Industry Surveys

Telecommunications: Europe

SEPTEMBER 2022

Adrian Ng, CFA
Equity Analyst

Navin Kalaiselvam
Industry Analyst

CONTENTS

Contacts

Sales Inquires & Client Support
800.220.0502
cservices@cfraresearch.com

Media Inquiries
press@cfraresearch.com

CFRA
977 Seminole Trail, PMB 230
Charlottesville, VA 22901

Contributors

Raymond Jarvis
Senior Editor

Atifi Kuddus, Geraldine Tan
Associate Editors

Marc Bastow
Contributing Editor

CHARTS & FIGURES

NEW THEMES

What's Changed: Unlike North America and Asia, the EU lags in 5G rollout. Head to page 15 for our 5G outlook and trends.

What's Changed: Europe's "fiber to home" initiative is ambitious, but a necessary one as we view it to be the backbone of the EU's digital transformation 2030 target. More on this on page 17.

What's Changed: While there aren't many EU telcos cashing in on the metaverse as yet, there is no denying that this trending topic will be an integral part of the industry in the coming years. Our analysis on page 18

EXECUTIVE SUMMARY

We are positive on the telecommunications industry in Europe in the second half of 2022 and going into 2023. Thus far, 2022 has proved to be a challenging year for the market as a whole, which we view as relatively positive for Europe's telecommunication industry. As a more defensive market, the telecommunications industry is less affected by the downturn, even though the structural issues of stagnant revenue growth remain. The return of international travel in Europe in 2022 also resulted in a strong rebound in roaming revenues which helped the industry. We still see good cash flow supporting dividend payout, as well as geopolitical tensions and high inflation supporting the shift into value. On the other hand, rising interest rates could drive investors away from assets that are seen as "bond-like" (*i.e.,* telco stocks, which tend to have high dividend yields and steady cash flows).

Asset Monetization and M&A Slower Than Expected

Dealmaking was ramping up going into 2022 with the focus on M&A activity shifting towards industry consolidation, with a constant flow of news reports on rumors of several large players in the industry holding talks about combining operations in more competitive markets.

Private equity and infrastructure funds remain interested in telco assets in 2022 and asset monetization remains a major theme for the industry. However, the rising interest rate environment has made such deals less attractive given the highly leveraged nature.

For the remaining of 2022 and early 2023, we think consolidation remains an important theme for the industry, but dealmaking to slow down as the cost of debt increases with higher interest rates.

5G Investment Remains Major Cash Outflow

As M&A activity dwindles, the main capex expenditure in 2022 will likely be 5G. With spectrum auctions mostly done, physical investment continues to ramp up. Meanwhile, monetization of 5G remains challenging for the telcos. On the other side of this is the divestments of tower and infrastructure assets by major telco operators, which may reduce the amount of physical investment by the telcos themselves.

Roaming Revenue Starts Returning

The Covid-19 pandemic in 2020 and 2021 had a strong negative impact on international travel and therefore roaming revenue as well. We see in 2022 that roaming revenue has begun to return to many major telcos and is driving a return to the growth story.

Industry Valuations Remain Low

The EV/Forward EBITDA multiple of the S&P Europe 350 Telecommunication Services sub-index has been steadily improving in recent years, starting around 7x in early 2021 to around 8.6x in August 2022. Dividend yields have also increased substantially, with some large-cap names (*e.g.,* Vodafone Group, Orange S.A., and Telefonica S.A.) yielding over 7%. The high inflationary environment and cautious market sentiment bode well for the industry, in our opinion.

Telecommunications: Europe

Outlook: Positive

MARKET CAP BREAKDOWN*

RANK NO.	COMPANY NAME	MARKET CAP ($ Billion)
1	Deutsche Telekom	93.1
2	Vodafone Group	33.6
3	Orange S.A.	26.0
4	Swisscom AG	26.0
6	Cellnex Telecom S.A.	22.5
7	Telefonica S.A.	21.3
7	BT Group	15.4
8	Telenor ASA	13.9
9	Telia Company AB	12.6
10	Koninklijke	12.0
	Others	25.6

**Data as of September 20, 2022.*

Source: CFRA, S&P Global Market Intelligence.

†Refer to the Comparative Company Analysis section of this survey for other companies in the industry.

ETF FOCUS

DE:EXV2 iShares STOXX Europe 600 Telecommunications	AUM (€M) 168.7	Expense Ratio 0.46
TELE Lyxor STOXX 600 Europe 600 Telecommunications UCITS	AUM (€M) 46.8	Expense Ratio 0.3
FDD First Trust Stoxx European Select Dividend Index	AUM ($M) 181.6	Expense Ratio 0.58
IXP iShares Global Comm Services	AUM ($M) 174.9	Expense Ratio 0.40

BY THE NUMBERS

€138.9 billion
Expected total mobile revenue in 2022

1.08 billion
Estimated total mobile subscriptions in 2022

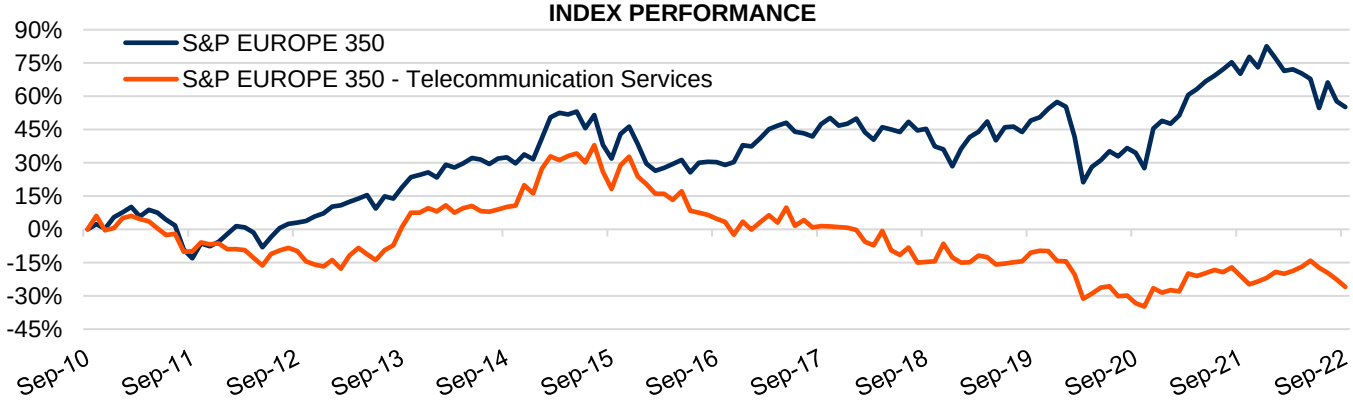
€90.9 billion
Transaction value of all M&A for the European telecom industry in 2021

€33.8
Estimated monthly average mass-market telecoms spend per capita in Europe for 2021

~1.3%
Estimated telecoms service spend as a proportion of GDP in 2021

€14.40
Monthly average mobile ARPU for 2021

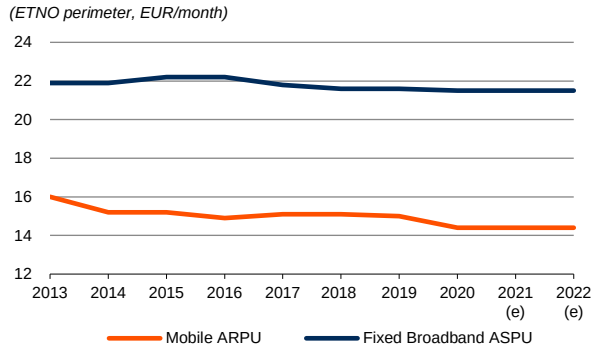
INDEX PERFORMANCE



Data through September 20, 2022.
Source: CFRA, S&P Global Market Intelligence.

FINANCIAL METRICS

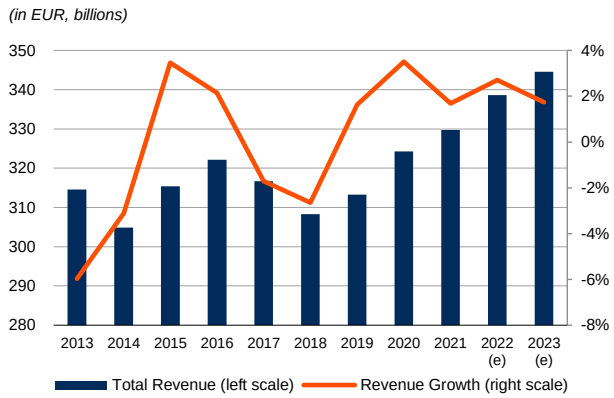
Average Revenue per User (ARPU)



e-Estimate
ASPU: Average spend per user.
Source: ETNO, Analysys Mason.

- Telecom subscribers across Europe are paying less per month for their fixed and mobile services, despite the introduction of new products and the increased use of data.
- Over the last 10 years, the overall ARPU for fixed broadband services has remained flat at a little below €22. However, mobile ARPU has dropped to €14.4 in 2020 and is expected to be stagnant at the same rate in 2021 and 2022, based on data from European Telecommunications Network Operators (ETNO).
- Mobile ARPU trends vary across Europe. The key factor in determining ARPU has been the degree of competition in each country, and there is some correlation between high levels of competition and low ARPU.

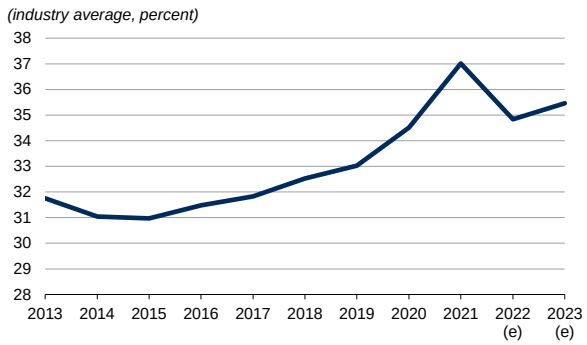
Revenue



e-Estimate
Source: CFRA, S&P Global Market Intelligence.

- CFRA expects project revenue to grow 2.7% and 1.7% in 2022 and 2023, respectively, as roaming revenues start trickling back in and service revenues improve.
- Revenue in Western Europe has been stable as falling voice revenue was offset by growth in data services, especially in fixed broadband. In Central and Eastern Europe, there is a modest amount of growth in the mobile business as users continue to transfer from feature phones to smartphones and uptake of data plans.

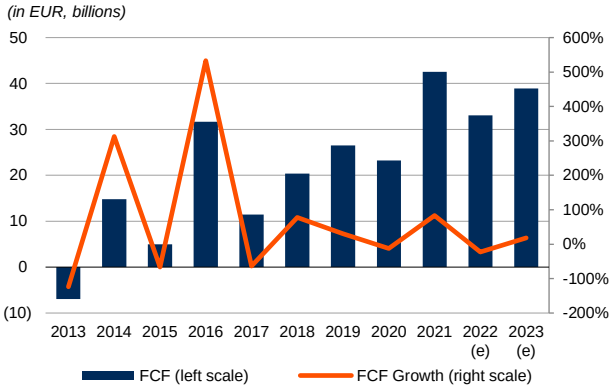
EBITDA Margin



e-Estimate
*Source: CFRA, S&P Global Market Intelligence.

- Industry EBITDA margins have trended upwards since 2015, which we attribute mainly to increased offerings of digital services such as enterprise solutions and security. European telecom companies ventured into areas like data and security to improve their margins beyond the traditional connectivity model.
- CFRA projects EBITDA margin to increase to about 34.8% in 2022 and 35.5% in 2023, as larger telecom giants are increasing prices along with the added benefits from increase in roaming.

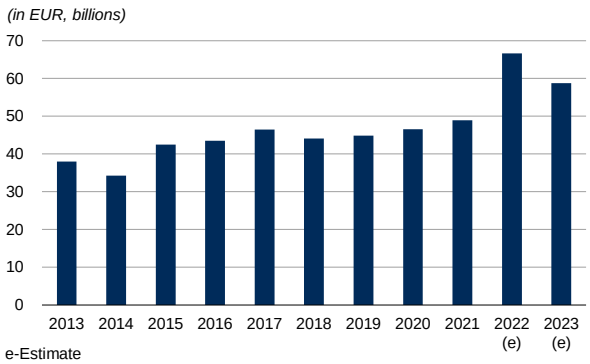
Free Cash Flow (FCF)



e-Estiimate
Source: CFRA, S&P Global Market Intelligence.

- CFRA expects industry FCF to decline 22% in 2022 and return to 18% growth in 2023 as telcos are investing heavily in 5G and fiber-to-the-home (FTTH) to support migration from traditional workflows to digitalization.
- On the other side of the equation, the increased scrutiny of Chinese equipment providers hurts cash flows as telcos are given fewer choices. Nonetheless, what can be seen is that telecom operators have moved on from the scrutiny surrounding Chinese equipment and are sourcing from the likes of Nokia and Ericcson.

Capital Expenditure

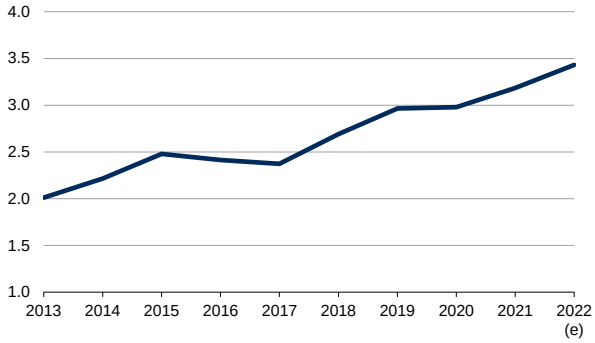


e-Estimate
Source: CFRA, S&P Global Market Intelligence.

- European telecom operators have resumed 2022 outlays amid rising 5G ambitions and full fiber rollouts. By the end of 2022, the industry capex is expected to peak at €66.6 billion.
- Spending pressures are ever-increasing for telecom companies as the European Commission laid out ambitious connectivity targets for 2030 in its Communication on “Europe’s Digital Decade”.

Net Debt-to-EBITDA

(industry average, in multiples)



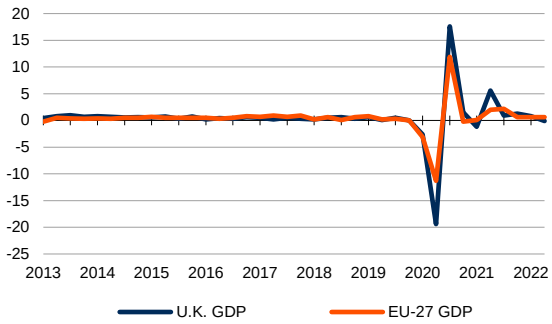
e-Estimate
Source: CFRA, S&P Global Market Intelligence.

- Industry net debt-to-EBITDA had risen from 2.0x in 2013 to 3.2x in 2021.
- We expect industry net debt-to-EBITDA to increase further to 3.4x by the end of 2022, as telecom operators are expected to take on further debt to fund capex and spectrum bids. CFRA expects this trend to continue for European telcos until 2023 as investments in 5G and FTTH deployment continues.

KEY INDUSTRY DRIVERS

GDP Growth for the U.K. & EU-27

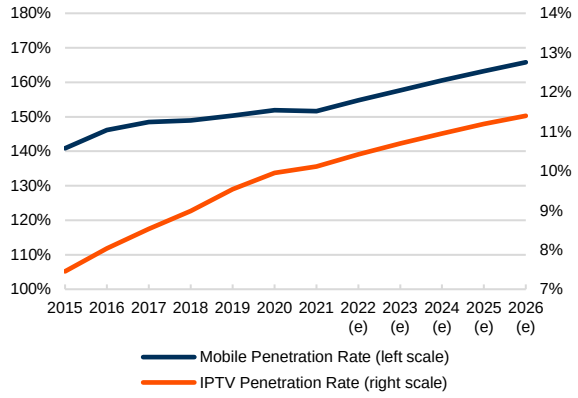
(percent change, Y/Y)



*Data through second quarter 2022
Source: Eurostat.

- U.K. GDP is estimated to have fallen by 0.1% in the second quarter of 2022 and is 0.6% above its pre-pandemic level. The level of quarterly GDP grew by 2.9%, higher than the second quarter of 2021, according to the Office for National Statistics.
- The Bank of England (BoE) forecasts GDP would grow 3.5% in 2022 instead of the previous projection of 7.5%, highlighting that the U.K. will enter recession later this year as the U.K. and the rest of Europe face increasing gas prices due to sanctions against Russia (Russian oil and gas flow continues to decline), elevated global inflation rates and continuing supply chain disruption (partly due to lockdowns in China and the Russia-Ukraine crisis).

Mobile Broadband and IPTV Penetration Rate



Source: S&P Global Market Intelligence, Kagan, CFRA.

- Mobile broadband penetration rate in select Western European countries has generally been higher compared to other countries in Europe and is expected to grow further.
- IPTV penetration rate continues to rise as demand for video-streaming services such as Netflix, Amazon Prime, and Disney+, alongside increasing content variety. In CFRA's view, bundling IPTV services will now remain a source of growth for the industry as traditional pay-TV penetration rate will continue to decline further.

INDUSTRY TRENDS

Profit Share Map

PROFIT SHARE MAP OF EUROPE COMMUNICATION SERVICES SECTOR
(last twelve months through August 22, 2022)

Source: CFRA, S&P Global Market Intelligence.

In Europe's Communication Services sector, the Diversified Telecommunication Services industry has the largest share of revenue at 72% and the second highest EBITDA margin at 27.6%, followed by the Wireless Telecommunication Services industry with a share of revenue of 13% and the highest EBITDA margin of 29%. The Diversified Telecommunication Services industry includes Alternative Carriers, which are providers of communication services, including wireless, wireline, and internet (broadband) services to businesses and consumers, which explains the lion's share of the Communications Services sector.

Porter's Five Forces

Below, we use the Porter's Five Forces framework as a tool to analyze the competitive environment of the European telecommunications industry.

Porter's Five Forces Analysis	
Threat of New Entrants or New Entry (Low)	A new company would need infrastructure in order to enter the market and sell its services. This infrastructure – even if rented – requires substantial amounts of money and specific competencies. In addition, a new operator is unlikely to possess broad infrastructure that links different countries in Europe and therefore has to rely on existing infrastructure owned by third parties (at least at the beginning of operating the business). This is done by paying owners of the infrastructure, which are mainly governments and incumbent telco players, using their infrastructure to offer services to customers. These operators are known as mobile virtual network operators (MVNOs). However, gaining access to this infrastructure is not easy; business relationships with the incumbents need to be established, requiring high volumes of capital.

Bargaining Power of Suppliers (Moderate)	MVNOs need several categories of suppliers to run their business smoothly: the energy suppliers, other telco operators, and the supplier of the technical equipment needed to install the telecommunications connections and build and maintain the network. With the bundling of telco and media services, content owners are also now a big supplier to the telcos. Relationships with energy suppliers are generally long-term once the agreement is made. If a telco were to switch to another energy supplier, switching costs would not be high as the product received (energy) is essentially the same. Therefore, the bargaining power of energy suppliers is low. Generally, the bargaining power of the telco operators that supply MVNOs depends on their size. A large telco operator typically has high quality and convenient routes, which are in high demand, in addition to broad networks, which means the operator does not have to buy a lot of traffic from other telcos, compared to operators with more limited networks. All these factors lead to larger telcos having higher bargaining power over MVNOs. Telcos constantly spend to improve, upgrade, and extend their networks with the equipment and expertise from the communications equipment supplier. The products and services required by the telco operator are quite specific to the business and strategically important for successful operation. Furthermore, switching costs can be high as equipment from another supplier may have slightly different specifications, which could compromise compatibility with existing networks. Therefore, we consider the bargaining power of such suppliers as high. Media content owners include studios, distributors, and sports licensing holders. Contracts in this space are generally renegotiated every few years and have become a major differentiator for telcos. We believe the bargaining power of these suppliers is high as different corporations bid for the same content and contracts are relatively short.
Bargaining Power of Customers (Moderate)	Telco operators offer communication services mainly to three types of customers: end-users, MVNOs, and enterprises. Although a single user cannot bargain with a large company on the price of its services, the user can easily switch to another operator and choose a more convenient and cheaper offer. That said, bundled offerings have helped mitigate users' tendency to switch providers (i.e., made them more loyal). Similar to what was discussed in the bargaining power of suppliers above, the bargaining power of an MVNO customer depends on its size. Concerning private enterprises, bargaining power is low, mainly due to the high switching costs involved and the importance of such services to the operations of the enterprises. Additional technical services, such as installation, upgrades, and maintenance, are also needed by the customer.

Degree of Rivalry/Competition (High)	Although the number of operators in each country is not extremely high, all the remaining features that determine rivalry in the industry as high can be found in the European Telco industry. First, fixed costs in the industry are the largest portion of total costs, and telcos cannot raise prices higher than the regulated price cap. Second, there are few possibilities to differentiate the services offered. Every company offers similar and comparable products and services, which increases rivalry. Third, barriers to exit are high, as assets and competencies developed while operating in the industry are specific to the industry and not easily transferrable and re-used in another business. Fourth, production capacity offered by operators is theoretically unlimited; as long as there is supply of energy, operators can send additional traffic over their networks, which could intensify competition. Notably, the recent 5G auctions have produced a shift in the competitive environment as MVNOs won spectrum allocations, making them full-fledged MVNOs.
Threat of Substitutes (High)	Telecom operators face serious threats of product and service substitutes from non-traditional telecom industries. Cable TV and satellite operators compete with telecom companies for customers with their own direct lines into homes, broadband internet services, and satellite links. Railway and energy utility companies are building high-capacity telecom networks alongside their tracks and pipelines. On top of that, as cut-rate or even free internet voice calls (e.g., Skype, WhatsApp) become more reliable, telecom companies are at risk of losing their core voice revenue share to internet telephony.

Competitive Environment

In general, the competitive environment in the telecommunications segment is quite stable, given the large capital needed for entry and the maturity of the industry. That said, there are instances where the competitive environment is shaken up, such as when Iliad entered the Italian market as the country's fourth mobile network operator, spurring more competitive pricing.

Key Players in European Telecoms

A number of companies operate across the major European country markets. Usually, each country has its own incumbent operator that was historically a state-owned company. These companies were typically privatized in the 1990s. The incumbents generally operate both mobile and fixed networks; the U.K.'s British Telecom (BT) was an exception from 2001 (when it demerged its mobile business) to 2016 (when it bought wireless operator EE). Below, we have indicated M (for mobile services) and F (for fixed) in cases where an operator actually owns network assets supporting these services.

EUROPEAN TELECOM OPERATORS' SERVICES

COMPANY NAME	U.K.	FRANCE	GERMANY	ITALY	SPAIN	NETHERLANDS
Bouygues		F,M				
BT	F,M					
Deutsche Telekom	M		F,M			F,M
FT-Orange	F,M	F,M			F,M	
Hutchison	M			M		
Iliad		F,M		M		
United Internet			F			
KPN						F,M
MasMovil					F,M	
Altice France (formerly SFR)		F,M				
Tele2						F,M
Telecom Italia				F,M		
Telefonica	M		F,M		F,M	
Vodafone	F,M		F,M	F,M	F,M	
Total number of major operators	6	4	3	4	4	3

F-Fixed, M-Mobile.
Source: Company reports.

Excluded from this matrix are operators that do not own telecom infrastructure but merely resell third-party services; such service providers are referred to as MVNOs and broadband resellers. We have also excluded cable TV operators, which, in addition to offering pay-TV, typically compete in the fixed-voice and broadband markets and offer mobile services as an MVNO. Cable operators typically operate only in their domestic market.

Consolidation has Returned Albeit Slow for the European Telecom Industry

While consolidation has occurred naturally, regulators have also sought to encourage a more unified approach to telecom operators across Europe in the hope that this will spur innovation and help the region catch up with the U.S. and Asia. CFRA believes that markets with four or more players could benefit from consolidation. Telcos remain interested in acquiring media businesses to bolster their bundled offerings and differentiate their products, in our opinion. We expect to see newsflow on this front pick up throughout 2022.

Operating Environment

The U.K. and European Union Start to Close the Gap in 5G Rollouts Slowly
The number of Europeans able to connect to a 5G network was 51.6% in 2021, much slower than Americans' 93.1% and South Korea's 93.9%, according to a report by telecom trade body ETNO in February 2022. Slow pace investment in strategic 5G and fiber networks contributing to a weaker financial and market position compared to global peers seem to cause the gap in 5G coverage between Europe and other regions like U.S. and Asia.

UNITED KINGDOM

In December 2021, the U.K. telecommunications regulator, the Office of Communications (Ofcom), published the annual license fees (ALFs) for paired spectrum in the 2100 MHz band. The four biggest U.K. mobile operators, EE, Three UK, O2, and Vodafone, will be required to pay the following annual fees: EE, GBP22.44 million; O2, GBP11.22 million; Three UK, GBP16.55 million; and Vodafone, GBP16.61 million. These fees will increase by CPI each year.

All four mobile operators have already launched their initial 5G service in the U.K. Meanwhile, mobile operators O2 and EE expanded their 5G network footprint in the country. O2 said its nationwide 5G network now covers 64% of the population in the capital due to deployment of low band 5G spectrum. The mobile operator said it delivered connectivity to over 2,000 sites across the country in 2021 and now has 5G coverage in 300 towns and cities. As of May 2022, EE has confirmed its 5G network covers more than 50% of the U.K. population.

SPAIN

In June 2022, Spain's Congress of Deputies voted to revise the 2014 General Telecommunication Law. One of the important clauses included was to implement minimum download speeds increased to 100Mbps for 100% of the population within the following twelve months from June 2022 as compared to the previous target of 2025.

Spain raised a total of US$1.3 billion for the 700 MHz band in July 2021. Vodafone Spain spent a total of €350 million on 2x10 MHz blocks; Telefonica spent €310 million for the same block, paying less due to faster rollout obligations; and Orange paid €350 million for the same spectrum block as others. As with the U.K., we do not see a big change in Spain's competitive environment, based on the results of the latest 5G auction.

FRANCE

The French telecom regulator, Autorité de Régulation des Communications Électroniques et des Postes (Arcep), completed its long-awaited auction of 3.4-3.8 GHz bands in October 2020, reaching a total bid of €2.8 billion. During the first stage, each mobile operator committed to acquiring 50 MHz prior to the start of the process. In the second stage of the auction process, 11 blocks of 10 MHz spectrum were put up for sale. Orange bid €854 million for a total of 90 MHz; SFR €728 million on 80 MHz, with Bouygues and Iliad each bidding €602 million for 70 MHz. The regulator highlighted that licensees are required to activate 5G service on 3,000 sites by the end of 2022, 8,000 sites by the end of 2024, and 10,500 by the end of 2025.

Increased Capex for 5G Rollout in 2022

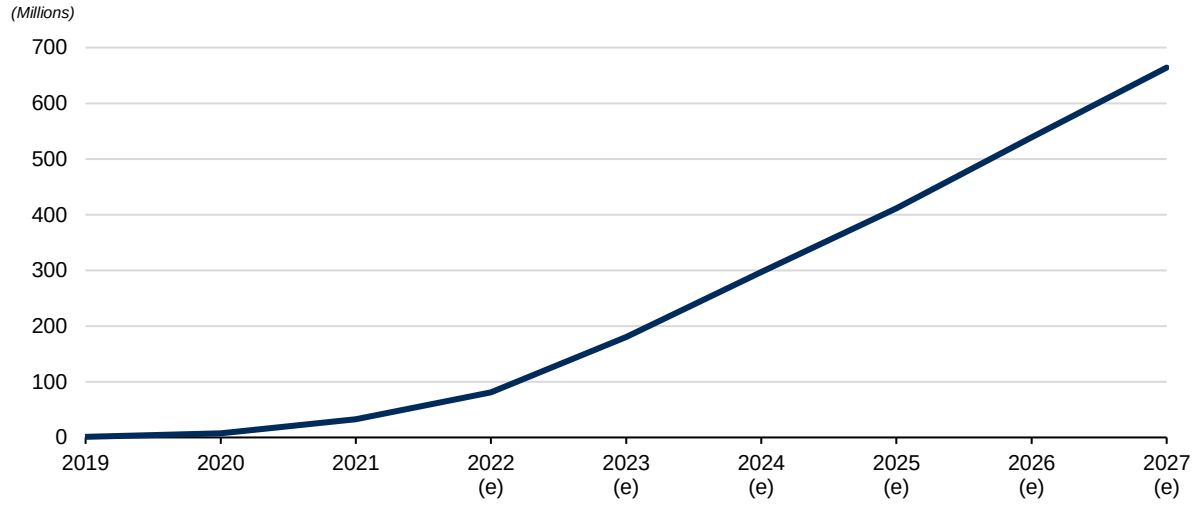
The European Union (EU) has ambitions to dominate the Internet of Things (IoT). Europe is already a leader in the semiconductor components critical for the rise of IoT, but due to regulatory inertia, it lags behind Asia and North America in the implementation of 5G connections, which are necessary for IoT to work. This has prompted regulators to put in requirements for spectrum auction bidders to frontload infrastructure investment necessary for 5G, which resulted in backlash from the larger telecommunication companies that already find themselves having to share capacity with MVNO rivals offering cheaper packages. With Drillisch winning 5G spectrum in the German auction, there will be a new network operator in Germany. The new entrant is expected to spend more on infrastructure rollout to catch up with the incumbents. However, all operators have noted that there are barriers to them accelerating investment into infrastructure, with the incumbents pointing out steep auction prices and the limited participation of Huawei, and the new entrant criticizing the auction terms for the lack of "stronger commitment to more competition," which we believe points to the operators wanting more flexibility in their rollout plans. We do not see authorities relenting on capex requirements, especially as the Covid-19 lockdowns impacted rollout in 2020.

CFRA expects industry capex to increase in 2022 and 2023 as well to support 5G rollouts. Higher capex, to some extent, also reflects pandemic-led deferrals and reprioritization of initiatives (*e.g.,* spending to support the unanticipated fixed-broadband surge). We expect increased spending for 5G wireless spectrum in the second half of 2021 and to carry on in 2022, particularly for the mid-band and high-band spectrum. As Europe's telcos evolve to 5G, one of the biggest opportunities in the near term is that it is a much more cost-effective technology, with the cost per gigabyte on a 5G network being up to 10 times more efficient than on 4G.

5G Outlook: Subscriptions, Monetization, Enterprise Drivers

5G mobile subscriptions in Europe are expected to grow 1930.6% between 2021 and 2027, from 32.7 million to 664 million, according to Ericsson. Availability of cheaper 5G handsets, as well as Apple's newly launched iPhone 14 series, will increase the adoption rate of 5G in Europe. Apart from cheaper 5G handsets, CFRA expects gaming, shopping using augmented reality (AR), and streaming will be the main drivers for 5G subscriptions for the consumer side of things, especially in Western Europe and Nordic countries.

5G MOBILE SUBSCRIPTIONS IN EUROPE

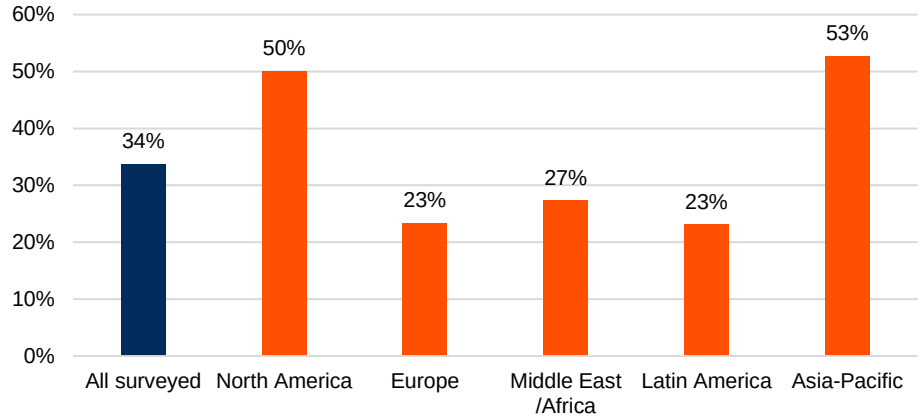


Source: Ericsson.

Gaming and Enterprise Solutions are Critical to 5G Monetization

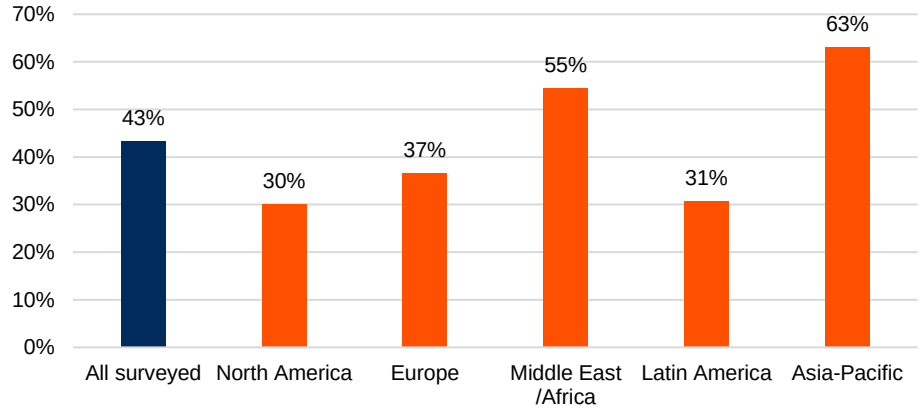
Unlike 2G, 3G, or 4G, the monetization of 5G will likely be harder. Although the benefits offered by 5G services are substantial, telecom operators' efforts to monetize the technology face some fundamental challenges. Traditionally, telecom operator revenue is mainly driven by the consumer. When 4G launched, 4G devices were already available from major players such as Samsung and Apple. At that time, many customers actively upgraded their 3G mobile services to 4G mobile services. With 5G, in contrast, consumer awareness is much lower, while enterprise use case scenarios are much higher.

CLOUD GAMING AS A 5G DRIVER BY SURVEY REGION
(percentage)



Source: Kagan, S&P Global Market Intelligence Global 5G survey. Question: What consumer use cases are your company projecting to help accelerate 5G adoption? Base: All surveyed-83; North America-10; Europe-30; Middle East/Africa-11; Latin America-13; Asia-Pacific-19.

LOW-LATENCY GAMING AS A 5G DRIVER BY SURVEY REGION
(percentage)



Source: Kagan, S&P Global Market Intelligence Global 5G survey. Question: What consumer use cases are your company projecting to help accelerate 5G adoption? Base: All surveyed-83; North America-10; Europe-30; Middle East/Africa-11; Latin America-13; Asia-Pacific-19.

According to a survey conducted by Kagan, among the majority of wireless operator decision-makers (from vice-president, director, and senior network-level professionals), gaming was cited as a key 5G growth driver. Several Asia Pacific operators are increasing the speeds of their 5G networks by adding more spectrum bands and network enhancements and investing in multi-access edge computing (MEC) to support low-latency applications.

Kagan's Global 5G survey finds that when it comes to 5G networks, wireless operators see a clear use case for the enterprise, such as private networks, automated factories, and remote monitoring. However, use cases for the consumer market have been more ambiguous beyond faster data speeds.

IDC expects 5G growth remain robust as many markets transition to 5G. Total market for 5G mobile phones is forecasted to climb 44.7% by the end of 2022, growing nearly 26% from 2021, according to IDC. IDC continues to expect solid consumer demand due to the increasing number of affordable 5G smartphones.

TOP DRIVERS FOR ENTERPRISE 5G ADOPTION
(percentage of total respondents)

	Total	North America	Europe	Middle East and Africa	Latin America	Asia Pacific
Autonomous Cars	55%	80%	43%	45%	62%	63%
Cloud Services	61%	100%	67%	36%	46%	58%
Autonomous Fleet Vehicles (*e.g.,* trucking)	33%	70%	27%	45%	23%	21%
Telemedicine	46%	30%	57%	36%	46%	42%
Remote surgery	65%	30%	80%	64%	46%	74%
Factory Automation	70%	100%	60%	64%	62%	79%
Smart City Applications	76%	90%	77%	73%	92%	58%

Source: Kagan's September 2021 survey B2B Global 5G survey. Question: What enterprise use cases are your company projecting to help accelerate 5G adoption? Base: All surveyed-83; North America-10;Europe-30; Middle-East/Africa-11; Latin America-13; Asia-Pacific-19.

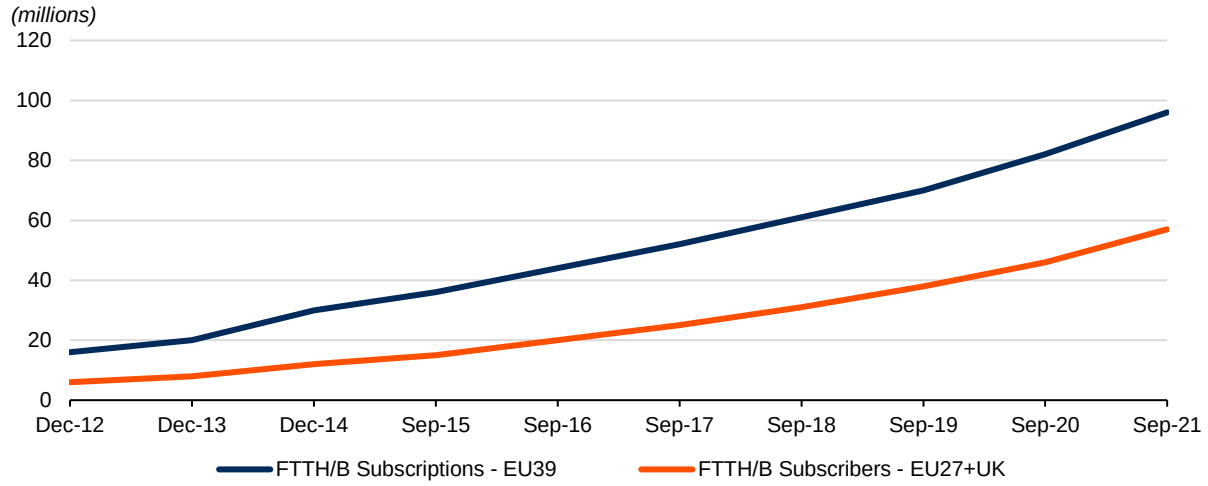
Fiber to the Home/Building (FTTH/B): Backbone of EU's Digital Decade Ambitions

The FTTH Council Europe defines "fiber to the home" as an access network architecture in which the final connection to the subscriber's premises is optical fiber. The fiber optic communications path terminates on or inside the premises for the purpose of carrying out communication services to a single subscriber. FTTH is the only type of fixed-line access network solution that is truly proofed against all future developments and eventualities; therefore, the only one that it makes sense to invest in where a new network is being deployed.

FTTH provides key advantages to a nation in terms of delivering a reliable higher bandwidth that the current information-led economies and communities demand. FTTH poses lower carbon footprint as its deployment requires reduced energy to build and run fiber networks.

CFRA believes that Europe's ambitious connectivity targets of gigabit for everyone and 5G everywhere by 2030 relies heavily on the deployment of optical fiber network. According to the FTTH Council Europe's Market Panorama 2022 report, FTTH/B subscriptions for EU39 reached 96 million with EU-27 + U.K. accounting for 60%. 49% of European homes are now covered by full fiber with Iceland, Spain, and Sweden having more than 50% of total homes with full fiber.

FTTH/B SUBSCRIBERS: COMPARISON EU-27 + U.K. and EU-39



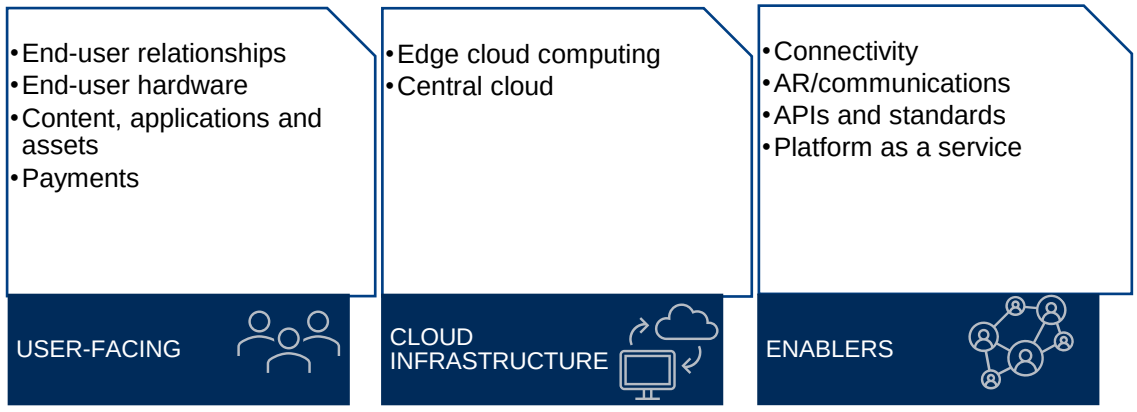
Source: FTTH Council Europe.

Telcos Ventures Into Metaverse

Metaverse has certainly been brought up in the larger market discussion in 2022, and it will be even more popular in the coming years. Metaverse is a word that was coined by author Neal Stephenson in his 1992 sci-fi novel Snow Crash. In the novel, Stephenson defined the metaverse to be an all-encompassing digital world that exists parallel to the real world. Matthew Ball, a venture capitalist and angel investor, is one of the leading experts in the metaverse universe. In his own words, Metaverse is best understood as 'a quasi-successor state to the mobile internet' since Metaverse will not fundamentally replace the internet but will build upon and iteratively transform it.

Metaverse is a massively scaled and interoperable network of real-time rendered 3D virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users, and with continuity of data, such as identity, history, entitlements, objects, communications, and payments. According to Ball, the Metaverse relies on low latency and higher bandwidth for its existence. As 5G services are expected to deliver higher multi-gigabits-per-second (multi-Gpbs) peak data speeds and low latency, consumers will be able to enter the metaverse.

FRAMEWORK FOR CONSIDERING APPROACHES TO THE METAVERSE



Source: Analysys Mason, Matthew Ball.

The framework for considering approaches to the metaverse originally created by Matthew Ball has since been regrouped by Analysys Mason into 10 sub-categories and three super-categories, as shown in the

chart above. A telco does not need to excel in every aspect to be successful, and operators will naturally succeed in some areas (such as connectivity) and hyperscalers in others (central cloud).
The three super-categories have been defined by Analysys Mason as follows:

- **User-facing.** This includes end users and their 'digital life'; the hardware that enables them to interact with the metaverse, the content that they consume, and the applications and payment systems through which they engage in commerce.
- **Enablers.** We use this term broadly so as to incorporate all elements that enable metaverse services to operate and users to interact: connectivity, real-time communication both within different points in the metaverse and from the metaverse out to the 'real world' (for example via AR), the APIs and standards, and platforms that support and enable that activity.
- **Cloud infrastructure.** The hardware and processing resources upon which the metaverse software and platform runs.

CFRA expects that a full-fledged metaverse is decades away. Nonetheless, the hardware ecosystem that supports emerging technologies and trends could bring about an experience never seen before. CFRA believes that Asian telco players could monetize the metaverse by offering content and applications that complement user interests in enterprise deployment (marketing, branding, shopping) and consumer deployment (gaming, content creation).

SK Telecom was able to take advantage of South Korean consumers' interest in using AR/VR services more than those in other developed markets, according to Analysys Mason. As of the second quarter of 2022, SK Telecom's ifland (SK Telecom's metaverse ecosystem) has 1.63 million monthly active users. Following the successful deployment of ifland in South Korea, Deutsche Telekom has teamed up with SK Telecom's investment firm, SK Square Co, to launch its metaverse platform and services in Europe, as reported by SK Telekom in May 2022.

Return of Roaming Helps Revenue in 2022
Due to lockdowns at the start of the pandemic, roaming revenues have declined substantially. As lockdowns are lifted and international travel resumed, roaming revenues have been on the rise. This rebound, however, is limited by the EU's Roam Like at Home regulation, which prohibits roaming charges directed at consumers, with telcos mostly earning wholesale interconnection fees, largely benefitting telcos that operate in destination countries. CFRA expects the 2022 FIFA World Cup, hosted by Qatar in November this year, to boost European telecom revenues due to roaming and also streaming of the world cup matches. 16 of the 32 competing national teams in this world cup are from Europe.

Limited Room for Subscriber Growth
Mobile subscriptions continue to slow due to a high penetration rate in the region, with the number of unique mobile subscribers expected to grow to 87% in 2025 from 86% in 2021, according to GSMA. In fact, Europe has the highest regional rate at 86%, just above 84% in North America and 81% in the Commonwealth of Independent States (CIS), according to GSMA's "The Mobile Economy 2022" Report.

Saturation of the total addressable market in Europe, particularly in Northern and Southern Europe, is edging closer. Material increases in the number of subscribers are likely to come from the larger European mobile markets, where there is still room for growth. GSMA expects the majority of Europe's subscriber growth to come from the Netherlands, France, Germany, Italy, and Spain.

5G Provides Opportunity for Telecom Operators to Win New MVNO Deals
The commercialization of 5G is giving telecom operators an opportunity to win over new MVNO deals as they reconsider their options in light of the next-generation networks. For example, MVNO Ting Mobile decided to switch its U.S. service from T-Mobile to Verizon after T-Mobile failed to offer the promised benefits of a combined network after its merger with Sprint was delayed.

In February 2022, U.K.-based MVNO Truphone secured a 5-year partnership agreement with BT Wholesale covering MVNO access services. Truphone's customers will have access to EE's geographic reach. EE now covers more than 86% of the U.K. with 4G. BT Group is the U.K.'s leading telecommunications and network provider. Truphone is one of the world's leading innovators in eSIM, cloud, and digital solutions.

As telecom operators begin to offer 5G services, MVNOs are reassessing carrier offerings. We think telecom operators that aim to attract or retain MVNOs will need to establish widely available 5G services to differentiate their networks.

M&A Environment

Mergers & Acquisition (M&A): Growing Infrastructure Ambitions
As a mature industry, M&A activity has been about consolidation, with incumbents joining together to capture a larger piece of the pie than they could individually. Telecom operators have also shown a growing interest in acquiring businesses in the media business to bolster their bundled offerings. Dealmaking, in general, was on the rise in the first half of 2021 (see table below), and M&A activity in the industry could still ramp up in 2022, albeit slower, driven by ongoing private equity and infrastructure fund interest and the perennial push for service provider consolidation.

EUROPE TELECOMMUNICATIONS M&A ACTIVITY IN 2021
(deals of at least $1,000 million as of September 1, 2022, arranged by deal value)

DATE ANNOUNCED	BUYER	BUYER COUNTRY	TARGET	TARGET COUNTRY	DEAL VALUE ($M)	DEAL STATUS
09/07/21	Investor Group (Apax Partners LLP & Warburg Pincus LLC)	U.K.	T-Mobile Netherlands Holdings B.V.	Netherlands	5,691.9	Completed
03/10/22	Turkey Wealth Fund Management Co.	Turkey	Turk Telekomunikasyon Anonim Sirketi	Turkey	1,650.0	Completed
02/18/22	Lyse AS	Norway	Ice Group Scandinavia Holdings AS	Norway	1,051.4	Completed

Sources: CFRA, S&P Global Market Intelligence.

On March 8, 2022, Orange confirmed discussions on a merger between its Spanish operation and rival operator Masmovil, with the two entities aiming to create a 50:50 joint venture for their offerings in Spain. This joint venture is expected to create an enterprise value of US$19.6 billion and more than 20 million mobile, 7 million fixed, and almost 1.5 million TV customers. It's estimated that the joint venture will have revenue of more than US$8.2 billion and generate synergies with an annual run rate in excess of US$489 million from the third year after the closing of the transaction. On July 23, 2022, Orange and MasMovil signed a binding agreement to combine operations in Spain. The transaction is expected to be signed by the second quarter of 2022 and to close by the second quarter of 2023.

HOW THE INDUSTRY OPERATES

Companies in the telecommunications industry, or telcos, are primarily service organizations that employ a wide range of predominantly unionized workers, including engineers, computer programmers, service technicians, sales agents, and marketers. Telcos provide fixed-line and wireless communication services.

Fixed-line communications include voice and broadband (internet connectivity) services delivered to the home and enterprise. Wireless communication allows people to stay in touch anytime and almost anywhere through handheld telephones. Unconstrained by wires, mobile system users can communicate while traveling. The wireless phone converts the speaker's voice into radio waves that travel through the air until they reach a receiver at a nearby base station. The base station then sends the call through the telephone network to the intended recipient.

Born from radio dispatch technology and developed by Bell Laboratories in the 1960s, mobile communication began with analog transmission and evolved into digital technology. Consumer services originated in specialized mobile radio (SMR) service, an analog technology initially used in automotive telephony. In the 1980s, cellular telephone service using analog technology was initiated. Cellular service derives its name from the small geographic regions, called cells, into which a service area is divided. By the late 1980s, second-generation (2G) digital mobile services were launched on a global system for mobile communications (GSM), which was adopted as a common standard across Europe; in the U.S., in contrast, a technology battle between GSM and code division multiple access (CDMA) operators persisted until 2011, when Long-Term Evolution or LTE (a 3G standard now commonly referred to as 4G) was adopted as a common global wireless technology. Additionally, 3GPP, the industry standards group, proposed the 5G New Radio (NR) standard together with LTE as its submission to the IMT-2020 standard.

A Brief History of Europe's Wireless Telecom Market

Incumbent operators were at the forefront in the deployment of wireless communications services in Europe. These companies had originally been state-owned monopolies that provided local as well as national and international long-distance service. The wave of liberalization and privatization of the 1990s, aimed at creating a more dynamic and efficient industry, transformed the telecommunications market. Nevertheless, the newly public companies retained both their broad reach into all segments of the market and, often, their rather cumbersome way of doing business.

Telcos Go Global to Grow

Although governments typically retained either a significant stake or a so-called golden share in telecommunications companies (which gave them the right to veto management decisions), the newly privatized carriers were forced to answer to private shareholders for the first time. Under pressure from global equity markets, European companies felt the need to improve their earnings outlook. Mergers were often seen as the easiest way to gain access to a new geographical market.

With capital easily available, international partnerships and acquisitions were viewed as a painless way to satisfy companies' need to grow. Latin America underwent the same wave of liberalization and privatization as Europe and European companies played on their cultural ties to enter those markets. The unification of Europe under the EU umbrella and common currency also stimulated consolidation by making the regional scope more desirable.

In addition, wireless and internet technologies were coming of age at this turbulent time, and incumbent fixed-line operators dove into these markets to propel growth. The steady and rich revenue streams

provided by fixed-line services initially supported the investments needed to build wireless networks and upgrade existing wireline systems to support internet access.

Leveraging Wireless Strength
Several incumbents sought to leverage the spectacular growth of their wireless and internet business units by spinning them off as independent companies. Some companies that planned to implement this strategy were brought up short by the collapse of the equities markets beginning in 2001. Still, others found that the small size of their domestic markets required cross-border consolidation to remain competitive. The creation of TeliaSonera AB, which combined the incumbent telecommunications companies of Sweden and Finland, exemplifies this strategy.

Cost of 3G/4G Stimulated Alliances, 5G Likely to Do the Same
The licensing of 3G spectrum in Europe became a driver of alliances. After an unexpectedly expensive auction in the U.K., companies began to question whether they could afford to buy licenses single-handedly and then invest in the infrastructure needed to deploy services. They formed consortiums to bid on other licenses throughout Europe, though the advent of these alliances raised the possibility that companies that partnered in one market might be competitors in another.

Companies also used alliances to build 3G networks. Some licenses joined forces within individual markets to build a single network to service the partners, which continued to compete for customers. In many cases, this required regulatory approval, but regulators generally cooperated considering the financial burden licensing costs placed on service providers. Still, several operators returned their licenses to regulators, planning to avoid the cost of building a network while still offering advanced services by leasing capacity from competitors in MVNO arrangements.

The 3G licensing process and acquisition spree among European telecommunications providers sent debt levels to unprecedented heights. Although mobile services continued to grow and provide revenues, several operators had to shed assets and concentrate on core businesses and geographies to get their finances back in order.

Alcatel-Lucent, Cisco, Clearwire, Intel Corp., Samsung Electronics, and Sprint formed the Open Patent Alliance (OPA) in June 2008 to accelerate the adoption and deployment of worldwide interoperability for microwave access (WiMAX) technology. The OPA aims to stimulate a larger WiMAX industry that supports innovation worldwide through broader choice and lower equipment and service costs.

MVNOs Exert Pressure
Unlike traditional wireless operators, MVNOs do not own their networks. They purchase cellular airtime from network operators and resell wireless services to their own customers. In an intensely competitive marketplace, MVNOs differentiate themselves through branding and by offering low prices. Notably, the recent 5G auctions have produced a shift in the competitive environment as MVNOs won spectrum allocations, making them full-fledged MVNOs.

How Wireless Works

Wireless carriers operate a network of radio towers that are connected to each other and to the larger, fixed-line network, usually referred to as the public switched telephone network (PSTN). Each carrier earns revenue by charging customers various types of access fees to use its network.

Mobile service has proven enormously popular. The number of mobile subscribers overtook that of fixed lines globally in 2002, according to the International Telecommunication Union (ITU), the leading United Nations agency for information and communication technology issues.

The fundamental unit of the network is the base station, which is owned by the carrier and contains radio transmitters and receivers, usually mounted on a tower. They convert the radio signals sent from a mobile handset into electrical signals that are then transmitted to a mobile switching center, which converts the signals into a form that can be relayed to other base stations or to the PSTN.

Each base station covers a particular area, forming a "cell," which slightly overlaps other cells to form a contiguous service area. As a customer travels from one cell to the next, the mobile switching center coordinates a handoff to maintain the continuity of the call. Calls travel between a customer's handset and a base station using radio waves. The amount of radio spectrum that is suitable for communications is limited and must be shared by governments among military and commercial users, including mobile operators. Before frequency-sharing techniques were developed, the limited number of radio channels put a tight cap on the number of mobile subscribers.

The Evolution of Wireless Services

Each cellular network is based on a technological standard, or "access technology," that determines how customers share the radio channels needed for wireless service. The first-generation (1G) cellular systems used an analog signal, in which each subscriber was allocated a radio channel when making a call. Few of these networks exist anymore, having been replaced by digital systems. The 2G of cellular networks was based on digital signals, in which the voice signal is translated into a series of 1s and 0s. Digital signals allow for data services and greater security. Most importantly, they permit multiple customers to share a single radio channel.

While there are two major competing digital technology standards used in digital wireless networks around the world, GSM is the only standard in use in Western Europe. It is mandatory for carriers in countries belonging to the European Telecommunications Standards Institute (ETSI) and has been widely adopted elsewhere.

In contrast to the U.S. and Japan, Europe's adoption of a single 2G technology standard has served the region's industry well by ensuring compatibility between carriers. This makes possible widespread international roaming and data interconnections. The European Community has replicated this success by adopting the universal mobile telecommunications system (UMTS) standard as its single 3G platform.

2G Technologies

GSM and CDMA are the dominant 2G technologies globally.

◆ **Global system for mobile communications.** Global system for mobile communications (GSM) is an ETSI standard that allows manufacturers to make equipment compatible with other GSM products within a framework of fair and reasonable intellectual property licensing. It is based on a spectrum-sharing technology called time division multiple access (TDMA).

TDMA represents a refinement of frequency division multiple access (FDMA) that was used in analog systems. FDMA divided the allocated spectrum into many channels, each 30 kilohertz (kHz) in size. Each caller used a full channel. TDMA divides each channel into eight time slots – seven carrying traffic and the eighth carrying control signals. The technology, therefore, increases network capacity by a factor of seven versus analog systems while using the same amount of spectrum.

◆ **Code division multiple access.** Code division multiple access (CDMA) is an alternative to GSM. U.S.-based Qualcomm Inc. developed CDMA in the late 1980s. Vendors selling equipment based on that standard must pay the company a royalty for the right to do so. CDMA takes a digitized voice signal that has been turned into bits and assigns a code to each bit. The encoded speech is then sent as a scrambled transmission over the air. At the other end (a handset or base station), the speech is reassembled into its original format.

2.5G Technologies
Despite spending billions of dollars buying 3G licenses in 2000–2001, most European operators did not rush to deploy 3G networks in the early part of the decade, given financial constraints resulting from the collapse of the internet bubble. Instead, many GSM operators sought to take advantage of so-called 2.5G technologies to enable data services over their existing infrastructure. The major 2.5G extensions for GSM are general packet radio service (GPRS) and enhanced data rates for global evolution (EDGE).

For a standard GSM network, the first evolutionary step is to add GPRS, which allows data services to be provided over GSM networks. It has a maximum transmission speed of 20.2 kilobits per second (kbps) per time slot. While GSM uses digital signals instead of analog, it still uses circuit switching; that is, a handset must find an unoccupied slot of a radio channel and make a connection with the base station so that the handset can send or receive information. In other words, circuit-switched networks allocate the entire slot to a single subscriber for a given period – whether that customer is using it or not. GPRS uses packet-switched technology, which is only in use when a customer is sending or receiving data.

Compared with GPRS, EDGE uses more efficient coding and modulation schemes, which allow up to 59.2 kbps per time slot. While both GPRS and EDGE are essentially software upgrades of the existing 2G network infrastructure, they both required a new generation of handsets to be in subscribers' hands to take advantage of the technology.

3G Technologies
Wideband code division multiple access (WCDMA, known as universal mobile telecommunications system, or UMTS in Europe), and CDMA2000 are the two 3G platforms currently in use globally. Both systems use the code division multiplexing technique championed by Qualcomm. There are multiple generations of both technology platforms, with data rates starting around 400 kbps and reaching around 2,000 kbps more recently. Higher 3G data speeds enable enhanced multimedia (e.g., video transmission) as well as internet access (email and web browsing).

In the same way that EDGE and GPRS were software upgrades of 2G networks, high-speed packet access (HSPA) has emerged as an enhancement to WCDMA/UMTS systems. There are multiple versions of HSPA that have evolved with data rates ranging from 1,200 kbps all the way up to 84,400 kbps.

Beyond HSPA, operators are looking at LTE as the common technology choice globally for enhancing mobile network capacity. LTE uses an air interface multiplexing technique known as Orthogonal Frequency Division Multiple Access (OFDMA) and uses an all-Internet Protocol networking architecture. The LTE specification provides downlink peak rates of at least 100 Mbps and uplink rates of at least 50 Mbps.

4G Technologies
There are three major standards for 4G technology: long-term evolution (LTE), ultra-mobile broadband (UMB), and mobile WiMAX. Among the three, network providers offer LTE, WiMAX, or both, depending on how these technologies benefit their business. By far, LTE is the preferred 4G standard, as it is compatible with existing WCDMA and HSPA networks. LTE supports channel bandwidths from 1.25 MHz to 20 MHz, and both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) operations.

LTE technically does not meet the criteria of a 4G wireless service, as specified in the 3rd Generation Partnership Project (3GPP) documents. However, due to marketing pressures and the significant advancements that WiMAX and LTE bring to the original 3G technologies, the International Telecommunication Union (ITU) decided that LTE and these technologies can be called 4G.

In 2011, the LTE-Advanced (LTE-A) standard was formalized. It is a major enhancement to the LTE standard, offering peak data rates of up to 1GB/second. One of the major features of LTE-A technology is

the availability of carrier aggregation. This allows service providers to combine up to five separate LTE carrier bands and increase the peak user data rate, raise the overall capacity of their networks, and exploit fragmented spectrum allocations.

5G: Looking to the Future

While the deployment of 5G networks started in late 2018, commercial deployment of 5G networks is aimed at meeting the requirements for mobile communications beyond 2020. Rising mobile data consumption requires more support, a key objective of the 5G network.

4G wireless technology provides the foundation for 5G. Unlike 4G, which requires large, high-power cell towers to radiate signals over long distances, 5G wireless signals will be transmitted via large numbers of small cell stations located in places like light poles or building roofs. 5G uses a 5G New Radio interface, along with other new digital technology called massive multiple-input multiple-output (MIMO), to transfer more data over the air for faster speed, reduced congestion, and lower latency. 5G download speeds can reach 1,000 Mbps. Low-band 5G is more likely to be available for more rural locations with speeds up to 250 Mbps, while mid-band 5G is available in major urban areas with download speeds up to 900 Mbps.

Initially, 5G standards were associated with the International Telecommunication Union's International Mobile Telecommunications-2020 (IMT-2020) standard, which required a theoretical peak download capacity of 20 gigabits per second, along with other requirements. However, 3GPP, the industry standards group, proposed the 5G New Radio (NR) standard together with LTE as its submission to the IMT-2020 standard.

After initially delivering "Non-Stand-Alone" (NSA) NR specifications for 5G in late 2017, 3GPP worked on completing Release 15, which is the first full set of 5G standards. While initial specifications enabled NSA 5G radio systems to be supported by existing 4G infrastructure, Release 15 extends to cover "standalone" 5G, with a new radio system complemented by a next-generation core network. On July 2, 2020, 3GPP finalized Release 16, the second set of specifications for 5G New Radio technology. Release 16 is set to target enhancements for new capabilities and expansion into different verticals, including support for unlicensed spectrum, industrial IoT, and automotive applications. Looking ahead, 3GPP highlighted that Release 17 is expected to be completed in 2022.

6G: Initial Research Kicked Off

Although 5G was only introduced in 2020, the European telcos find themselves lagging behind China's progress in terms of 5G rollout. The European Cout of Auditors released a special report back in January 2022 stating that delays in the deployment of 5G networks have put the EU's 2025 and 2030 objectives at risk of achieving them. The delays were mainly due to the postponement of auctioning off spectrum bands during the Covid-19 pandemic and the security concerns on over-reliance of vendors from non-EU 5G vendors that might present a security risk.

CFRA believes it is unsurprising that the EU would like to be in the leadership position for the next inevitable 6G. On July 11, 2022, Nokia announced it will lead 6G-ANNA, a German national-funded 6G lighthouse project. Nokia will collaborate with the 29 partners in 6G-ANNA to lead and drive 6G research and standardization. Nokia believes that 6G will expand and transform what a network can do. It will fuse the human, physical and digital worlds to liberate our innate human potential.

WIRELESS TECHNOLOGY STANDARDS				
GENERATION		**ACCESS TECHNOLOGY**	**TRANSMISSION SPEED**	**ADVANTAGES / DISADVANTAGES**
2G		GSM	14.4 kbps	Widely deployed, allows international roaming
		cdmaOne (IS-95A)	14.4 kbps	Stronger security features, longer handset battery life, more efficient use of bandwidth than GSM. Disadvantages include lack of global roaming capabilities, narrow deployment, fewer equipment suppliers, proprietary technology.
2.5G	For GSMA	GPRS	64 kbps	"Always on" allows easier Internet browsing. Bandwidth shared with other users a disadvantage.
		EDGE	384 kbps peak, 140-160 kbps more likely.	Allows greater data rates per timeslot than GSM/GPRS.
	For CDMA	cdmaOne (IS-95B)	64 kbps peak, 14.4 kbps typical.	4 to 5 times capacity of GSM systems.
3G		WCDMA	2 Mbps peak, 400 kbps typical.	Faster data speeds and greater capacity than CDMA2000 1X. More expensive to deploy than CDMA2000 1X. Not compatible with earlier GSM networks.
		TD-SCDMA	2 Mbps peak, 1.2 Mbps typical.	Excellent for transmitting Internet data. Wide coverage area, more efficient use of spectrum for one-way transfer. Disadvantages include no commercial deployments, few equipment vendors.
		CDMA2000 1X(Release 0)	307 kbps peak, 144 kbps typical.	Greater voice and data transmission capacity than cdmaOne using same bandwidth.
		CDMA 1X EV-DO (Evolution-Data/Optimized)	2.4 Mbps peak, 750 kbps typical.	Faster data speeds, handsets compatible with earlier CDMA networks.
		CDMA 1X EV-DV (Evolution-Data/Voice)	3.1 Mbps peak	Able to deliver real-time video streaming.
3.5G	For GSMA/ WCDMA	HSDPA (High-Speed Downlink Packet Access)	14 Mbps future potential, currently 3.6 Mbps	Delivers streaming video, interactive gaming, and multimedia music WCDMA tracks at speeds almost 3 times faster than WCDMA. Compatible with GSM/WCDMA.
	For GSMA/W-CDMA	HSPA+ R8 (High-Speed Packet Access Plus)	Enhances rates up to 42 Mbps; future potential to 84 Mbps and beyond	Doubles data capacity over HSPA, more than doubles voice capacity over WCMDA. Enhances end-user experience, improved "always-on" experience.
	For CDMA	CDMA 1X EV-DO Revision A (Evolution-Data Optimized)	3.1 Mbps peak download speed, 1.8 Mbps upload	Revision A is an upgrade for CDMA 1X EV-DO. Compatible with CDMA networks.
4G	For GSMA/ WCDMA	LTE (Long Term Evolution)	100 Mbps peak download, 50 Mbps upload	Widely supported by equipment suppliers and wireless operators. Compatible with GSM/WCDMA.
		LTE-Advanced	1 Gbps peak download, 500Mbps upload	Compatible with GSM/WCDMA/LTE.
	For CDMA	UMB (Ultra Mobile Broadband)	288 Mbps peak download, 75 Mbps upload	Compatible with CDMA networks. Disadvantages on fewer equipment suppliers. Discontinued.
		WiMAX	128 Mbps peak download, 100 Mbps upload	High power consumption a disadvantage.
5G	For GSMA	New Radio (NR)	Low-Band Specttrum (<1 GHz): 250 Mbps peak download	Provide widest coverage among the spectrums. Lower data speeds as compared to mid-band and high-band spectrum.
			Mid-Band Spectrum (1-6 GHz): 900 Mbps peak download	Provide wide coverage with high data speeds.
			High-Band Spectrum (>24 GHz): 2 Gbps peak download	Able to transmit very high volume of data at ultra-high speeds. Short range of coverage and cannot penetrate buildings.
Sources: CFRA, CDMA Development Group; GSMA Intelligence; S&P Global.				

Handsets and Brands: Critical Ingredients for Success

While a strong technological underpinning is crucial to success in the wireless industry, other factors also play a role, including the handsets a company provides its subscribers and the branding of its services. We discuss these below.

◆ **Handsets.** Handsets are an important part of the wireless services industry since they are the primary interface between customer and service. Mobile phone price, size, battery life, and other features help determine whether service providers can attract subscribers.

In many markets, wireless service providers subsidize the cost of handsets to reduce the upfront cost to subscribers. Companies seek to recoup the cost of the subsidies over time through higher subscription

fees. This strategy has succeeded in luring a wide range of customers to wireless service, boosting subscriber numbers. Nevertheless, the cost has weighed on service providers. European operators began to reduce subsidies in the aftermath of the very expensive 3G licensing process in Europe as they tried to reduce the unsustainable degree of leverage.

◆ **Brands.** Mobile communications are evolving beyond voice services to include messaging, video, music, games, transactions, and information. People use their mobile devices to connect to a vast array of services, information, and entertainment, as well as to their friends and workplace. Blending some of the attributes of traditional telephony, personal computers, and entertainment and gaming devices, wireless communications are nevertheless unique because they provide ubiquity, mobility, and personalization.

Marketers in the wireless industry understand that their brands must reflect customer desires and product attributes, as well as differentiate their services in the increasingly competitive marketplace. Wireless operators are not only competing with other mobile companies; they must also compete with the brands of handset manufacturers (e.g., Samsung), application providers (e.g., Facebook), and providers of content (e.g., Netflix and Disney+).

The French incumbent (originally known as France Télécom) extended its Orange brand to encompass all its digital services (internet, TV, and mobile) and activities worldwide. When its decision was announced in 2006, France Télécom stated that the Orange brand was a strong asset for the company's convergence strategy, including communications, movies, games, and music. In July 2013, France Télécom changed its name to Orange.

More recently, U.K. telecoms Vodafone and Three have launched sub-brands aimed at reaching new users, notably younger ones, who are not attracted to the main brands. In August 2017, Vodafone launched Voxi, a SIM-only brand, to under-25s only, which targeted younger users who had no interest in the old "Voice-Data-Phone" brand that was coined in the 1980s.

Governments Control the Airwaves

Governments exercise a large degree of control over the wireless telecom industry because they are responsible for distributing the scarce radio spectrum necessary for providing mobile services. Regulatory authorities often use the ability to restrict access to spectrum to advance policy objectives related to competition and industry growth.

Governments decide how many wireless carriers will exist within their jurisdiction when they set the number of licenses available for spectrum allocation. They also have a high degree of influence over which carriers operate in their markets. Governments distribute spectrum to carriers in two main ways. They can auction licenses to the highest bidder; the license is awarded to the company whose proposal most closely matches a specific set of criteria. A hybrid approach combining elements of the two has also emerged.

Licenses often come with obligations and conditions for service. Governments can impose requirements regarding when service will begin, what areas of the country will be covered, and what portion of the population will be included. Political considerations often drive these decisions, though within technically feasible parameters. Other obligations may include pricing constraints, universal service obligations, and provision of emergency services.

In addition to controlling the airwaves, governments also regulate telecommunications services. At the inception of the wireless industry, a regulatory-free environment was in place to promote its growth. However, since 2005, mobile regulation has increased materially in the European mobile markets. The

increase in regulation has come together with a reduction of regulatory pressure on the fixed-line activities and the wireless industry reaching maturity.

Termination Fees Attract Regulatory Scrutiny

While the mobile communications industry historically has been regulated with a light hand virtually worldwide, an issue that has come to the fore in Europe is that of termination, or interconnection, charges. Operators, whether mobile or fixed, must pay these fees when a call initiated on their networks terminates on that of another operator. This is especially important in regions, such as Europe, with a calling-party-pays system (the person originating the call is charged for the service).

The EU has been very proactive in promoting an EU-wide regulation affecting mobile termination tariffs and roaming tariffs, both areas in which mobile operators were abusing their dominant position. As a result, mobile termination tariffs were cut by more than 60% from 2006 through 2010.

The concept of “substantial market power” (SMP), considered to exist when a company’s market share exceeds 25%, forms the core of the EC interconnection rules. National regulators can impose stricter price regulations on companies deemed to have SMP. Regulators may require that these companies set their termination fees according to a cost accounting system. Regulatory decisions regarding interconnection fees can have a material impact on a company’s top and bottom lines. Some critics argue that wireless operators use high interconnection fees for incoming calls to finance other activities.

Although the EC is seeking to harmonize how countries deal with competition abuses, each regulator decides when SMP exists in its country, and so treatments may vary. Furthermore, the structure of a wireless operator may determine how regulatory decisions on prices affect the company. An operator that owns both fixed-line and wireless operations will benefit from any cuts to termination charges on the fixed-line side, while a pure-play wireless operator will not have this cushion. Smaller operators are normally allowed higher termination fees than large operators, but regulation normally includes a progressive reduction in the asymmetry.

International Roaming Agreements

In Europe, the existence of a single technology standard has facilitated roaming—the ability to use a mobile phone outside the provider’s home service area. Roaming involves both technological and business issues.

Technically, for roaming to work, a customer’s home network must be able to communicate with the network being visited to register and validate the presence of the customer on the visited network. The various transmitters and receivers, signaling systems, and mobile switching centers must be compatible and able to interact. In addition, the customer’s home and visited networks must have an agreement to allow their customers to use each other’s systems. Such agreements deal with issues such as the exchange of payment and billing information, and cost of access.

Roaming agreements affect carriers’ competitiveness by helping them to attract new customers and revenue. Customers who rely heavily on their mobile phones would like to be able to use them when traveling. The service is generally more attractive to high-end customers who use their mobile phone for business purposes than it is for those seeking a convenient means of basic telecom service.

Roaming fees, like interconnection fees, have come under regulatory scrutiny in Europe. In March 2006, the Commission proposed revised rules for operators to reduce international mobile roaming charges for voice services. To promote the Digital Single Market strategy of the region, the EC abolished roaming charges in 2017. After Brexit, the U.K.’s trade deal with the EU does not rule out additional charges for U.K. customers using their mobile phone in EU countries. The U.K. mobile operators said they do not

plan to reintroduce roaming charges for now, but it may not be as simple as that in the coming years, in our view.

Allocations of Spectrum

The ITU allocates global radio spectrum as well as satellite orbits, develops technical standards for networks and technologies to interconnect seamlessly, and endeavors to improve access to Information and Communication Technology (ICT) across communities worldwide. Managing the spectrum involves the allocation of non-overlapping blocks of frequencies for users (e.g., broadcasters, military, and mobile operators). It also involves the assignment of specific frequencies within the allocated blocks to different "licensees," according to the ITU, and these licensees have the exclusive right to use the assigned frequencies. In general, spectrum users receive temporary licenses, even though renewal is often a formality.

The ITU holds the World Radiocommunication Conference (WRC) every two to three years to establish a global framework for the use of the radio spectrum. The WRC aims to establish frequency allocations and regulatory procedures for the smooth operation of global radiocommunication services, without the interference of competing signals and transmissions.

Measuring Wireless Penetration and Subscribers

Wireless penetration, defined as the number of customers as a percentage of total population, is often used to evaluate the potential for future growth of a specific market. However, subscription numbers may be based on devices and data cards rather than individual subscribers, leading to distortions in the figures. Furthermore, many companies do not regularly purge their subscriber lists of inactive customers, thus inflating the numbers. There is also a lag when a subscriber switches providers, in which case both the former and new service providers may count the customer.

HOW TO VALUE A COMPANY IN THIS INDUSTRY

Several indicators can be used to evaluate the health of a wireless operator or market. Some of the most important are described below.

Industry Drivers

◆ **Subscriber base.** The number of subscribers and the monthly change in subscribers, is one of the most-watched indicators of a wireless market's health and a company's performance within the market. If the market is growing, monthly subscriber additions are scrutinized for signs of how fast it is growing, whether growth is accelerating or decelerating, and which carrier is winning a larger or smaller share of the new signups.

Subscriber growth rates are also important in judging the success of new technology standards, the popularity of various types of services, and a company's skill at marketing them. Subscriber numbers must also be viewed in the context of a company's marketing efforts. Weak subscriber growth despite strong promotional activity and price discounting may indicate that the market is becoming saturated.

All the major European carriers are publicly owned, so subscriber numbers can be found in their financial reports. However, because wireless operators own stakes in other carriers, they often report wholly owned and partially owned subscribers separately. Due to differences in methodologies for measuring these, data provided by companies may be inconsistent with numbers published by government agencies and data aggregators.

◆ **Penetration.** The number of customers for a service as a percentage of total population. The International Telecommunication Union (ITU) publishes these data annually by country.

◆ **Market share.** Market share data are readily available for wireless carriers since subscriber numbers are publicly available. The total number of cellular users in each country can be obtained by consulting the ITU website. Market share is an important indicator of the strength of a carrier in its market. In European countries, there is often a dominant wireless operator, often related to an incumbent fixed-line carrier. However, in most markets, a second tier of operators provides a considerable degree of competition.

◆ **Average revenue per user.** Together with subscriber numbers and market share, the average revenue per user (ARPU) for a company and for a national or regional market is a highly telling indicator of the outlook for growth and development. The overall level of ARPU indicates how much customers are willing to spend on wireless service.

Trends in ARPU are also important. ARPU may or may not rise when new, advanced services are introduced. Given the high cost of acquiring new customers through price discounts, handset subsidies, or marketing campaigns, most wireless companies focus on increasing the ARPU of customers they already have, rather than spending heavily to find new customers. ARPU data are usually included in each carrier's financial reports.

◆ **Minutes of use.** Minutes of use (MOU) is an important indicator of how much each customer uses the network and, thus, of the company's ability to handle current traffic and future growth. When the average MOU is high, networks must have a greater capacity to serve the same subscriber base than in cases where the average MOU is lower. MOU measures the popularity of a service, as well as the carriers' need for investment in new capacity. MOU data are usually included in each carrier's financial reports.

◆ **Churn.** Customer churn, or the amount of turnover within a customer group, is an important yardstick of how well a company can retain customers and, thus, of its pricing power and popularity. Wireless carriers are constantly striving to reduce churn rates because it is more expensive to attract new customers than to retain existing ones. Like ARPU and MOU, churn rates are usually included in each carrier's financial reports.

◆ **Handset sales.** Sales of mobile handsets are important indicators of wireless demand and of interest in new services. Sales figures can be obtained from the financial reports of major handset manufacturers such as Nokia and Samsung, as well as from market researchers such as the International Data Corp. (IDC) and Gartner.

Company Analysis

In Europe, most service operators in the telecommunications industry offer both fixed and mobile services. BT Group plc was an exception: from 2001 (when the company spun off its mobile operations) to 2006 (when BT acquired EE), the company was a "pure" wireline player, although it offered mobile services on a mobile virtual network operator or MVNO basis.

The analysis of a telecom company requires the analysis of the market conditions (penetration/maturity, competition, and regulation) and of company-specific variables (scale and market position, product and market strategy, operating efficiency, and cost structure).

Most Western European telecom operators concentrate their wireline operations in their domestic markets, with international expansion focused on wireless. This is due to late privatization and follow-up liberalization of European telecom markets, with fixed-line networks regarded as assets of "national" interest and thus excluded from foreign ownership. With the network build-up completed under state ownership, the follow-up rollout of a second countrywide network would have been economically unviable.

While many Western European telecom incumbents concentrated their fixed-line operations in their domestic markets, they spread their mobile operations throughout many European and emerging markets. Emerging markets are less saturated and thus offer more opportunity for growth (through increasing subscriber numbers) than do Western European markets, although average revenue per user (ARPU) levels and consumption of mobile data service are lower. While emerging markets offer subscriber growth, European countries outside the home market offer increasing scale and a wider subscriber base to distribute new value-added fifth-generation (5G) products.

With traditional public switched telephone network (PSTN) lines (both analog and ISDN) in permanent decline, the development of new technologies such as Internet Protocol (IP)-based products and their evolution in the market also need to be considered.

Market Analysis

Market Maturity/Saturation

The European telecom markets are already highly saturated, with unique mobile subscriber penetration rates forecasted to reach 87% by the end of 2025, from 86% in 2021, according to the GSMA. However, these penetration rates vary between countries, making some markets (e.g., France) more attractive than others. Across Europe, 5G connections are expected to surge from about 1% of total connections in 2021 to 9% by 2025, while the 4G connections are expected to reach 70% of total connections in 2025, from 49% in 2021, according to GSMA.

The European industry has made mobile communication accessible to all, expanding the user age brackets and lowering the cost to reach ever-lower income levels, which, together with double SIM cards

and machine-to-machine, explains the high penetration rate. As such, further growth must come from increasing ARPU rather than just increasing customer numbers as in the past.

Competition

A key distinction to make when analyzing the competitive environment is whether it is infrastructure-based or non-infrastructure-based.

◆ **Infrastructure-based competition.** Infrastructure-based competition has its pros and cons. On the one hand, given the higher level of investment required, competitive behavior tends to be more rational and less price-based—and, thus, less value-destructive for the incumbent in the short term. However, it affects all the incumbent's revenue structure: operators can provide not only traffic-based products but also access, and thus have a closer relationship to the end customer, which makes them a larger threat in the market. In countries with widespread cable penetration, the telecom incumbent enjoys a lower share of all access lines and operates in a market that is more competitive overall.

◆ **Non-infrastructure-based competition.** Non-infrastructure-based competition has adopted different forms and shapes, evolving as technology and the regulatory framework have changed. The opening of the market started in the voice and data traffic segment. Thus, the first form of competition started with traffic resellers using either call-by-call selection (where the user could dial a code before the destination number to have the call carried by a non-incumbent carrier) or carrier pre-selection (where all user calls are carried by a previously chosen carrier). More recently, access has been liberalized with the implementation of unbundled local loop (ULL) and wholesale line rental (WLR). As ULL and WLR gain traction, both call-by-call selection and carrier pre-selection have been progressively losing market share.

The implementation of local loop unbundling has been one of the main regulatory measures adopted in Europe, as it opened the last mile to competitors that could place their own equipment in the local exchanges. It created a hybrid between infrastructure- and non-infrastructure-based competition because unbundling requires some level of capital investment not required in other forms of competition. The implementation of WLR also moves resellers up the food chain, from traffic competitors to access competitors, strengthening their relationship with the end customer, which they now bill for voice and access. All told, the greater the cable and unbundling penetration, the more competitive the overall market is, and the less worthwhile it is to enter or remain in the market, in CFRA's view.

The attractiveness of most wireless telecom markets depends on the number of network-based players, and the existence and number of MVNOs in the market. The larger the number of network operators and MVNOs operating in a market, the less attractive the market becomes.

MVNOs were not introduced into most European markets until the late 1990s. They are operators that buy capacity on a wholesale basis from the network operators and resell it to the consumer market. They often compete on price, so the larger the number operating in a market, the more competitive the market becomes. The U.K. market is an example: the combination of four network operators and a large number of MVNOs has made it one of the more competitive markets in Europe prior to Brexit, driving earnings before interest, taxes, depreciation, and amortization (EBITDA) margins to the low 20s and high teens (versus margins in the mid-40s in some other European markets).

Regulation

The main objective of the national regulatory authorities (NRAs) is to promote competition in the domestic markets, while the EU Commission for Telecommunications presents vision and avenues for Europe's digital transformation. On March 9, 2021, EU Commission proposed a Digital Compass for the EU's digital decade that evolves around four major points: 1)Skills, 2)Digital transformation of businesses, 3)Secure and sustainable digital infrastructures and 4) Digitalization of public services.

◆ **Wireline regulation.** This regulation has progressively shifted its focus from retail markets (during the 1990s and early years of this decade) to the wholesale market (since the mid-2000s). With a small number of domestic competitors in each market, the first objective was to cut artificially high retail voice traffic tariffs while raising artificially low line-rental fees. As this was achieved and the number of domestic players increased, regulators moved to facilitate competitors' operations, their access to the incumbents' network, and fair interconnection rates. Wholesale regulation is largely cost-based (marginal costs or long-run incremental costs), and the EU expects wholesale prices not to diverge materially across European markets; however, with different cost structures in the various markets, the Commission does not expect a full price convergence.

Many European NRAs have moved to full deregulation of retail prices, freeing operators from price controls or prior notification. This, together with increased flexibility to launch bundled products (voice and broadband, voice/broadband and TV, voice/broadband/TV and mobile), has materially improved the incumbents' approach to the market, increasing their competitive position.

National regulators' approaches to their markets have been (and remain) different, with some NRAs following a much more protectionist approach. In CFRA's view, the benefits of short-term protectionism will be more than offset by the slower development of new markets and by the incumbents' reduced ability to adapt to new times and new competition.

◆ **Wireless regulation.** This has come on two key fronts. The first area of intervention involved actions that allowed new players to enter the market, either through new licenses or legally opening the market to MVNOs; the second involved actions to lower interconnection and roaming tariffs.

◆ **New entrants.** The model for MVNOs has been relatively consistent since its conception in the 1990s when the liberalization of the regulatory frameworks first made it possible for a third-party company to buy wholesale bulk access to 2G networks. The process saw the entry of some MVNOs in the European markets. Now, no doubt that 5G is now top of the list for most MVNOs' network strategy and the recent 5G auctions have produced a shift in the competitive environment, in our view, as MVNOs won spectrum allocations, making them full-fledged mobile network operators. CFRA thinks markets with minor MVNO presence have remained more attractive than those with many MVNOs.

◆ **Interconnection and roaming tariffs.** On the tariff front, the calling-party-pays (CPP) model that operates throughout Europe (versus the U.S. model in which the subscriber pays to make and receive calls) had in the past allowed the operators to impose high MTRs with little relation to the actual cost of terminating the call in the mobile network. To correct this situation, national regulatory agencies (prompted by the EU Commission for Information Society and Media, in many cases) started to implement 3-year termination cut paths that led to interconnection tariff cuts close to 50% (from double-digit tariffs to a weighted average of a maximum rate of 0.74 euro cents per minute as of January 2020); this will be reviewed annually by the EC.

This process, together with the saturation of the markets and the increasing levels of competition, contributed to the significant slowdown in mobile revenue growth in the past four years (incoming revenues represented about 30% of mobile revenues before the termination cuts were implemented). However, it had a lower impact on mobile margins, as operators also experienced a reduction in their interconnection costs.

Roaming services were next to be affected by regulatory actions, with unrealistically high tariffs before the EU intervention. The EU path to lower voice roaming tariffs stretches until 2013 and includes total tariff cuts of 30%–40% from 2007 to 2013. Although the impact of roaming cuts on revenues has been lower than the impact of termination cuts (roaming revenues represented between 3% and 8% of service revenues, in most cases), their impact on margins has been strong, given the high margins of voice roaming. The EC abolished roaming charges in June 2017.

Key Company Variables

Scale and Market Positioning

Scale (an operator's subscriber base) provides cost advantages in purchasing (spectrum, handsets, and network infrastructure) and in sales and marketing. As a result, market leaders and large-scale players tend to enjoy higher margins than smaller players operating in the same market.

Historically, scale has driven most of the acquisitions among European players. Examples include Telefónica's acquisition of O2's operations in Europe, France Télécom's acquisition of Orange, KPN's acquisition of E-Plus, and the subsequent acquisition by Telefónica Germany of E-Plus from KPN. Although European players use the same mobile technology, acquirers need to consider market positioning before undertaking an acquisition.

Market positioning is a critical element that can overcome the disadvantages of being a small player, as E-Plus' operations previously demonstrated in Germany, where the company delivered higher margins than its larger incumbent competitors did. (We note that one of those rivals, Telefónica Germany, has since bought E-Plus and combined it with its own O2 Germany operations.) Companies can opt to serve the high end or the low end of the market, the corporate or the residential segment, and follow a multi-niche strategy or a mass-market one; each of these decisions will have an impact on a company's margins and growth rates. Initially targeting the high end of the market, with materially higher ARPUs and lower churn rates, should help a company deliver higher margins, but higher handset subsidies and more dedicated customer care channels (especially when targeting the corporate sector) might erode the margin difference over time. On the other hand, a SIM-card-only, multi-niche strategy (e.g., immigrant communities, international traffic, youth groups), similar to that implemented by E-Plus in Germany some years ago, can prove very profitable, as the company managed to minimize the cost structure to match its target market.

Product and Market Strategy

In the wireless segment, operators employ target market strategies, with some targeting the high end or the low end, market value share, or subscriber share. Wireline incumbents, on the other hand, rarely use such strategies, given existing excess network capacity and the universal service obligation under which incumbents must offer services to all population segments. Resellers that focus on price versus quality use price strategies and market segmentation, while incumbents highlight the quality of service to justify higher prices.

In terms of market positioning among incumbents, we can differentiate between those that happily and proactively embrace the new technologies—Voice over Internet Protocol (VoIP), Internet Protocol TV (IPTV), early fiber rollout, etc.—and those that have been more cautious, trying to maximize the returns on the old PSTN network. Although new IP-based services such as VoIP cannibalize existing telco revenues, CFRA thinks it is preferable to cannibalize one's own revenues than let that revenue go to a third-party. Moreover, with IPTV, telcos have found a way to cannibalize the revenues of an adjacent market (pay-TV)—taking revenue from cable and satellite operators in a bid to offset the decline in their fixed-line core revenue base.

Cost Structure

Wireless operating cost structures are largely variable, with marketing and selling expenses the critical component, and easily adjustable. Wireline operations' cost structures, in contrast, are less flexible, with a significant component of fixed costs (mainly personnel). Some personnel cost structures were inherited from when companies were state-owned, with personnel retaining civil service status after privatization, and hence difficult to fire.

Pension deficits are another element to consider when analyzing wireline operations. For example, BT Group has significant unfunded pension liabilities in its balance sheet that must be financed from the company's operating cash flows (at the expense of shareholder dividends) and whose net present value (net of taxes) needs to be subtracted from the enterprise value of the company to calculate the value to shareholders.

Aside from marketing and selling expenses, the outsourcing of some network maintenance tasks to equipment vendors has also been a tool some operators have used successfully to lower costs.

On the capital expenditures (capex) front, the implementation of network-sharing agreements between operators is likely to be another important tool to reduce cash costs in the near future. This is especially advantageous in rural areas that are less densely populated.

Capital Investment
Similar to operating costs, capital investment in wireless networks has remained more flexible than fixed-line investment, with companies able to cut down on investment fast and to very low levels (about 10% of revenues) once the 3G network rollout was completed. To replace the 4G network, the introduction of 5G will also result in a significant pick-up in capex for European telecom operators on average.

In the case of wireline networks, companies have tried to concentrate their investment in growth areas (mainly broadband), moving away from investing in traditional services. Fiber access could drive fixed-line capex in the years to come, although with the demand for services and regulation uncertain, many fixed-line operators are reluctant to commit to significant deployments.

Valuation

From POPs to P/Es
When a new wireless service provider is issued a license, the license's valuation may be expressed in terms of the potential size of the market based on its population, which is compared with wireless subscriber penetration rates over time. At this point in a company's development, no other valuation measure is frequently available.

Start-up wireless carriers take on heavy debt loads to buy licenses and build networks. Cultivating a customer base that yields substantial revenues usually takes several years and significant marketing outlays. Thus, the cost per potential customer that the company paid in obtaining its license, also known as price per percentage of population (POP), reflects prospects for cash flows far in the future. At this early stage of a company's development, stock-market prices tend to fluctuate on the back of changes in forecasts and investor sentiment.

As operating income increases, investors turn from per-POP comparisons to valuation measures based on sales or EBITDA. Typically, for the first several years of operation in new markets, wireless companies experience net losses and have significant debt obligations on their balance sheets.

Most operators have enterprise values-to-EBITDA multiples (stock price plus long-term liabilities minus cash, divided by sales) in the mid- to upper-single-digit range. Standard valuations based on P/E ratios (price divided by net earnings) can be used for more developed, publicly held wireless companies. EBITDA is the most popular metric for evaluating enterprise value.

Free Cash Flow
In the end, valuation of wireless phone companies is like any other business – it is an exercise in forecasting and discounting cash flows. The investor's objective is to obtain a free cash flow (FCF) estimate for the total enterprise, including equity and debt holders. FCF can be calculated by subtracting capex from an after-tax estimate of EBITDA.

Historically, capex has exceeded EBITDA for most firms because the industry required large upfront investments and was still in the growth phase of its development. However, as the industry grows and capital spending levels off, significant FCF has been realized in each year since 2003. Projections assume reasonable anticipated growth rates based on market penetration, total covered POPs, churn trends, net customer additions, and ARPU trends.

Sum of Parts

With companies expanding their mobile operations abroad (Europe, as well as emerging markets) and company cash flows coming from diverse geographies (different market penetration as well as different competitive and regulatory environments), a sum-of-the-parts valuation would be a preferred approach to value telecom operations. This approach enables accounting for different growth and risk profiles for each operation (especially important when emerging and developed operations are combined). The sum-of-the-parts valuation can then be based on market multiples – more readily available for emerging market operations where there are still some pure wireless players than for European operations – or on FCFs.

Ownership Stakes

Finally, it is also important when analyzing a company to know the extent of government ownership. State ownership will affect the company on several fronts, including personnel redundancy plans, M&A, and shareholder distribution policies. The progressive disposal of such a stake will also have an impact on stock price performance, depending on the volume.

GLOSSARY

2G—A second-generation digital wireless network that is voice-centric, although it may include some data capabilities (such as text messaging). 2G networks are circuit-switched.

2.5G—More feature-rich than 2G networks, but still not capable of full 3G services. Often an evolutionary step designed to help carriers raise new revenue from data services without full investment in, and deployment of, a 3G network.

3G—A third-generation network that uses packets, rather than circuit switching; the resulting higher capacity and faster data transfer rates can provide real-time video, high-speed multimedia, and mobile internet access.

3.5G—An evolutionary step toward 4G, with faster transmission speeds and higher capacity; supports features such as streaming video.

4G—A faster data rate than 3G services, expected to be up to 20 megabits per second (Mbps), compared with 2.4 Mbps for most 3G services; 4G transfers data at 100 Mbps while the user is moving and at 1 gigabit per second (Gbps) when stationary.

5G—A fifth-generation network designed to connect virtually everyone and everything together, including machines, objects, and devices.

5G NR (New Radio)—A set of standards that replace the LTE network 4G wireless communications standard.

6G—A sixth-generation network that is expected to overcome the shortfalls of 5G.

Analog—Analog wireless telephone systems convert voice signals into electromagnetic waves, rather than the 1s and 0s of digital networks.

Average revenue per user (ARPU)—A measure of a carrier's average monthly revenue generated by each customer account.

Bandwidth—The amount of data that can be transmitted in a fixed period. For digital devices, bandwidth is usually expressed in bits or bytes per second (bps). For analog devices, bandwidth is expressed in cycles per second, or Hertz (Hz). The bandwidth needed to send a given signal depends on the amount of information the signal contains. FM radio takes 10 times as much bandwidth as AM radio, a differential that explains FM's higher fidelity; a TV channel requires 33 times the bandwidth of an FM station. In telecommunications, bandwidth measures two characteristics of an electronic transmission: range and capacity. It describes the range of electrical frequencies (from short to long waves) that a device can handle without distortion: the higher the bandwidth, the better the quality of the voice or data transmission. Bandwidth also describes the capacity of a channel, which determines what kinds of communications it can carry. A voice-grade bandwidth is four kilohertz.

Broadband—A transmission facility with a bandwidth greater than four kilohertz (the amount needed to transmit voice communications); it can carry numerous voice, video, and data channels simultaneously.

Code division multiple access (CDMA)—One of several technology standards used to let many subscribers share the same radio channel. CDMA2000 and wideband code division multiple access (WCDMA) are used for 3G networks.

Data Center—A building, dedicated space within a building, or a group of buildings used to house servers and associated components, such as telecommunications and storage systems.

Frequency Division Duplex (FDD)—A method for establishing a full-duplex communications link that uses two different radio frequencies for transmitter and receiver operations.

Global system for mobile communications (GSM)—Europe's digital cellular standard, based on time division multiple access (TDMA) technology.

Handset—Equipment purchased and carried by a subscriber to send and receive calls.

Hertz (Hz)—Cycles per second, a measure of radio frequency. Kilohertz (kHz) = thousands; megahertz (MHz) = millions; gigahertz (GHz) = thousand millions; terahertz (THz) = million millions. The spectrum allocated to wireless services is measured in Hertz, as is the size of radio channels used to provide service.

Internet of Things (IoT)—The concept of connecting any device with an on and off switch to the Internet and/or each other, including mobile phones, wearables, lamps, headphones, appliances, cars, and more.

International Mobile Telecommunications-2020 (IMT-2020)—The requirements issued by the ITU Radiocommunication Sector (ITU-R) of the International Telecommunication Union in 2015 for 5G networks, devices, and services.

Mobile virtual network operator (MVNO)—A wireless service provider that owns minimal or no facilities but resells capacity on other service providers' networks.

Penetration—The number of customers for a service as a percentage of population (POP).

Roaming—Ability to move from one carrier's network to that of another without interruption of service or loss of signal; utilized when subscribers travel outside their carrier's local network.

Roaming agreements—Agreements between wireless carriers to allow their customers to use other networks, usually for a fee. They are important in Europe as an increasingly mobile population becomes accustomed to the widespread availability of wireless service. Particularly for business users, the need for wireless service does not end at national borders. Having international roaming agreements for key countries can be an important factor in a company's efforts to gain new customers.

Time division Duplexing (TDD)—Refers to duplex communication where uplink is separated from downlink by the allocation of different time slots in the same frequency band.

Time division multiple access (TDMA)—An access technology that reached its full maturity in 2G networks.

Time division-synchronous code division multiple access (TD-SCDMA)—A 3G access technology developed by Siemens AG and the Chinese Academy of Telecommunications Technology (now known as Datang Technology). TD-SCDMA was one of the five 3G technology standards approved by the International Telecommunication Union (ITU).

Wireless fidelity (Wi-Fi)—Wireless technology providing Internet access at speeds of up to 11 megabits per second. Also known as 802.11b, this radio technology has limited reach to connect laptops or portable devices with a Wi-Fi card to a Wi-Fi access node in the network.

Worldwide interoperability for microwave access (WiMAX)—A wireless technology based on the 802.16 technology standard for 2 GHz to 11 GHz within a wireless metropolitan area network. WiMAX provides broadband wireless connectivity to fixed and mobile users. It has a service range of up to 50 kilometers and provides data rates of up to 280 megabits per second per base station.

INDUSTRY REFERENCES

RESEARCH FIRMS

Analysys Mason
analysysmason.com
Global consulting and research firm specializing in telecoms, media, and technology.

Gartner Inc.
gartner.com
Technology research and advisory firm.

International Data Corp. (IDC)
idc.com
Technology market research and advisory services.

REGULATORY & GOVERNMENT AGENCIES

Autorité de Régulation des Communications Électroniques et des Postes (ARCEP)
arcep.fr
Independent regulator and competition authority for the French communications industries, responsible for overseeing television, radio, telecommunications, and wireless communications services.

European Commission (EC)
ec.europa.eu
Administrative institution implementing the policies, laws, and treaties of the EU.

The International Monetary Fund (IMF)
imf.org
Group of 189 countries working to foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty around the world.

Office for National Statistics
ons.gov.uk
U.K.'s largest independent producer of official statistics and the recognized national statistical institute of the U.K.; responsible for collecting and publishing statistics related to the economy.

Office of Communications (Ofcom)
ofcom.org.uk
Independent regulator and competition authority for the U.K. communications industries, with responsibilities for television, radio, telecommunications, and wireless communications services.

TRADE ASSOCIATIONS

European Telecommunications Network Operators' Association (ETNO)
etno.eu
Trade association representing Europe's telecommunications network operators. Acts as principal policy group for European e-communications network operators.

GSMA
gsma.com
Mobile operator group that represents handset and device makers, software companies, equipment providers, and Internet companies.

OTHERS

International Telecommunication Union (ITU)
itu.int
The leading United Nations agency for information and communication technology issues; provides statistics on the global communications industry. The ITU coordinates the shared global use of the radio spectrum, promotes international cooperation in assigning satellite orbits, works to improve telecommunication infrastructure in the developing world, and helps to establish the worldwide standards that foster seamless interconnection of a vast range of communications systems.

Corporate Europe Observatory (CEO)
corporateeurope.org
Corporate Europe Observatory is a research and campaign group working to expose and challenge the privileged access and influence enjoyed by corporations and their lobby groups in EU policy making.

COMPARATIVE COMPANY ANALYSIS

					Operating Revenues															
					Million $							CAGR(%)			Index Basis (2012=100)					
Ticker	Company	Country		Yr. End	2021	2020	2019	2018	2017	2016	2015	10-Yr.	5-Yr.	1-Yr.	2021	2020	2019	2018	2017	2016
	INTEGRATED TELECOMMUNICATION SERVICES																			
LSE:BT.A	BT GROUP PLC	United Kingdom	#	MAR	27,407.5	29,386.4	28,516.8	30,509.6	33,297.8	30,132.5	27,383.0	0.6	2.3	(6.9)	100	107	104	111	122	110
BME:CLNX	CELLNEX TELECOM, S.A.	Spain		DEC	2,773.1	1,911.0	1,122.2	993.2	909.7	707.7	624.9	NA	29.5	56.1	444	306	180	159	146	113
XTRA:DTE	DEUTSCHE TELEKOM AG	Germany		DEC	111,683.0	103,792.0	82,974.0	78,118.0	77,272.0	75,243.0	71,318.0	6.7	8.2	7.6	157	146	116	110	108	106
HLSE:ELISA	ELISA OYJ	Finland		DEC	1,997.9	1,894.6	1,843.5	1,831.5	1,787.4	1,635.7	1,569.5	2.7	4.1	5.5	127	121	117	117	114	104
ENXTAM:KPN	KONINKLIJKE KPN N.V.	Netherlands		DEC	5,271.0	5,284.0	5,500.0	5,633.0	5,740.0	6,806.0	7,008.0	(8.6)	(5.0)	(0.2)	75	75	78	80	82	97
ENXTPA:ORA	ORANGE S.A.	France		DEC	42,522.0	42,270.0	42,238.0	41,381.0	40,859.0	40,708.0	40,236.0	(0.6)	0.9	0.6	106	105	105	103	102	101
ENXTBR:PROX	PROXIMUS PLC	Belgium		DEC	5,537.0	5,443.0	5,638.0	5,638.0	5,764.0	5,829.0	5,944.0	(1.4)	(1.0)	1.7	93	92	95	95	97	98
SWX:SCMN	SWISSCOM AG	Switzerland		DEC	10,786.6	10,256.3	10,537.8	10,397.8	9,965.6	10,858.1	10,739.5	(0.3)	(0.8)	0.7	100	96	98	97	93	101
BIT:TIT	TELECOM ITALIA S.P.A.	Italy		DEC	15,316.0	15,805.0	17,974.0	18,940.0	19,828.0	19,025.0	19,719.0	(5.5)	(4.2)	(3.1)	78	80	91	96	101	96
BME:TEF	TELEFÓNICA, S.A.	Spain		DEC	40,048.0	43,949.0	49,312.0	49,508.0	52,871.0	52,903.0	55,862.0	(4.5)	(5.4)	(8.9)	72	79	88	89	95	95
OB:TEL	TELENOR ASA	Norway		DEC	11,002.9	11,048.5	11,522.1	10,674.5	11,401.7	13,804.1	13,333.0	1.1	(2.5)	(4.8)	83	83	86	80	86	104
OM:TELIA	TELIA COMPANY AB (PUBL)	Sweden		DEC	8,590.9	8,878.1	8,200.0	8,212.2	8,117.8	8,784.9	9,434.6	(1.7)	1.0	(1.0)	91	94	87	87	86	93
XTRA:UTDI	UNITED INTERNET AG	Germany		DEC	5,646.2	5,367.2	5,194.1	5,102.9	4,206.3	3,808.1	3,715.7	10.4	8.2	5.2	152	144	140	137	113	102
	WIRELESS TELECOMMUNICATION SERVICES																			
OM:TEL2 B	TELE2 AB (PUBL)	Sweden		DEC	2,605.1	2,643.2	2,594.8	2,140.0	2,183.9	1,892.2	2,109.3	(4.2)	8.1	0.9	124	125	123	101	104	90
LSE:VOD	VODAFONE GROUP PUBLIC LIMITED COMPANY	United Kingdom	#	MAR	45,580.0	43,809.0	44,974.0	43,666.0	46,571.0	47,631.0	49,810.0	(0.5)	(2.5)	(2.6)	92	88	90	88	93	96

Note: Data as originally reported. CAGR-Compound annual growth rate. #Of the following calendar year.
Souce: S&P Capital IQ.

Net Income

Ticker	Company	Country		Yr. End	Million $ 2021	2020	2019	2018	2017	2016	2015	CAGR(%) 10-Yr.	5-Yr.	1-Yr.	Index Basis (2012=100) 2021	2020	2019	2018	2017	2016
	INTEGRATED TELECOMMUNICATION SERVICES																			
LSE:BT.A	BT GROUP PLC	United Kingdom	#	MAR	1,674.7	2,027.9	2,158.8	2,811.6	2,852.1	2,389.4	3,551.8	(0.2)	(9.8)	(15.1)	47	57	61	79	80	67
BME:CLNX	CELLNEX TELECOM, S.A.	Spain		DEC	(399.6)	(165.7)	(10.3)	(17.2)	31.5	42.0	51.4	282.1	NM	159.5	-778	-323	-20	-33	61	82
XTRA:DTE	DEUTSCHE TELEKOM AG	Germany		DEC	4,749.2	5,086.2	4,339.6	2,480.0	4,155.9	2,823.8	3,534.1	22.7	9.3	0.4	134	144	123	70	118	80
HLSE:ELISA	ELISA OYJ	Finland		DEC	390.8	401.2	340.0	361.6	404.2	271.4	264.0	5.5	6.0	4.8	148	152	129	137	153	103
ENXTAM:KPN	KONINKLIJKE KPN N.V.	Netherlands		DEC	1,464.8	685.0	702.5	321.7	468.3	837.1	692.9	(1.8)	10.2	130.0	211	99	101	46	68	121
ENXTPA:ORA	ORANGE S.A.	France		DEC	265.0	5,898.5	3,371.1	2,237.2	2,213.0	2,969.5	2,880.3	(24.5)	(39.2)	(95.2)	9	205	117	78	77	103
ENXTBR:PROX	PROXIMUS PLC	Belgium		DEC	503.8	689.9	418.6	418.6	586.5	552.1	523.5	(5.2)	(3.3)	(21.5)	96	132	80	80	112	105
SWX:SCMN	SWISSCOM AG	Switzerland		DEC	2,009.6	1,729.3	1,726.4	1,551.9	1,611.0	1,579.1	1,359.4	10.4	2.7	19.7	148	127	127	114	119	116
BIT:TIT	TELECOM ITALIA S.P.A.	Italy		DEC	(9,839.6)	8,836.7	1,027.9	(1,615.5)	1,346.1	1,908.6	(76.0)	6.0	NM	NM	12,943	NM	NM	2,125	NM	NM
BME:TEF	TELEFÓNICA, S.A.	Spain		DEC	9,254.0	1,935.2	1,281.6	3,813.8	3,760.8	2,500.8	669.0	4.2	28.0	414.3	1,383	289	192	570	562	374
OB:TEL	TELENOR ASA	Norway		DEC	173.4	2,023.2	884.2	1,699.7	1,463.9	329.1	385.7	(14.3)	(11.6)	(91.2)	45	525	229	441	380	85
OM:TELIA	TELIA COMPANY AB (PUBL)	Sweden		DEC	1,291.7	(2,799.7)	759.3	361.5	1,185.6	411.1	1,013.0	(4.4)	25.6	NM	128	-276	75	36	117	41
XTRA:UTDI	UNITED INTERNET AG	Germany		DEC	473.6	355.4	475.7	216.2	779.5	189.0	397.9	9.9	18.4	43.3	119	89	120	54	196	47
	WIRELESS TELECOMMUNICATION SERVICES																			
OM:TEL2 B	TELE2 AB (PUBL)	Sweden		DEC	476.2	902.0	535.7	96.1	23.5	(250.0)	334.7	(1.0)	NM	(41.9)	142	270	160	29	7	-75
LSE:VOD	VODAFONE GROUP PUBLIC LIMITED COMPAI	United Kingdom	#	MAR	2,319.5	131.5	(1,011.0)	(9,001.1)	3,004.8	(6,733.3)	(6,155.7)	(34.7)	NM	NM	-38	-2	16	146	-49	109

Note: Data as originally reported. CAGR-Compound annual growth rate. #Of the following calendar year.
Souce: S&P Capital IQ.

Ticker	Company	Country		Yr. End	Current Ratio						Debt/Capital Ratio (%)						Debt as a % of Net Working Capital					
					2021	2020	2019	2018	2017	2016	2021	2020	2019	2018	2017	2016	2021	2020	2019	2018	2017	2016
	INTEGRATED TELECOMMUNICATION SERVICES																					
LSE:BT.A	BT GROUP PLC	United Kingdom	#	MAR	1.0	1.2	1.1	1.1	0.8	0.6	50.3	57.8	53.4	59.2	54.5	54.3	NM	1139.0	1657.6	1740.9	NM	NM
BME:CLNX	CELLNEX TELECOM, S.A.	Spain		DEC	1.9	4.8	4.1	1.3	1.2	1.8	48.5	51.1	50.2	83.0	80.4	75.3	632.0	227.8	247.3	2080.9	3038.8	1052.4
XTRA:DTE	DEUTSCHE TELEKOM AG	Germany		DEC	0.9	1.0	0.8	0.8	0.7	0.8	54.9	56.6	54.3	53.6	52.7	55.4	NM	NM	NM	NM	NM	NM
HLSE:ELISA	ELISA OYJ	Finland		DEC	1.3	1.3	1.2	0.9	1.0	1.0	48.7	49.8	52.9	48.1	52.7	56.5	641.6	652.9	1429.1	NM	NM	NM
ENXTAM:KPN	KONINKLIJKE KPN N.V.	Netherlands		DEC	0.8	0.7	0.7	0.9	1.8	0.8	66.1	70.3	70.0	79.5	69.5	69.2	NM	NM	NM	NM	546.7	NM
ENXTPA:ORA	ORANGE S.A.	France		DEC	0.9	0.9	0.9	0.7	0.7	0.8	50.3	46.4	49.8	47.1	46.9	47.9	NM	NM	NM	NM	NM	NM
ENXTBR:PRO	PROXIMUS PLC	Belgium		DEC	0.7	0.8	0.8	0.8	0.7	0.7	49.7	48.2	47.0	46.0	40.3	45.7	NM	NM	NM	NM	NM	NM
SWX:SCMN	SWISSCOM AG	Switzerland		DEC	0.9	0.9	0.8	0.9	0.7	0.9	35.2	41.0	43.9	47.8	44.0	52.3	NM	NM	NM	NM	NM	NM
BIT:TIT	TELECOM ITALIA S.P.A.	Italy		DEC	0.9	1.0	1.2	0.7	0.8	0.9	51.5	45.1	53.1	51.7	52.1	54.3	NM	NM	1174.5	NM	NM	NM
BME:TEF	TELEFÓNICA, S.A.	Spain		DEC	1.0	1.2	0.8	0.8	0.7	0.6	55.2	69.8	63.0	62.7	63.5	61.6	NM	763.8	NM	NM	NM	NM
OB:TEL	TELENOR ASA	Norway		DEC	0.7	0.8	0.6	0.7	0.7	0.7	74.1	69.6	66.5	51.0	48.0	54.9	NM	NM	NM	NM	NM	NM
OM:TELIA	TELIA COMPANY AB (PUBL)	Sweden		DEC	1.0	0.9	0.8	1.2	2.2	1.3	48.5	58.2	53.1	45.5	45.5	47.0	NM	NM	NM	969.9	235.7	487.5
XTRA:UTDI	UNITED INTERNET AG	Germany		DEC	1.0	1.1	1.1	1.0	0.6	0.5	23.4	21.0	24.5	27.7	30.4	53.0	NM	953.2	1463.7	2669.5	NM	NM
	WIRELESS TELECOMMUNICATION SERVICES																					
OM:TEL2 B	TELE2 AB (PUBL)	Sweden		DEC	1.3	0.6	0.7	1.2	1.8	0.7	43.0	40.2	40.8	45.8	40.0	31.9	674.1	NM	NM	863.3	132.7	NM
LSE:VOD	VODAFONE GROUP PUBLIC LIMITED COMPAN	United Kingdom	#	MAR	0.8	1.0	1.0	1.6	1.0	1.0	51.6	49.4	52.8	47.0	37.3	38.4	NM	NM	NM	381.2	NM	12054.3

Note: Data as originally reported. CAGR-Compound annual growth rate. #Of the following calendar year.
Souce: S&P Capital IQ.

Ticker	Company	Country		Yr. End	Return on Revenues (%)						Return on Assets (%)						Return on Equity (%)					
					2021	2020	2019	2018	2017	2016	2021	2020	2019	2018	2017	2016	2021	2020	2019	2018	2017	2016
	INTEGRATED TELECOMMUNICATION SERVICES																					
LSE:BT.A	BT GROUP PLC	United Kingdom	#	MAR	6.1	6.9	7.6	9.2	8.6	7.9	2.6	2.9	3.3	4.7	4.7	4.5	9.4	11.1	13.9	21.5	22.3	20.7
BME:CLNX	CELLNEX TELECOM, S.A.	Spain		DEC	NM	NM	NM	NM	3.5	5.9	NM	NM	NM	NM	0.6	1.4	NM	NM	NM	NM	4.1	7.4
XTRA:DTE	DEUTSCHE TELEKOM AG	Germany		DEC	3.7	4.0	4.7	2.8	4.5	3.6	1.5	1.6	2.3	1.5	2.4	1.8	7.9	11.4	11.8	7.8	13.7	8.1
HLSE:ELISA	ELISA OYJ	Finland		DEC	17.2	17.3	16.4	17.2	18.8	15.7	11.3	10.8	10.8	11.8	13.0	10.2	28.8	28.1	26.6	29.2	33.5	27.1
ENXTAM:KPN	KONINKLIJKE KPN N.V.	Netherlands		DEC	24.4	10.6	11.4	5.0	6.8	11.7	10.1	4.6	5.1	2.2	2.8	5.4	43.8	21.8	28.0	10.9	11.0	8.6
ENXTPA:ORA	ORANGE S.A.	France		DEC	0.5	11.4	7.1	4.7	4.5	6.9	0.2	4.5	2.8	2.0	1.9	2.9	2.1	14.1	9.5	6.5	6.0	2.6
ENXTBR:PRO	PROXIMUS PLC	Belgium		DEC	8.0	10.4	6.6	8.8	9.1	9.0	4.8	6.4	4.2	5.7	6.0	6.4	14.8	19.3	12.7	16.8	18.0	18.4
SWX:SCMN	SWISSCOM AG	Switzerland		DEC	16.4	13.8	14.6	13.0	13.5	13.8	7.4	6.3	6.9	6.8	7.1	7.5	18.1	16.6	19.5	19.2	22.1	27.3
BIT:TIT	TELECOM ITALIA S.P.A.	Italy		DEC	NM	45.7	5.1	NM	5.7	9.5	NM	9.9	1.3	NM	1.6	2.6	NM	28.6	5.5	NM	5.4	8.6
BME:TEF	TELEFÓNICA, S.A.	Spain		DEC	20.3	3.6	2.3	6.7	5.9	4.5	7.5	1.5	1.0	2.9	2.7	1.9	45.7	9.0	6.3	14.7	12.3	8.9
OB:TEL	TELENOR ASA	Norway		DEC	1.4	15.0	6.8	13.9	10.7	2.3	0.7	6.8	3.1	7.7	5.9	1.4	30.1	41.0	24.4	20.0	22.3	22.6
OM:TELIA	TELIA COMPANY AB (PUBL)	Sweden		DEC	13.2	NM	8.3	3.8	12.2	4.4	4.9	NM	2.7	1.3	4.0	1.5	15.9	NM	7.8	9.1	8.4	16.7
XTRA:UTDI	UNITED INTERNET AG	Germany		DEC	7.4	5.4	8.2	3.7	15.4	4.7	4.3	3.1	4.6	2.3	8.5	4.4	10.6	7.7	11.8	7.3	24.7	15.0
	WIRELESS TELECOMMUNICATION SERVICES																					
OM:TEL2 B	TELE2 AB (PUBL)	Sweden		DEC	16.1	27.9	18.4	3.9	0.9	NM	5.8	9.8	6.3	1.0	0.5	NM	12.4	21.4	6.8	4.1	13.7	9.7
LSE:VOD	VODAFONE GROUP PUBLIC LIMITED COMPAI	United Kingdom	#	MAR	4.6	0.3	NM	NM	5.2	NM	1.4	0.1	NM	NM	1.7	NM	4.6	0.9	NM	NM	6.7	NM

Note: Data as originally reported. CAGR-Compound annual growth rate. #Of the following calendar year.
Souce: S&P Capital IQ.

				Price/Earnings Ratio (High-Low)						Dividend Payout Ratio (%)						Dividend Yield (High-Low, %)					
Ticker	Company	Country	Yr. End	2021	2020	2016	2015	2014	2013	2021	2020	2019	2018	2017	2016	2021	2020	2019	2018	2017	2016
	INTEGRATED TELECOMMUNICATION SERVICES																				
LSE:BT.A	BT GROUP PLC	United Kingdom	MAR	10 - 7	13 - 6	NA - NA	NA - NA	NA - NA	NA - NA	18	0	88	70	75	75	3.0 - 0.0	15.2 - 0.0	11.0 - 6.7	7.6 - 5.8	6.8 - 4.1	4.6 - 2.5
BME:CLNX	CELLNEX TELECOM, S.A.	Spain	DEC	NM - NM	NM - NM	100 - 73	84 - 72	NA - NA	NA - NA	0	0	NM	NM	76	53	0.1 - 0.1	0.2 - 0.1	0.3 - 0.1	0.4 - 0.2	0.5 - 0.4	0.7 - 0.4
XTRA:DTE	DEUTSCHE TELEKOM AG	Germany	DEC	22 - 17	19 - 12	29 - 24	25 - 18	21 - 16	59 - 38	75	74	92	142	45	60	4.2 - 3.3	4.1 - 3.2	5.5 - 3.6	5.0 - 4.3	5.2 - 3.8	4.1 - 3.3
HLSE:ELISA	ELISA OYJ	Finland	DEC	26 - 21	29 - 21	22 - 18	24 - 15	17 - 13	15 - 11	90	90	92	83	71	87	4.3 - 3.6	4.2 - 3.5	4.4 - 3.2	4.9 - 3.5	4.9 - 3.9	4.9 - 4.1
ENXTAM:KPN	KONINKLIJKE KPN N.V.	Netherlands	DEC	10 - 8	21 - 14	21 - 15	26 - 18	NM - NM	NM - NM	44	95	82	193	131	53	5.1 - 3.9	5.2 - 4.3	7.1 - 4.4	5.2 - 4.1	5.8 - 4.0	4.9 - 3.8
ENXTPA:ORA	ORANGE S.A.	France	DEC	3550 - 2989	8 - 5	17 - 14	19 - 14	47 - 28	15 - 10	1015	39	71	110	109	57	7.8 - 5.9	7.5 - 6.5	8.1 - 4.9	5.3 - 4.3	4.9 - 4.3	4.8 - 4.0
ROX	PROXIMUS PLC	Belgium	DEC	14 - 12	15 - 9	20 - 16	24 - 19	16 - 10	12 - 8	88	86	130	95	93	93	10.8 - 6.4	9.3 - 6.4	9.8 - 5.5	6.8 - 5.3	7.8 - 5.2	5.8 - 4.6
N	SWISSCOM AG	Switzerland	DEC	16 - 13	19 - 16	17 - 14	22 - 18	18 - 14	15 - 12	62	75	68	75	73	71	4.5 - 3.8	4.8 - 4.0	4.8 - 3.8	5.0 - 4.2	5.1 - 4.1	5.1 - 4.2
BIT:TIT	TELECOM ITALIA S.P.A.	Italy	DEC	NM - NM	2 - 1	14 - 7	NM - NM	16 - 11	NM - NM	NM	5	30	NM	21	13	2.9 - 0.0	3.3 - 2.0	3.4 - 2.5	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
BME:TEF	TELEFÓNICA, S.A.	Spain	DEC	3 - 2	29 - 12	25 - 18	196 - 138	23 - 19	14 - 10	8	52	180	61	61	101	8.1 - 5.9	12.7 - 7.0	14.3 - 5.8	6.7 - 5.0	6.0 - 4.6	5.2 - 3.8
0																					
OB:TEL	TELENOR ASA	Norway	DEC	146 - 122	14 - 11	79 - 63	81 - 63	26 - 21	27 - 20	824	71	156	81	100	397	9.1 - 6.1	6.8 - 5.6	6.3 - 5.0	5.2 - 4.4	5.4 - 4.1	6.1 - 4.2
	TELIA COMPANY AB (PUBL)	Sweden	DEC	14 - 12	NM - NM	50 - 40	28 - 20	16 - 13	16 - 12	70	NM	139	308	89	348	6.0 - 5.0	6.0 - 5.0	5.9 - 4.5	5.9 - 5.3	6.1 - 5.0	8.8 - 5.0
XTRA:UTDI	UNITED INTERNET AG	Germany	DEC	18 - 14	28 - 14	58 - 40	29 - 20	17 - 13	29 - 15	22	32	2	90	25	80	2.4 - 1.4	1.6 - 1.3	2.0 - 0.2	2.8 - 0.1	2.4 - 1.3	2.0 - 1.4
	WIRELESS TELECOMMUNICATION SERVICES																				
OM:TEL2 B	TELE2 AB (PUBL)	Sweden	DEC	21 - 17	14 - 10	NM - NM	19 - 12	20 - 14	4 - 2	96	51	143	236	1369	NM	19.8 - 6.6	8.3 - 4.5	5.2 - 2.9	3.8 - 3.0	5.6 - 3.3	7.9 - 4.8
LSE:VOD	VODAFONE GROUP PUBLIC LIMITED COMPAN	United Kingdom	MAR	373 - 269	NM - NM	NM - NM	9 - 7	2 - 1	228 - 184	118	2167	NM	NM	161	NM	7.2 - 5.3	8.1 - 5.3	10.9 - 4.5	9.7 - 6.0	6.6 - 5.5	6.5 - 4.8

Note: Data as originally reported. CAGR-Compound annual growth rate. #Of the following calendar year.

Souce: S&P Capital IQ.

Ticker	Company	Country	Yr. End	Earnings per Share ($)						Tangible Book Value per Share ($)						Share Price (High-Low, $)											
				2021	2020	2019	2018	2017	2016	2021	2020	2019	2018	2017	2016	2021		2020		2019		2018		2017		2016	
	INTEGRATED TELECOMMUNICATION SERVICES																										
LSE:BT.A	BT GROUP PLC	United Kingdom	MAR	0.15	0.17	0.20	0.25	0.23	0.22	0.18	(0.20)	0.10	(0.49)	(0.52)	(0.79)	2.46	1.43	2.22	1.06	2.86	1.86	3.10	2.24	4.51	2.73	5.88	4.00
BME:CLNX	CELLNEX TELECOM, S.A.	Spain	DEC	(0.58)	(0.35)	(0.03)	(0.06)	0.11	0.17	(15.93)	(8.10)	(4.48)	(6.16)	(6.27)	(4.08)	61.92	39.24	60.78	33.40	42.05	21.93	24.98	19.54	21.94	13.05	17.21	12.55
XTRA:DTE	DEUTSCHE TELEKOM AG	Germany	DEC	0.87	0.88	0.82	0.46	0.74	0.58	(17.76)	(16.92)	(7.24)	(6.68)	(6.34)	(6.18)	18.92	14.60	16.75	10.41	16.26	13.95	15.60	12.72	18.15	14.62	16.52	13.54
HLSE:ELISA	ELISA OYJ	Finland	DEC	2.15	2.05	1.90	1.98	2.11	1.61	(0.87)	(0.99)	(0.87)	(0.63)	(0.95)	(0.43)	56.18	45.10	58.88	40.79	49.91	35.51	41.95	31.68	36.94	30.42	35.80	28.40
ENXTAM:KPN	KONINKLIJKE KPN N.V.	Netherlands	DEC	0.30	0.13	0.15	0.05	0.08	0.17	0.05	(0.15)	(0.12)	(0.31)	0.03	0.08	2.98	2.50	2.79	1.70	2.98	2.36	2.93	2.14	3.15	2.51	3.71	2.56
ENXTPA:ORA	ORANGE S.A.	France	DEC	0.00	1.71	1.02	0.62	0.59	0.95	(2.55)	(3.07)	(3.96)	(3.99)	(3.86)	(3.89)	10.74	8.93	13.55	8.63	15.38	13.08	15.25	13.32	15.80	13.50	16.67	12.38
ENXTBR:PROX	PROXIMUS PLC	Belgium	DEC	1.37	1.75	1.16	1.57	1.62	1.62	(2.24)	(1.89)	(2.17)	(1.92)	(2.07)	(1.73)	19.16	15.95	27.12	15.01	28.26	21.51	28.20	19.16	32.98	26.24	31.98	25.13
SWX:SCMN	SWISSCOM AG	Switzerland	DEC	34.11	27.29	29.70	26.17	25.90	28.88	73.36	46.07	33.16	20.49	11.75	(7.17)	542.47	440.13	533.88	412.75	481.58	405.85	470.98	379.02	450.34	367.28	492.87	398.03
BIT:TIT	TELECOM ITALIA S.P.A.	Italy	DEC	(0.41)	0.33	0.04	(0.07)	0.05	0.08	(0.39)	(0.16)	(0.50)	(0.77)	(0.72)	(0.73)	0.51	0.30	0.57	0.29	0.59	0.43	0.88	0.48	0.92	0.66	1.17	0.63
BME:TEF	TELEFÓNICA, S.A.	Spain	DEC	1.37	0.23	0.15	0.54	0.56	0.42	(1.07)	(3.19)	(4.75)	(4.81)	(5.45)	(6.34)	4.32	3.24	6.57	2.71	7.90	5.86	8.60	6.59	10.63	8.10	10.35	7.45
OB:TEL	TELENOR ASA	Norway	DEC	0.11	1.17	0.55	1.01	0.81	0.21	(0.81)	(0.13)	(0.05)	(0.09)	0.03	(0.49)	15.96	13.15	16.40	12.47	19.34	15.83	19.32	14.92	19.10	12.94	16.61	12.86
OM:TELIA	TELIA COMPANY AB (PUBL)	Sweden	DEC	0.28	(0.56)	0.16	0.07	0.23	0.09	(0.25)	(0.61)	(0.28)	0.13	0.58	0.46	3.89	3.28	4.22	3.02	4.28	3.71	4.33	3.48	4.10	3.51	4.53	3.54
XTRA:UTDI	UNITED INTERNET AG	Germany	DEC	2.22	1.54	2.13	0.94	3.24	0.88	(6.43)	(6.74)	(7.82)	(2.76)	(4.89)	(1.28)	39.34	31.35	43.88	20.76	40.42	24.21	59.80	34.14	59.17	37.01	49.89	34.42
	WIRELESS TELECOMMUNICATION SERVICES																										
OM:TEL2 B	TELE2 AB (PUBL)	Sweden	DEC	0.60	1.07	0.69	0.16	0.04	(0.52)	(2.02)	(2.05)	(1.85)	(1.92)	1.56	1.12	13.24	10.16	15.44	9.86	14.17	10.44	11.89	9.12	11.25	7.36	8.84	6.87
LSE:VOD	VODAFONE GROUP PUBLIC LIMITED COMPAI	United Kingdom	MAR	0.07	0.00	(0.03)	(0.29)	0.09	(0.23)	0.05	0.08	0.28	0.78	0.91	0.98	1.70	1.27	1.77	1.04	2.00	1.44	2.67	1.59	2.67	2.10	2.81	2.21

Note: Data as originally reported. CAGR-Compound annual growth rate. #Of the following calendar year.
Souce: S&P Capital IQ.

Disclosures

CFRA's Industry Surveys Reports (the "Industry Surveys") have been prepared by Accounting Research & Analytics, LLC and/or one of its affiliates. The Industry Surveys are published and originally distributed by Accounting Research & Analytics, LLC d/b/a CFRA ("CFRA US"), with the following exceptions: In the United Kingdom/European Union/European Economic Area, the Industry Surveys are published and originally distributed by CFRA U.K. Limited (company number 08456139 registered in England & Wales with its registered office address at New Derwent House, 69-73 Theobalds Road, London, WC1X 8TA, United Kingdom), which is regulated by the U.K. Financial Conduct Authority (No. 775151); in Malaysia, the Industry Surveys are published and originally distributed by CFRA MY Sdn Bhd (Company No. 683377-A) and regulated by Securities Commission Malaysia, No. CMSL/A0181/2007 ("CFRA Malaysia"). CFRA Malaysia is a wholly-owned subsidiary of CFRA US. For Recipients in Canada: This report is not prepared subject to Canadian disclosure requirements and may not be suitable for Canadian investors.

The content of this report and the opinions expressed herein are those of CFRA based upon publicly-available information that CFRA believes to be reliable and the opinions are subject to change without notice. This analysis has not been submitted to, nor received approval from, the United States Securities and Exchange Commission or any other regulatory body. While CFRA exercised due care in compiling this analysis, CFRA AND ALL RELATED ENTITIES SPECIFICALLY DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, to the full extent permitted by law, regarding the accuracy, completeness, or usefulness of this information and assumes no liability with respect to the consequences of relying on this information for investment or other purposes.

No content (including ratings, credit-related analyses and data, valuations, model, software or other application or output therefrom) or any part thereof (Content) may be modified, reverse engineered, reproduced or distributed in any form by any means, or stored in a database or retrieval system, without the prior written permission of CFRA. The Content shall not be used for any unlawful or unauthorized purposes. CFRA and any third-party providers, as well as their directors, officers, shareholders, employees or agents do not guarantee the accuracy, completeness, timeliness or availability of the Content.

Past performance is not necessarily indicative of future results. This document may contain forward-looking statements or forecasts; such forecasts are not a reliable indicator of future performance.

This report is not intended to, and does not, constitute an offer or solicitation to buy and sell securities or engage in any investment activity. This report is for informational purposes only. Recommendations in this report are not made with respect to any particular investor or type of investor. Securities, financial instruments or strategies mentioned herein may not be suitable for all investors and this material is not intended for any specific investor and does not take into account an investor's particular investment objectives, financial situations or needs. Before acting on any recommendation in this material, you should consider whether it is suitable for your particular circumstances and, if necessary, seek professional advice.

CFRA may license certain intellectual property or provide services to, or otherwise have a business relationship with, certain issuers of securities that are the subject of CFRA research reports, including exchange-traded investments whose investment objective is to substantially replicate the returns of a proprietary index of CFRA. In cases where CFRA is paid fees that are tied to the amount of assets invested in a fund or the volume of trading activity in a fund, investment in the fund may result in CFRA receiving compensation in addition to the subscription fees or other compensation for services rendered by CFRA, however, no part of CFRA's compensation for services is tied to any recommendation or rating. Additional information on a subject company may be available upon request.

CFRA's financial data provider is S&P Global Market Intelligence. THIS DOCUMENT CONTAINS COPYRIGHTED AND TRADE SECRET MATERIAL DISTRIBUTED UNDER LICENSE FROM S&P GLOBAL MARKET INTELLIGENCE. FOR RECIPIENT'S INTERNAL USE ONLY.

The Global Industry Classification Standard (GICS®) was developed by and/or is the exclusive property of MSCI, Inc. and S&P Global Market Intelligence. GICS is a service mark of MSCI and S&P Global Market Intelligence and has been licensed for use by CFRA.

Certain information in this report is provided by S&P Global, Inc. and/or its affiliates and subsidiaries (collectively "S&P Global"). Such information is subject to the following disclaimers and notices: "Copyright © 2022, S&P Global Market Intelligence (and its affiliates as applicable). All rights reserved. Nothing contained herein is investment advice and a reference to a particular investment or security, a credit rating or any observation concerning a security or investment provided by S&P Global is not a recommendation to buy, sell or hold such investment or security or make any other investment decisions. This may contain information obtained from third parties, including ratings from credit ratings agencies. Reproduction and distribution of S&P Global's information and third-party content in any form is prohibited except with the prior written permission of S&P Global or the related third party, as applicable. Neither S&P Global nor its third-party providers guarantee the accuracy, completeness, timeliness or availability of any information, including ratings, and are not responsible for any errors or omissions (negligent or otherwise), regardless of the cause, or for the results obtained from the use of such information or content. S&P GLOBAL AND ITS THIRD-PARTY CONTENT PROVIDERS GIVE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR

PURPOSE OR USE AND ALL S&P INFORMATION IS PROVIDED ON AN AS-IS BASIS. S&P GLOBAL AND ITS THIRD-PARTY CONTENT PROVIDERS SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, EXEMPLARY, COMPENSATORY, PUNITIVE, SPECIAL OR CONSEQUENTIAL DAMAGES, COSTS, EXPENSES, LEGAL FEES, OR LOSSES (INCLUDING LOST INCOME OR PROFITS AND OPPORTUNITY COSTS OR LOSSES CAUSED BY NEGLIGENCE) IN CONNECTION WITH ANY USE OF THEIR INFORMATION OR CONTENT, INCLUDING RATINGS. Credit ratings are statements of opinions and are not statements of fact or recommendations to purchase, hold or sell securities. They do not address the suitability of securities or the suitability of securities for investment purposes, and should not be relied on as investment advice."

Certain information in this report may be provided by Securities Evaluations, Inc. ("SE"), a wholly owned subsidiary of Intercontinental Exchange. SE is a registered investment adviser with the United States Securities and Exchange Commission (SEC). SE's advisory services include evaluated pricing and model valuation of fixed income securities, derivative valuations and Odd-Lot Pricing that consists of bid- and ask-side evaluated prices for U.S. Municipal and U.S. Corporate Securities (together called valuation services). Such information is subject to the following disclaimers and notices: "No content (including credit-related analyses and data, valuations, model, software or other application or output therefrom) or any part thereof (Content) may be modified, reverse engineered, reproduced or distributed in any form by any means, or stored in a database or retrieval system, without the prior written permission of SE. The Content shall not be used for any unlawful or unauthorized purposes. SE and any third-party providers, as well as their directors, officers, shareholders, employees or agents (collectively SE Parties) do not guarantee the accuracy, completeness, timeliness or availability of the Content. SE Parties are not responsible for any errors or omissions (negligent or otherwise), regardless of the cause, for the results obtained from the use of the Content, or for the security or maintenance of any data input by the user. The Content is provided on an "as is" basis. SE PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION.

In no event shall SE Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs or losses caused by negligence) in connection with any use of the Content even if advised of the possibility of such damages. Credit-related and other analyses and statements in the Content are statements of opinion as of the date they are expressed and not statements of fact or recommendations to purchase, hold, or sell any securities or to make any investment decisions. SE assumes no obligation to update the Content following publication in any form or format. The Content should not be relied on and is not a substitute for the skill, judgment and experience of the user, its management, employees, advisors and/or clients when making investment and other business decisions. SE's opinions and analyses do not address the suitability of any security. SE does not act as a fiduciary or an investment advisor. While SE has obtained information from sources it believes to be reliable, SE does not perform an audit and undertakes no duty of due diligence or independent verification of any information it receives. Valuations services are opinions and not statements of fact or recommendations to purchase, hold or sell any security or instrument, or to make any investment decisions. The information provided as part of valuations services should not be intended as an offer, promotion or solicitation for the purchase or sale of any security or other financial instrument nor should it be considered investment advice. Valuations services do not address the suitability of any security or instrument, and securities, financial instruments or strategies mentioned by SE may not be suitable for all investors. SE does not provide legal, accounting or tax advice, and clients and potential clients of valuation services should consult with an attorney and/or a tax or accounting professional regarding any specific legal, tax or accounting provision(s) applicable to their particular situations and in the countries and jurisdictions where they do business. SE has redistribution relationships that reflect evaluated pricing, derivative valuation and/or equity pricing services of other unaffiliated firms with which SE has contracted to distribute to its client base. Pricing and data provided by these third-party firms are the responsibilities of those firms, and not SE, and are produced under those firms' methodologies, policies and procedures. Valuations services provided by SE and products containing valuations services may not be available in all countries or jurisdictions. Copyright © 2022 by Intercontinental Exchange Inc. All rights reserved."