity and credit markets

Unlike the U.S. and Europe, where there is a degree of homogeneity, Asia Pacific is a highly diverse region, and the pace of 5G rollout varies markedly amid different market structures and regulatory environments. South Korea was first to roll out 5G in April 2019, followed closely by Australia, China, and Japan, whereas India aims to begin in 2022.

In the Asia-Pacific region, as in the U.S., the 4G rollout resulted in significant shareholder value creation that was captured primarily by the U.S.-domiciled FAANGs (Facebook, Apple, Amazon, Netflix, and Google) and their Asian equivalents, the BATs (Baidu, Alibaba, and Tencent). "Asia-Pacific carriers also experienced a decline in credit quality as balance sheets became stretched, with significant increases in leverage to fund 4G investments in a highly competitive environment, limiting revenue growth," said Alicia Low, head of credit research for the region, based in Australia. "The proverbial $64,000 question is, will 5G be different for Asia-Pacific wireless network operators?"

While 4G and prior rollouts degenerated into a race to the bottom in terms of prices, 5G incumbents appear to have learned from past experiences, with more rational competition and carriers preferring to differentiate based on network quality and speed rather than exclusively on price.

Inflation accelerating back to a pre-COVID pace from currently sluggish levels in Asia should provide carriers with cover to lift pricing, but its double-edged sword could also lead to higher-than-expected 5G rollout costs.

We observe greater capital discipline, particularly in developed markets such as South Korea and Australia, in linking 5G investment to demand growth. Following in the footsteps of U.S. counterparts, Asia-Pacific carriers have or are in the process of recycling capital through divestment of infrastructure assets such as cell towers, with proceeds redeployed into 5G, capital management, and debt reduction—all supportive of credit fundamentals.

As in the European Union, the post-pandemic regulatory environment in the Asia-Pacific region is likely to be more benign, with telecoms seen as national champions and enablers for digitization to support economies recovering from COVID. The regulatory pendulum is swinging against FAANGS and BATs because of their market dominance.

"Although it's fraught with danger to declare 'this time is different,' said Low, "four emerging trends—demand-driven capital expenditures, pricing discipline, capital recycling, and more benign regulatory environments—are supportive for both equity and credit markets in Asia-Pacific telecoms not seen in prior rollouts."

Opportunities for active fixed income managers in global telecoms

"We expect credit profiles in this sector to be broadly stable to slightly improving," said Miles. "There are, however, differences among telecom credits, and we will deploy our global research capabilities to identify which companies in each region may have better prospects for improving their credit profiles and select securities that offer attractive risk-adjusted returns."

By investing in a Vanguard active global credit fund, you get access to this expertise and can benefit from attractive investment opportunities globally.

Active Fixed Income at Vanguard

Taxable bond	Municipal bond				
$335B in AUM *14 funds*/1 ETF*	$230B in AUM *5 national funds/7 state-specific funds*	30+ Portfolio managers	30+ Traders	60+ Research analysts	140+ Dedicated team members

* Includes funds advised by Wellington Management Company LLP.
Note: Data are as of December 31, 2021.

Connect with Vanguard®

For more information about Vanguard funds and ETFs, visit vanguard.com to obtain a prospectus or, if available, a summary prospectus. Investment objectives, risks, charges, expenses, and other important information about a fund are contained in the prospectus; read and consider it carefully before investing.

Vanguard ETF Shares are not redeemable with the issuing Fund other than in very large aggregations worth millions of dollars. Instead, investors must buy and sell Vanguard ETF Shares in the secondary market and hold those shares in a brokerage account. In doing so, the investor may incur brokerage commissions and may pay more than net asset value when buying and receive less than net asset value when selling.

All investing is subject to risk, including the possible loss of the money you invest.

Diversification does not ensure a profit or protect against a loss.

Investments in bonds are subject to interest rate, credit, and inflation risk.

Investments in bonds issued by non-U.S. companies are subject to risks including country/regional risk and currency risk. These risks are especially high in emerging markets.

Funds that concentrate on a relatively narrow market sector face the risk of higher share-price volatility.

Vanguard®

Investment Products: Not a Deposit • Not FDIC Insured • Not Guaranteed by the Bank • May Lose Value • Not Insured by Any Federal Government Agency

Important Information

VIGM, S.A. de C.V. Asesor en Inversiones Independiente ("Vanguard Mexico") registration number: 30119-001-(14831)-19/09/2018. The registration of Vanguard Mexico before the Comisión Nacional Bancaria y de Valores ("CNBV") as an Asesor en Inversiones Independiente is not a certification of Vanguard Mexico's compliance with regulation applicable to Advisory Investment Services (Servicios de Inversión Asesorados) nor a certification on the accuracy of the information provided herein. The supervision scope of the CNBV is limited to Advisory Investment Services only and not all services provided by Vanguard Mexico.

This material is solely for informational purposes and does not constitute an offer or solicitation to sell or a solicitation of an offer to buy any security, nor shall any such securities be offered or sold to any person, in any jurisdiction in which an offer, solicitation, purchase or sale would be unlawful under the securities law of that jurisdiction. Reliance upon information in this material is at the sole discretion of the recipient.

Securities information provided in this document must be reviewed together with the offering information of each of the securities which may be found on Vanguard's website: https://www.vanguardmexico.com/institutional/products/en/list/overview or www.vanguard.com

Vanguard Mexico may recommend products of The Vanguard Group Inc. and its affiliates and such affiliates and their clients may maintain positions in the securities recommended by Vanguard Mexico.

ETFs can be bought and sold only through a broker and cannot be redeemed with the issuing fund other than in very large aggregations. Investing in ETFs entails stockbroker commission and a bid-offer spread which should be considered fully before investing. The market price of ETF Shares may be more or less than net asset value.

All investments are subject to risk, including the possible loss of the money you invest. Investments in bond funds are subject to interest rate, credit, and inflation risk. Governmental backing of securities applies only to the underlying securities and does not prevent share-price fluctuations. High-yield bonds generally have medium- and lower-range credit quality ratings and are therefore subject to a higher level of credit risk than bonds with higher credit quality ratings.

There is no guarantee that any forecasts made will come to pass. Past performance is no guarantee of future results.

Prices of mid- and small-cap stocks often fluctuate more than those of large-company stocks. Funds that concentrate on a relatively narrow market sector face the risk of higher share-price volatility. Stocks of companies are subject to national and regional political and economic risks and to the risk of currency fluctuations, these risks are especially high in emerging markets. Changes in exchange rates may have an adverse effect on the value, price or income of a fund.

The information contained in this material derived from third-party sources is deemed reliable, however Vanguard Mexico and The Vanguard Group Inc. are not responsible and do not guarantee the completeness or accuracy of such information.

This document should not be considered as an investment recommendation, a recommendation can only be provided by Vanguard Mexico upon completion of the relevant profiling and legal processes.

This document is for educational purposes only and does not take into consideration your background and specific circumstances nor any other investment profiling circumstances that could be material for taking an investment decision. We recommend getting professional advice based on your individual circumstances before taking an investment decision.

These materials are intended for institutional and sophisticated investors use only and not for public distribution.

Materials are provided only for the recipient's exclusive use and shall not be distributed to any other individual or entity. Broker-dealers, advisers, and other intermediaries must determine whether their clients are eligible for investment in the products discussed herein.

The information contained herein does not constitute an offer or solicitation and may not be treated as such in any jurisdiction where such an offer or solicitation is against the law, or to anyone for whom it is unlawful to make such an offer or solicitation, or if the person making the offer or solicitation is not qualified to do so.

THESE MATERIALS ARE PROVIDED AT THE REQUEST OF AND FOR THE EXCLUSIVE USE OF RECIPIENT AND CONTAIN HIGHLY CONFIDENTIAL INFORMATION, WHICH SHALL NOT BE REPRODUCED OR TRANSMITTED TO ANY THIRD PARTIES WITHOUT VANGUARD'S PRIOR WRITTEN CONSENT. THE CONTENTS OF THESE MATERIALS SHALL NOT BE UNDERSTOOD AS AN OFFER OR SOLICITATION TO BUY OR SELL SECURITIES IN BRAZIL AND VANGUARD IS NOT MAKING ANY REPRESENTATION WITH RESPECT TO THE ELIGIBILITY OF ANY RECIPIENT OF THESE MATERIALS TO ACQUIRE THE INTERESTS IN THE SECURITIES DESCRIBED HEREIN UNDER THE LAWS OF BRAZIL. SUCH SECURITIES HAVE NOT BEEN REGISTERED IN BRAZIL AND NONE OF THE INTERESTS IN SUCH SECURITIES MAY BE OFFERED, SOLD, OR DELIVERED, DIRECTLY OR INDIRECTLY, IN BRAZIL OR TO ANY RESIDENT OF BRAZIL EXCEPT PURSUANT TO THE APPLICABLE LAWS AND REGULATIONS OF BRAZIL.

PROVIDED AT THE REQUEST OF AND FOR THE EXCLUSIVE USE OF THE RECIPIENT. THE CONTENTS OF THIS DOCUMENT SHALL NOT BE UNDERSTOOD AS AN OFFER OR SOLICITATION TO BUY OR SELL SECURITIES IN BRAZIL AND VANGUARD IS NOT MAKING ANY REPRESENTATION WITH RESPECT TO THE ELIGIBILITY OF ANY RECIPIENT OF THIS DOCUMENT TO INVEST IN SECURITIES DESCRIBED HEREIN.

This document is provided at the request of and for the exclusive use of the recipient and does not constitute, and is not intended to constitute, a public offer in the Republic of Colombia, or an unlawful promotion of financial/capital market products. The offer of the financial products described herein is addressed to fewer than one hundred specifically identified investors. The financial products described herein may not be promoted or marketed in Colombia or to Colombian residents, unless such promotion and marketing is made in compliance with Decree 2555/2010 and other applicable rules and regulations related to the promotion of foreign financial/capital market products in Colombia.

The financial products described herein are not and will not be registered before the Colombian National Registry of Securities and Issuers (Registro Nacional de Valores y Emisores - RNVE) maintained by the Colombian Financial Superintendency, or before the Colombian Stock Exchange. Accordingly, the distribution of any documentation in regard to the financial products described here in will not constitute a public offering of securities in Colombia.

The financial products described herein may not be offered, sold or negotiated in Colombia, except under circumstances which do not constitute a public offering of securities under applicable Colombian securities laws and regulations; provided that, any authorized person of a firm authorized to offer foreign securities in Colombia must abide by the terms of Decree 2555/2010 to offer such products privately to its Colombian clients.

The distribution of this material and the offering of securities may be restricted in certain jurisdictions. The information contained in this material is for general guidance only, and it is the responsibility of any person or persons in possession of this material and wishing to make application for securities to inform themselves of, and to observe, all applicable laws and regulations of any relevant jurisdiction. Prospective applicants for securities should inform themselves of any applicable legal requirements, exchange control regulations and applicable taxes in the countries of their respective citizenship, residence or domicile.

This offer conforms to General Rule No. 336 of the Chilean Financial Market Commission (Comisión para el Mercado Financiero). The offer deals with securities not registered under Securities Market Law, nor in the Securities Registry nor in the Foreign Securities Registry of the Chilean Financial Market Commission, and therefore such securities are not subject to its oversight. Since such securities are not registered in Chile, the issuer is not obligated to provide public information in Chile regarding the securities. The securities shall not be subject to public offering unless they are duly registered in the corresponding Securities Registry in Chile. The issuer of the securities is not registered in the Registries maintained by the Chilean Financial Market Commission, therefore it is not subject to the supervision of the Chilean Financial Market Commission or the obligations of continuous information.

Esta oferta se acoge a la norma de carácter general No. 336 de la Comisión para el Mercado Financiero. La oferta versa sobre valores no inscritos bajo la Ley de Mercado de Valores en el Registro de Valores o en el Registro de Valores extranjeros que lleva la Comisión para el Mercado Financiero, por lo que tales valores no están sujetos a la fiscalización de ésta. Por tratarse de valores no inscritos, no existe la obligación por parte del emisor de entregar en Chile información pública respecto de esos valores. Los valores no podrán ser objeto de oferta pública mientras no sean inscritos en el Registro de Valores correspondiente. El emisor de los valores no se encuentra inscrito en los Registros que mantiene la Comisión para el Mercado Financiero, por lo que no se encuentra sometido a la fiscalización de la Comisión para el Mercado financiero ni a las obligaciones de información continua.

The securities described herein have not been registered under the Peruvian Securities Market Law (Decreto Supremo No 093-2002-EF) or before the Superintendencia del Mercado de Valores (the "SMV"). There will be no public offering of the securities in Peru and the securities may only be offered or sold to institutional investors (as defined in Appendix I of the Institutional Investors Market Regulation) in Peru by means of a private placement. The securities offered and sold in Peru may not be sold or transferred to any person other than an institutional investor unless such securities have been registered with the Registro Público del Mercado de Valores kept by the SMV. The SMV has not reviewed the information provided to the investor. This material is for the exclusive use of institutional investors in Peru and is not for public distribution.

The financial products described herein may be offered or sold in Bermuda only in compliance with the provisions of the Investment Business Act 2003 of Bermuda. Additionally, non-Bermudian persons may not carry on or engage in any trade or business in Bermuda unless such persons are authorized to do so under applicable Bermuda legislation. Engaging in the activity of offering or marketing the financial products described herein in Bermuda to persons in Bermuda may be deemed to be carrying on business in Bermuda.

Vanguard does not intend, and is not licensed or registered, to conduct business in, from or within the Cayman Islands, and the interests in the financial products described herein shall not be offered to members of the public in the Cayman Islands.

The financial products described herein have not been and will not be registered with the Securities Commission of The Bahamas. The financial products described herein are offered to persons who are non-resident or otherwise deemed non-resident for Bahamian Exchange Control purposes. The financial products described herein are not intended for persons (natural persons or legal entities) for which an offer or purchase would contravene the laws of their state (on account of nationality or domicile/registered office of the person concerned or for other reasons). Further, the offer constitutes an exempt distribution for the purposes of the Securities Industry Act, 2011 and the Securities Industry Regulations, 2012 of the Commonwealth of The Bahamas.

This document is not, and is not intended as, a public offer or advertisement of, or solicitation in respect of, securities, investments, or other investment business in the British Virgin Islands ("BVI"), and is not an offer to sell, or a solicitation or invitation to make offers to purchase or subscribe for, any securities, other investments, or services constituting investment business in BVI. Neither the securities mentioned in this document nor any prospectus or other document relating to them have been or are intended to be registered or filed with the Financial Services Commission of BVI or any department thereof.

This document is not intended to be distributed to individuals that are members of the public in the BVI or otherwise to individuals in the BVI. The funds are only available to, and any invitation or offer to subscribe, purchase, or otherwise acquire such funds will be made only to, persons outside the BVI, with the exception of persons resident in the BVI solely by virtue of being a company incorporated in the BVI or persons who are not considered to be "members of the public" under the Securities and Investment Business Act, 2010 ("SIBA").

Any person who receives this document in the BVI (other than a person who is not considered a member of the public in the BVI for purposes of SIBA, or a person resident in the BVI solely by virtue of being a company incorporated in the BVI and this document is received at its registered office in the BVI) should not act or rely on this document or any of its contents.

Any person who receives this document in the BVI (other than a person who is not considered a member of the public in the BVI for purposes of SIBA, or a person resident in the BVI solely by virtue of being a company incorporated in the BVI and this document is received at its registered office in the BVI) should not act or rely on this document or any of its contents.

This document does not constitute an offer or solicitation to invest in the securities mentioned herein. It is directed at professional / sophisticated investors in the United States for their use and information. The financial products describe herein are only available for investment by non-U.S. investors, and this document should not be given to a retail investor in the United States. Any entity responsible for forwarding this material, which is produced by VIGM, S.A. de C.V., Asesor en Inversiones Independiente in Mexico, to other parties takes responsibility for ensuring compliance with applicable securities laws in connection with its distribution.

Connect with Vanguard®