NOKIA CORP
Form 20-F
March 21, 2019
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As filed with the Securities and Exchange Commission on March 21, 2019

UNITED STATES

SECURITIES AND EXCHANGE COMMISSION

Washington, D.C. 20549

FORM 20-F

ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE

SECURITIES EXCHANGE ACT OF 1934

For the fiscal year ended December 31, 2018

Commission file number 1 13202

Nokia Corporation

(Exact name of Registrant as specified in its charter)

Republic of Finland
(Jurisdiction of incorporation)

Karaportti 3 FI 02610 Espoo, Finland
(Address of principal executive offices)

Esa Niinimäki, Vice President, Corporate Legal, Telephone: +358 (0) 10 44 88 000, Facsimile: +358 (0) 10 44 81 002, Karaportti 3, FI 02610 Espoo, Finland
(Name, Telephone, E-mail and/or Facsimile number and Address of Company Contact Person)

Securities registered pursuant to Section 12(b) of the Securities Exchange Act of 1934 (the "Exchange Act"):

Title of each class	Name of each exchange on which registered
American Depositary Shares	New York Stock Exchange
Shares	New York Stock Exchange(1)

(1) Not for trading, but only in connection with the registration of American Depositary Shares representing these shares, pursuant to the requirements of the Securities and Exchange Commission.

Securities registered pursuant to Section 12(g) of the Exchange Act: None

Securities for which there is a reporting obligation pursuant to Section 15(d) of the Exchange Act: None

Indicate the number of outstanding shares of each of the registrant's classes of capital or common stock as of the close of the period covered by the annual report. Shares: 5 635 945 159.

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act.	Yes No
If this report is an annual or transition report, indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 15(d) of the Exchange Act.	Yes No
Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Exchange Act during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days.	Yes No
Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files).	Yes No

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer", "smaller reporting
company" or "emerging growth company" in Rule 12b 2 of the Exchange Act. (Check one):

Large accelerated filer	Accelerated filer
Non-accelerated filer	Smaller reporting company
Emerging growth company	

Indicate by check mark which basis of accounting the registrant has used to prepare the financial statements included in this filing:

U.S. GAAP

International Financial Reporting Standards as issued by the International Accounting Standards Board

Other

If "Other" has been checked in response to the previous question, indicate by check mark which financial statement item the registrant has elected to follow.	Item 17 Item 18
If this is an annual report, indicate by check mark whether the registrant is a shell company (as defined in Rule 12b 2 of the Exchange Act).	Yes No

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Forward-looking statements

Certain statements contained in this Annual Report constitute "forward-looking statements". Forward-looking statements provide Nokia's current expectations of future events based on certain assumptions and include any statement that does not directly relate to any current or historical fact. The words “believe”, “expect”, “expectations”, “anticipate”, “foresee”, “see”, “target”, “estimate”, “designed”, “aim”, “plan”, “intend”, “influence”, “assumption”, “focus”, “c “should", "is to", "will”, "strive", "may" or similar expressions as they relate to us or our management are intended to identify these forward-looking statements, as well as statements regarding:

A)business strategies including the four pillars of Lead, Expand, Build and Create, market expansion, growth management, and future industry trends and megatrends and our plans to address them, including Future X;

B)future performance of our businesses and any expected future distributions and dividends;

C)expectations and targets regarding financial performance, results, operating expenses, taxes, currency exchange rates, hedging, cost savings and competitiveness, as well as results of operations including targeted synergies and those related to market share, prices, net sales, income and margins;

D)expectations, plans, timelines or benefits related to changes in our organizational and operational structure;

E)market developments in our current and future markets and their seasonality and cyclicality, including for communication service providers, as well as general economic conditions and future regulatory developments;

F)our position in the market, including product portfolio and geographical reach, and our ability to use the same to develop the relevant business or market and maintain our order pipeline over time;

G)any future collaboration or business collaboration agreements or patent license agreements or arbitration awards, including income from any collaboration or partnership, agreement or award;

H)timing of the development and delivery of our products and services, including our short term and longer term expectations around the deployment of 5G and our ability to capitalize on such deployment as well as use our global installed base as the platform for success in 5G, and the overall readiness of the 5G ecosystem;

I)the outcome of pending and threatened litigation, arbitration, disputes, regulatory proceedings or investigations by authorities;

J)restructurings, investments, capital structure optimization efforts, divestments and our ability to achieve the financial and operational targets set in connection with any such restructurings, investments, and capital structure optimization efforts including our 2019-2020 cost savings program;

K)future capital expenditures, temporary incremental expenditures or other R&D expenditures to develop or rollout new products, including 5G; and

L)the sustainability and corporate responsibility contained in the sustainability and corporate responsibility section of this annual report on Form 20-F.

These statements are based on management’s best assumptions and beliefs in light of the information currently available to it and are subject to a number of risks and uncertainties, many of which are beyond our control, which could cause actual results to differ materially from such statements. These statements are only predictions based upon

our current expectations and views of future events and developments and are subject to risks and uncertainties that are difficult to predict because they relate to events and depend on circumstances that will occur in the future. Risks and uncertainties that could affect these statements include by are not limited to the risk factors specified under "Operating and financial review and prospects Risk factors" of this annual report on Form-20 F and in our other filings or documents furnished with the U.S. Securities and Exchange Commission. Other unknown or unpredictable factors or underlying assumptions subsequently proven to be incorrect could cause actual results to differ materially from those in the forward-looking statements. We do not undertake any obligation to publicly update or revise forward-looking statements, whether as a result of new information, future events or otherwise, except to the extent legally required.

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Introduction and use of certain terms

Nokia Corporation is a public limited liability company incorporated under the laws of the Republic of Finland. In this annual report on Form 20 F, any reference to “we,” “us,” “the Group,” “the company” or “Nokia” means Nokia Corporation a its consolidated subsidiaries and generally to Nokia’s Continuing operations, except where we separately specify that the term means Nokia Corporation or a particular subsidiary or business segment only or our Discontinued operations. References to “our shares” matters relating to our shares or matters of corporate governance refer to the shares and corporate governance of Nokia Corporation.

Nokia Corporation has published its consolidated financial statements in euro for periods beginning on or after January 1, 1999. In this annual report on Form 20 F, references to “EUR,” “euro” or “€” are to the common currency of the European Economic and Monetary Union, references to “dollars”, “U.S. dollars”, “USD” or “$” are to the currency of the United States, and references to “Chinese yuan” or “Chinese yuan renminbi” or “CNY” are to the official currency of the People’s Republic of China. Solely for the convenience of the reader, this annual report on Form 20-F contains conversions of selected euro amounts into U.S. dollars at specified rates or, if not so specified, at the year-end rate of 1.1450 U.S. dollars per euro, and conversions of selected euro amounts into Chinese yuan renminbi at specified rates or, if not specified, at the year-end rate 7.8751 Chinese yuan renminbi per euro. The referred year-end rates where the European Central Bank reference rates on December 31, 2018. No representation is made that the amounts have been, could have been or could be converted into U.S. dollars or Chinese yuan at the rates indicated or at any other rates.

Additional terms are defined in the "Glossary of terms".

The information contained in, or accessible through, the websites linked throughout this annual report on Form 20 F is not incorporated by reference into this document and should not be considered a part of this document.

Nokia Corporation furnishes Citibank, N.A., as Depositary, with its consolidated financial statements and a related audit opinion of our independent auditors annually. These financial statements are prepared on the basis of International Financial Reporting Standards as issued by the International Accounting Standards Board and in conformity with IFRS as adopted by the European Union (IFRS). In accordance with the rules and regulations of the SEC, we do not provide a reconciliation of net income and shareholders’ equity in our consolidated financial statements to the generally accepted accounting principles in the United States, or U.S. GAAP. We also furnish the Depositary with quarterly reports containing unaudited financial information prepared on the basis of IFRS, as well as all notices of shareholders’ meetings and other reports and communications that are made available generally to our shareholders. The Depositary makes these notices, reports and communications available for inspection by record holders of American Depositary Receipts (ADRs), evidencing American Depositary Shares (ADSs), and distributes to all record holders of ADRs notices of shareholders’ meetings received by the Depositary.

In addition to the materials delivered to holders of ADRs by the Depositary, holders can access our consolidated financial statements, and other information included in our annual reports and proxy materials, at nokia.com/financials. This annual report on Form 20 F is also available at nokia.com/financials as well as on Citibank’s website at https://app.irdirect.net/company/49733/hotline/. Holders may also request a hard copy of this annual report by calling the toll-free number 1 877 NOKIA-ADR (1 877 665 4223), or by directing a written request to Citibank, N.A., Shareholder Services, PO Box 43077, Providence, RI 02940 3081, United States. With each annual distribution of our proxy materials, we offer our record holders of ADRs the option of receiving all of these documents electronically in the future.

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We create the technology

to connect the world

We are at the dawn of a new era. Digital technologies – cloud computing, artificial intelligence, machine learning, the Internet of Things and 5G networks – are changing our world. Nokia is driving innovation and the future of technology to power this digital age and transform how people live, work and communicate.

We push the boundaries of what is possible to create new ways of connecting people, things and services instantly and effortlessly. We build upon a foundation of integrity, quality and security. We help our customers navigate complex choices, drive productivity gains in physical and digital industries alike, and unlock new opportunities that provide extraordinary experiences in people's lives each day.

Financial Highlights

For the year ended December 31,	2018	2017	2016
Continuing operations	EURm	EURm	EURm
Net sales	22 563	23 147	23 641
Gross profit	8 446	9 139	8 524
Gross margin	37.4%	39.5%	36.1%
Operating (loss)/profit	(59)	16	(1 100)
Operating margin	(0.3)%	0.1%	(4.7)%
Loss for the year	(549)	(1 437)	(912)
	EUR	EUR	EUR
Earnings per share, diluted	(0.10)	(0.26)	(0.13)
Dividend per share	0.20	0.19	0.17

	2018	2017	2016
As of December 31	EURm	EURm	EURm
Net cash and current financial investments	3 493	3 051	4 514

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Letter from our President and CEO

“2018 saw the commercial deployment of 5G move forward in lead countries, and Nokia was at the forefront of this activity. In 2019 we expect to see more organizations around the world take their first steps in creating the infrastructure for the Fourth Industrial Revolution – and Nokia is ready to be their trusted partner.”

Financial Highlights

Although our performance in 2018 was below our expectations overall, we exited 2018 with a strong finish, confirming our expectation of accelerated sales momentum as the year progressed. Indeed, we had a strong second half with every one of our Networks Business Groups delivering year-on-year growth, excluding the impact of changes in foreign currency exchange rates. This drove growth in Nokia’s net sales for the year of 1%, excluding the impact of changes in foreign currency exchange rates.

Our Networks business delivered approximately 2% growth in 2018, excluding the impact of changes in foreign currency exchange rates, fueled by the continued success of our end-to-end strategy and the conversion of a healthy pipeline into net sales. This allowed us to take share in certain segments of the market, while the overall market itself declined slightly. High customer engagement in multiple elements of our 5G portfolio sees us enter 2019 with a strong Networks order backlog. In Nokia Technologies, we maintained our strong growth track record with 11% year-on-year growth in recurring licensing revenue.

Reflecting this momentum in the year, the Board of Directors will propose a maximum dividend of EUR 0.20 per share for 2018: a 5% increase compared to 2017.

Progress in our strategy

In our first pillar – leading in high-performance, end-to-end networks with Communications Service Providers – we have proven our capabilities as the commercialization of 5G begins. We proudly serve as a partner to most of 5G’s ‘first-movers’ with over 25 5G commercial deals and nearly 100 trials and pilots of the new technologies.

In our second pillar – expanding network sales to select vertical markets – we support a wide and growing range of organizations as they evaluate how best to digitalize their operations. Enterprises are increasingly looking at dedicated networks to enable them to have full control over networking solutions that have the characteristics they need for their business. Today we serve approximately 1 000 customers outside of our traditional Communications Service Provider base, bringing connectivity to some of the most complex, fast-moving industries on earth, including a number of new automotive, energy and transportation customers that placed their trust in our technologies in 2018.

In our third pillar – building a strong standalone software business at scale – we see clear signs of our strategy bearing fruit. Nokia Software is now a truly verticalized business, driven by a renewed sales organization, underpinned by simpler processes and boasting a modern, cloud-native common software foundation. The attractiveness of this proposition is borne out through strong 2018 sales momentum including wins with AT&T, BT, STC, Sky, Telenor One Europe and Verizon and the industry analyst research firm, Analysys Mason, ranked us the leading telecoms software company by revenue.

In our fourth pillar – creating new licensing opportunities – our successes in 2018 with existing and new licensee customers have validated our direction for Nokia Technologies. This year we have extended our patent licensing agreement with Samsung; signed a new multi-year patent license agreement with Chinese smartphone maker OPPO;

and benefited from continued progress made by our brand licensee, HMD Global, which unveiled a range of new products throughout 2018 with production capacity to deliver on demand. We see further potential in licensing to smartphone makers and in other markets which are using our patented inventions, such as automotive, consumer electronics and IoT devices such as smart meters.

Accelerating our strategy

Given the considerable momentum of our strategy, and with the successful Alcatel Lucent integration and associated cost-saving program completed, we took steps during 2018 to accelerate the execution of our strategy and position our business for 5G leadership. Alongside a new program targeting EUR 700m in annual cost savings(1) by the end of 2020, these steps have led to a number of organizational changes that further strengthen our ability to deliver on our 2019 and 2020 guidance.

First, we have created a new Business Group, Nokia Enterprise, that consolidates a range of existing, fast-growing activities into one organization. Led by Kathrin Buvac, Nokia Enterprise will enhance our ability to capture higher-growth, higher-margin opportunities as companies progress with their digital transformations.

Second, we have tailored Mobile Networks' operational focus on mobile radio products, led by Tommi Uitto, and consolidated all our Cloud Core activities and accountability into Nokia Software, under the leadership of Bhaskar Gorti.

We have also realigned Nokia's customer-facing organization into two regional groups, to make sure our customer focus is as strong as possible. The first group covers the Americas, led by Ricky Corker. The second is responsible for Europe, Middle East & Africa and Asia-Pacific, led by

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Federico Guillén who previously led Fixed Networks. The new President of Fixed Networks, Sandra Motley, is charged with continuing the operational discipline of the Business Group while capturing new market opportunities for its portfolio.

These changes have strengthened our organization, sharpened our focus, and added strong capabilities to Nokia's Group Leadership Team.

The 5G investment cycle

From the first trials to the first roll-outs, 2018 was the year in which 5G became a commercial reality. It is my firm belief that we now stand at the start of a meaningful, long-term technology trend that bodes uniquely well for Nokia.

5G will power networks that connect sensors, machines, platforms, systems and people in one seamless, automated 'whole'. This fundamental shift in network design will require several different stages of investment, each of which leads naturally to the next. Nokia's unique, end-to-end portfolio includes products and services for each stage of this process, leading to a virtuous cycle of investment that only Nokia can truly take advantage of.

The cycle has already begun with 5G radio access network (RAN) upgrades in 'first-mover' markets such as the US, Korea, China and Japan, which our Airscale portfolio enables. As well as radio, these networks also need high-capacity connectivity to data centers, requiring backhaul network expansion. Demand in the U.S. for our IP and Optical Anyhaul offer shows this trend already taking shape.

With networks built, operators will then need fixed-wireless access to expand "last-mile" connectivity. With the most complete fixed-wireless access product set of any provider, we are well-placed to tap this opportunity.

In due course, 'fast-follower' countries will commence their 5G roll-outs. Yet, by this point, 'first-mover' countries will already have entered the second stage of 5G evolution. Here, the focus will shift to network virtualization and edge cloud and smart network fabrics will be required to connect these edge clouds, all playing to Nokia's strength in cloud deployment and packet core.

Network slicing will follow, triggering a need for enhanced software that can control networks with high degrees of automation: our standalone software business and early moves in AI will allow us to capitalize.

Simultaneously, many enterprises will choose to build their own private networks, meeting bespoke performance, reliability and security requirements. These networks will leverage the same end-to-end technologies as CSPs, but on a smaller scale. These will need to be plugged into national or global networks, creating a seamless 'whole', driving even greater network traffic and shifting the cycle back to the beginning.

No other global company touches every link in this cycle. No matter how early or late stage the investment, be it a 'first-mover' or 'fast-follower' geography, a Communications Service Provider innovator or a digitally-minded enterprise, Nokia's end-to-end portfolio means that we can meet every 5G investment requirement that lies ahead.

Force for good

Digital technology increases productivity, reduces waste and connects the world, so it was pleasing that the radio networks we delivered to our customers served around 6.1 billion subscriptions worldwide this year, up about 10% from 2016. As the 5G era begins we will see even greater societal and industrial benefits.

Climate challenges remain critically important. We have worked hard to minimize the energy use of our products. Achievements included the first commercial liquid-cooled base station in the world, recognition as a leader by the CDP Climate rating, and achieving average energy savings of 43% for customers whose networks we modernized during 2018. These and many more examples of our sustainable development work can be found in our People & Planet Report, to be published in May 2019.

Looking ahead

Nokia exits 2018 with strength, energy and purpose. The year has not been without challenges, but nevertheless, we have remained focused on our commitments to our customers, people and shareholders. Our strategy is focused on the true areas of opportunity; our global team is committed, dynamic and capable of innovating and winning at the highest level; and our end-to-end portfolio has put us in a great position to grasp the transformative 5G opportunity ahead.

Rajeev Suri

President and CEO

(1) Excluding costs related to the acquisition of Alcatel Lucent and related integration, goodwill impairment charges, intangible asset amortization and other purchase price fair value adjustments, restructuring and associated charges and certain other items.

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Market trends driving our strategy

We are rebalancing for growth, putting Nokia at the heart of unprecedented opportunities in the Fourth Industrial Revolution to create the technology to connect the world.

In 2016 we identified six global megatrends that we believe continue to impact our current and potential customers, change the lives of people and impact business operations on a global scale. The Nokia Bell Labs Future X vision is directly aligned to these megatrends, providing opportunities for us to diversify into new growth areas.

The megatrends we have identified are:

(1) Network, compute and storage: Ever present broadband capacity coupled with a distributed cloud for ubiquitous compute and near infinite storage, allowing limitless connectivity and imperceptible latency as well as subscription-based and asset-less business models.
(2) Internet of Things: In addition to people, trillions of things are connected to the internet and amongst themselves, collecting unprecedented amounts of data in a private and business context.
(3) Augmented Intelligence: Artificial intelligence combined with human intelligence transforms the collected data into actionable insights, fundamentally changing the way decisions are made by businesses, governments and individuals, resulting in time savings, less waste, higher efficiency and new business models.
(4) Human and machine interaction: A range of new form factors that transform the way humans interact with each other and with machines, e.g. voice-based digital assistance, gesture control, smart clothes, implantable chips, robotics and Augmented and Virtual Reality.
(5) Social and trust economics: Ubiquitous connectivity, compute and storage, as well as technologies such as artificial intelligence and blockchain, enabling new business models based on sharing assets and distributed trust, allowing rapid scalability on a global level.
(6) Digitization and ecosystems: Next level of digitization beyond content and information, digitizing atoms with additive printing in an industrial, consumer and medical context, digitizing logistics and production processes, transforming global supply chains by massive-scale automation.

Nokia Bell Labs has developed Future X, our vision of a future network architecture that addresses these megatrends in a holistic way. This is our guide to building networks that meet the future needs of our customers and address the inherent opportunities in the megatrends. The Future X vision encompasses the key domains of future networks: emerging devices and sensors, massive-scale access, converged edge cloud, smart network fabric, universal adaptive core, programmable network operating systems, augmented cognition systems, digital value platforms and dynamic data security.

Simultaneously, driven by the megatrends and the resulting increasing relevance of networks to digitize business operations, we see a shift in who is investing in technology.

Our primary market with communication service providers (CSPs), in which we have a leadership position, is very large in size, but expected to provide a limited estimated growth opportunity, mainly driven by 5G.

However, the megatrends are increasing the demand for large high-performance networks in other key industries. Webscale companies – such as Google, Microsoft and Alibaba – are investing in cloud technology and network infrastructure at an increasing scale. As other vertical markets such as transportation, energy and the public sector (TEPS) digitize their operations, they need high-performing mission-critical networks as well. The same is true for TXLEs – technically sophisticated large enterprises, such as banks, that invest heavily in their own network infrastructures to gain a key competitive advantage. Our “Future X for industries” network architecture combines the

technologies that drive dramatic productivity improvements across a wide range of industry sectors. As technologies such as edge cloud supporting augmented intelligence and advanced security analytics as well as end-to-end 5G-capable networks become a reality, they will radically speed up the digital transformation of industries such as manufacturing, logistics, transportation and energy, as well as governments and cities. Nokia's holistic approach is helping to drive a new era of productivity and human–machine interaction that is expected to unlock trillions of dollars of economic value in the next decade.

We are addressing both our primary CSP market and the newly identified growth opportunities in the Industrial IoT with our "Rebalancing for Growth" strategy. The strategy builds on our core strength of delivering large high-performance networks by expanding our business into targeted, higher-growth and higher-margin vertical markets.

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Our strategy

Our four pillars

Our strategy builds on our business portfolio and continued drive to create technology that serves people and businesses and includes the following four key priorities.

1.Lead

Lead in high-performance, end-to-end networks with CSPs

Our position

Nokia is a leader in this area today and we will use our main competitive advantage – a near-100% end-to-end portfolio that we can deliver on a global scale – to maintain our leadership while managing for profitability.

Our focus areas

§ We are differentiating ourselves with our end-to-end networks that deliver benefits for our customers in automation, total cost of ownership and time to market.
§ We are establishing leadership in 5G through our presence with 5G leading customers in the first 5G markets globally and achieving global technology and quality excellence.
§ We are innovating in augmented intelligence, analytics and automation for fast and flawless delivery of our network infrastructure services.
§ We are providing industry-leading cognitive network services to improve network performance, operational efficiency and subscriber experience, and developing service business models to open new revenue streams for CSPs.
§ We are maintaining our leading market share in copper and fiber access, accelerating momentum in fixed wireless access, successfully expanding in the cable market, further developing new smart home solutions such as whole-home Wi-Fi, and simplifying network operations for our customers.
§ We are leveraging our superior products and the next-generation IP routing portfolio based on our FP4 chipset to grow in both edge and core routing, where we have a fully virtualized portfolio that is differentiated by performance, flexibility, security and quality.

Progress

§ We are driving the deployment of 5G: the number of customers already engaged with us on 5G is rapidly heading over the 100 mark, and amongst those we have already signed over 25 5G supply agreements. Our global base of mobile broadband customers puts us in a position of strength as 5G rollouts accelerate globally.
§ In July, 2018, we announced a landmark USD 3.5 billion agreement with T-Mobile to accelerate the deployment of their nationwide 5G network in the United States. During the year we also signed three separate framework agreements with a combined value of EUR 2 billion with China Mobile, China Telecom and China Unicom.
§ Independent third party assessments by P3/Connect and others testify to Nokia’s superior networks performance around the world.

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2.Expand

Expand network sales to select vertical markets

Our position

We continue to expand into select vertical markets that have high-performance, carrier-grade networking needs: Web and cloud companies; transportation, energy, public sector (TEPS); and TXLE (large enterprises for which technology is a strategic advantage). As the world becomes more digital and more automated, the kind of high-performance, low-latency networks once used almost exclusively in telecommunications are now needed by other organizations. This is especially true in organizations that own high-value, movable assets that are mission-critical. To address this growing need for high-performance networks, Nokia formed the Nokia Enterprise business group. With Nokia Enterprise, we have implemented a combined sales organization, a targeted portfolio and new solutions that address our customers' digitization and automation needs.

Our focus areas

§ Web and cloud customers increasingly require high-performance networks to improve customer experiences and to expand their primary business models. For web and cloud companies, we are focusing on an all-IP-led approach, providing IP routing and optical network infrastructure.
§ Large, tech-savvy enterprise (TXLE) customers need to virtualize and automate their hybrid cloud data centers with technology disruptions like software-defined wide area networking (SD-WAN), software-defined security, and branch office connectivity. Nokia can address those needs with SD-WAN and our all-IP portfolio.
§ TEPS customers require high-performance, mission-critical networking that digitizes their energy systems, rail systems and cities. They also need to layer on top of those networks industrial automation platforms that help digitize their operations. Nokia offers mission-critical networks, solutions for digitization and Industrial IoT, and industrial automation.
§ Other verticals also need to increase productivity and reduce costs through the digitization and automation of their operational systems. This can be accomplished with Industrial IoT platforms, automation platforms and private wireless networks. Nokia now targets these opportunities.

Progress

§ In 2018 we made good progress in our select vertical markets with over 150 new customers and we now have more than 1 000 enterprise customers. We consolidated our enterprise-specific activities into Nokia Enterprise, our new business group, which commenced operations January 1, 2019.
§ In 2018 we delivered constant currency sales growth of 9% in the enterprise space, excluding the third-party business that we are exiting, and posted solid profitability.
§ We unveiled our "Future X for industries" strategy and architecture, which leverages digital transformation technologies to catalyze productivity and economic growth for enterprises.
§ We also announced numerous private LTE deals during the year including Elektro, a power distributor in Brazil, and BMW's smart manufacturing facility in partnership with China Unicom.

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3.Build

Build a strong software business

Our position

With our existing software products, we are today a leader in the large and growing telecoms software market. Our ambition is to build on this foundation and strengthen our position by building software for Digital Time. This means intelligently connecting humans, machines and data to boost productivity and thus create time for what matters the most. We help our customers to connect data across their business, network and operations and help them create insights for maximizing their investments – in time, relationships, revenue and productivity. By doing so, we aim to create a global software player that has a growth and margin profile like leading software companies. The basis for all our activities is diligent cost management, lean operations and a focus on developing and engaging our people.

Our focus areas

§ We are accelerating our innovation to meet customer expectations faster. For this purpose, we are adopting the Common Software Foundation across all our products and making them cloud-native, as well as reorganizing our R&D for greater effectiveness. We are also gearing Services and Care to next-generation effectiveness for faster delivery and flawless customer service.
§ We are modernizing our portfolio via Connected Intelligence by incorporating artificial intelligence and machine learning everywhere, enabling new revenue streams, pushing the limits of automation in operations, and moving to secure cloud-native networks. Beyond individual products, we integrate and deliver results-oriented solutions across our portfolio and with strategic partners.
§ We are optimizing our go-to-market strategy with a refreshed software sales team, better pricing models and stronger partnerships.

Progress

§ Throughout the year our Nokia Software business group continued to demonstrate the strength of its portfolio by winning major accounts including BT, Telenor One Europe, STC, Telefónica UK and Sky.
§ Analysys Mason ranked Nokia #1 in telecom product software revenues and #2 in combined telecom product and product-related revenues in its latest annual report released in November, 2018.

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4.Create

Create new licensing opportunities

Our position

Our approach is to keep our patent licensing business strong, creating new revenue streams from patent and technology licensing and brand partnerships. We own one of the broadest and strongest patent portfolios in our industry, built from the innovation of Nokia, Nokia Siemens Networks and Alcatel Lucent. At the end of 2018 our patent portfolio included around 20 000 patent families, and we filed patents on more than 1 300 new inventions during 2018.

Our focus areas

§ We continue to renew the portfolio through innovation in multiple areas, especially cellular standard essential patents, in part as a result of the extensive research activities of Nokia Bell Labs.
§ In addition to renewing existing patent licenses on favorable terms, our aim is to add new licensees from the mobile industry, and we continue to expand patent licensing into new segments, such as automotive, IoT and consumer electronics. Besides this, we are exploring opportunities to license our unique audio/visual technologies to device creators.
§ Our brand licensing efforts are well underway – we see value creation opportunities in the mobile devices industry, leveraging our strong Nokia brand. Our exclusive brand licensee for mobile phones and tablets, HMD Global, has already launched a comprehensive portfolio of new Nokia-branded feature phones and smartphones.

Progress

§ Further validating our global licensing program, Nokia and the Chinese smartphone company OPPO signed a multi-year patent license agreement. In addition, we extended our patent licensing agreement with Samsung.
§ Nokia’s brand licensee HMD Global continued to refresh its smartphone portfolio with numerous new models and announced plans to double its manufacturing capacity in India to satisfy demand.

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Networks business

Market overview

Through our comprehensive end-to-end portfolio of products and services we are addressing a market that encompasses mobile and fixed network access infrastructure, IP routing and optical networks, mobile and converged core networks, as well as software platforms and applications.

Our personal lives and enterprises are becoming increasingly more digitized, driving exponential growth in data traffic and, in turn, driving the demand for our portfolio of highly reliable and high-performance networks to support massive connectivity.

Our Annual Report on Form 20-F for 2019 will reflect our new segment reporting structure, which separates the Networks and Software businesses. For more information, see Note 37, Subsequent events, in the Financial Statements section.

Competition

The main competitors in our primary market are Huawei, Ericsson and ZTE, and in some markets we also encounter Samsung. We also compete with technology experts in some of our other market segments, such as Juniper Networks and Cisco in the IP networking and security segments, and Ciena, Adtran and Calix in the optical networks and fixed access segments. Both the optical networks and Nokia Software market segments, as well as the microwave transport market segment remain highly fragmented.

Sales and marketing

Nokia considers its customers in two distinct markets. Our primary addressable market consists of CSPs. Our current enterprise business is small in comparison with our operator business but growing fast.

The geographically divided Customer Operations (CO) organizations are the primary interface with our CSP customers. The CO Americas organization focuses on our markets in North America and Latin America, while the CO EMEA & APAC organization is responsible for our Asia Pacific & Japan, Europe, Greater China, India, and Middle East and Africa markets.

The CO organizations have a comprehensive global presence (active in approximately 130 countries) and its structure ensures that our customers benefit from dedicated management attention and from our teams' deep understanding of local markets. This approach enables Nokia to maintain strong customer relationships.

The priority of the CO organizations is to serve our customers. And, since 2018, the CO organizations have been responsible for both delivery and sales, ensuring strong alignment between our customer-facing teams in each account. Our "One CDM" (customer delivery manager) model provides a strong counterpart to our customer team setup, ensuring that customers have a seamless experience when working with Nokia. This is particularly important given the value our customers put on Nokia's end-to-end approach, which can provide a solution to a customer need based on portfolio elements from several of our business groups.

The CO organization also works very closely with our sales and delivery colleagues in Nokia Software to ensure the right level of customer focus and expertise in this crucial area, and with our colleagues in Nokia Enterprise to make sure that we are efficient in developing and selling the solutions that will benefit both our CSP and enterprise customers. We strongly support our "Service-Provider-as-a-Partner" (SPaaP) sales approach, in which we work in

partnership with operators to address customers in the enterprise space. This model is proving to be a successful route to market for CSPs as well as for Nokia.

Research & development

We are one of the industry's largest R&D investors in information communication technology and we drive innovation across telecommunications and vertical industries to meet the needs of a digitally connected world. Product development is continually underway to meet the high programmability, agility and efficiency requirements of the next-generation software-defined networks that will accommodate mobile and fixed broadband, IoT, intelligent analytics and automation, which are used to forge new human possibilities.

We have a global network of R&D centers, each with individual technology and competence specialties. The main R&D centers are located in Belgium, Canada, China, Finland, France, Germany, Greece, Hungary, India, Italy, Japan, Poland, the Philippines, Portugal, Romania, the United Kingdom and the United States. We believe that the geographical diversity of our R&D network is an important competitive advantage for us. In addition, the ecosystem around each R&D center helps us to connect with experts on a global scale, and our R&D network is further complemented by cooperation with universities and other research facilities.

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Mobile Networks

Market overview

The primary market for our Mobile Networks business group includes technologies for mobile access and microwave transport. This encompasses access network technologies ranging from 2G to 5G licensed and unlicensed spectrum for both macro and small cell deployments.

Business overview and organization

We see a strong initial appetite for 5G in the most progressive and advanced mobile markets, and we are the only end-to-end mobile network vendor working with the major operators in the U.S., China, South Korea and Japan. Nokia is rolling out technology today to prepare our customers for commercial launches when 5G devices and spectrum become available.

In Mobile Networks our goal is to be the leader in 5G and provide the best value to our customers as they evolve their networks. In December 2017 the first 3GPP specifications were confirmed – including 5G New Radio (NR) – and since then, the technology and the market have moved fast. We continue to develop our 5G portfolio according to the latest 3GPP specifications and are proud of the number of industry firsts that we have completed on the path to 5G commercialization. Furthermore, we continue to invest significantly in our ReefShark processor family for baseband and RF. Our customers are moving fast as well: our first commercial 5G radio contract was signed in January 2018 with NTT DoCoMo in Japan based on 5G New Radio. As an industry, we have moved quickly from specifications to development, testing, and implementation in real networks. To this end, roughly half of our R&D personnel are fully focused on 5G and this is expected to increase as we continue to move personnel on a periodic and strategic basis. As we move from 4G to 5G, we aim to become a champion of continuous integration, continuous delivery and DevOps.

We have a global installed base that is expected to provide us with the platform for success in 5G. We have more than 400 customers in 4G/LTE and a robust AirScale platform, which can be upgraded from 4G to 5G. We built our AirScale portfolio and small cells, software and mobile transport solutions to work across all generations of technology and all relevant spectrum bands for efficient, simplified and optimized sites for our customers. In radio we build our access portfolio based on one architecture: Future X is the foundation of our reference architecture for all deployment models. The Nokia 5G Future X end-to-end product and services portfolio combines high-capacity 5G New Radio, core, SDN-controlled “Anyhaul” transport, edge clouds, and software orchestration to provide a complete set of network capabilities for commercial 5G

Competition

The mobile networks market is a highly consolidated market as a whole, and our main competitors are Huawei and Ericsson. Additionally, there are two regional vendors, ZTE and Samsung, that have an estimated market share of below 10%. The microwave transport market segment, however, remains fragmented.

In January 2018, Nokia announced its end-to-end 5G Future X network architecture and ReefShark chipset. The ReefShark chipset decreases the size of massive MIMO antennas by 50%, increasing deployment options, and achieves a 64% reduction in power consumption of baseband units. We also launched the world’s first MulteFire small cell, enabling industries, enterprises, smart cities and mobile service providers to leverage global unlicensed spectrum for secure, high-capacity private LTE networks.

In July 2018 Nokia and T-Mobile announced a $3.5 billion, multi-year 5G network agreement. Under the agreement, Nokia will provide T-Mobile with its complete end-to-end 5G technology, software and services portfolio.

Firsts: First Over the Air (OTA) NSA video streaming call with the Airphone at the end of April, first full L1 release for ABIL (based on 3GPP shadow specification V4) created in early May, live 5G installations in Oulu for 3.5 GHz and 28 GHz, and industry firsts, like the Edge Cloud data center solution for the 5G era. we were the first in the US to demonstrate a 5G NR connection over massive MIMO with Sprint. We achieved the first 5G NR mobility call with Verizon and reached peak data speeds of 1.45 gigabits per second (Gbps) on LTE in a live commercial environment using six channel carrier aggregation with Verizon and Qualcomm. Meanwhile we helped San Marino become the first 5G state in Europe with Telecom Italia and, in China, we achieved the world’s first 3GPP-compliant 5G NR test of the same kind completed with a 3rd party device with China Mobile.

2018 highlights

In January, Nokia unveiled its new ReefShark chipsets which leverage in-house silicon expertise to dramatically reduce the size, cost and power consumption of operators' networks and meet the massive compute and radio requirements of 5G.

In July, Nokia and T-Mobile announced a USD 3.5 billion, multi-year 5G network agreement. Under the agreement, Nokia will provide T-Mobile with its complete end-to-end 5G technology, software and services portfolio.

In August, Verizon and Nokia completed first 5G NR mobility call.

In September, AT&T selected Nokia as a supplier to seamlessly accelerate the transformation of their network to 5G.

In November, Nokia signed frame agreements worth more than EUR 2 billion with three Chinese operators. Agreements will increase network speed and capacity as well as improve reliability across China, while introducing new network capabilities as operators evolve toward 5G.

In December, Nokia and Telenor Group announced plans to deploy AirGile cloud-native core solution to transform mobile network operations in Scandinavia. Deployment in Denmark, Norway and Sweden will enable new capabilities in service agility, scalability, automation and network slicing as Telenor evolves toward 5G.

In December, Helsinki Airport became the first 5G airport in the world with Nokia network technology.

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Fixed Networks

Market overview

The primary market of Fixed Networks is the CSPs. In this market, the shift from copper to fiber has been accelerating in all regions and we see a strong rise of next-generation copper and fiber technologies, such as G.fast and XGS-PON (10 gigabit passive optical networks). Virtualization of fixed access networks is slowly but surely picking up. Complementary technologies such as fixed wireless access and whole-home Wi-Fi are clearly gaining traction. We have been diversifying our business into new segments, including cable MSOs, energy, government, enterprise and non-traditional players with new business models, such as investment firms.

Business overview and organization

We are diversifying our portfolio with constant innovation and have the industry's most complete portfolio to make our customers' business case work. In 2018 the results of our 2017 R&D investments started paying off. We had breakthroughs with the first European and Asian customers for Unified Cable Access, and the first contracts for Nokia Wi-Fi, Wireless PON and 5G to-the-home. We also signed five new virtualization customers for our software-defined access solution. We are also diversifying geographically, with breakthroughs with service providers in new and important growth markets such as Japan, South Korea and India.

The Fixed Networks strategy is based on a concept we call the "power of and": fixed and mobile; gigabit to and into the home; the network and the cloud.

The first pillar of this strategy, fixed and mobile, is about offering the right technology mix to deliver gigabit access to more people, faster. It comprises copper, fiber, coax and fixed wireless access technologies. Nokia is a market leader in copper technologies, such as VDSL2 vectoring, Vplus and G.fast. We also increased our market share in fiber, with technologies such as GPON, ethernet point-to-point and 10 gigabit next-generation fiber technologies (with XGS-PON getting significant market traction). We have been enlarging our portfolio with new ASICs for our leading G.fast and VDSL2 solutions, new options for our copper platforms called Long Reach VDSL2 (VDSL2-LR) and new fixed wireless access products, including FastMile high-gain outdoor receivers and indoor gateways.

For cable operators, Nokia offers the true end-to-end technology capabilities needed to support growing capacity requirements today and into the future. Nokia's Unified Cable Access solution has put an end to the industry debate on R-PHY versus R-MACPHY and offers a full toolbox of fiber, coax and virtualized distributed access architecture solutions. The Unified Access Solution is now being deployed with the first European customer, after a successful debut in the US last year. Nokia has also brought to life the technology, Full Duplex Docsis, to support 10Gbps symmetrical services over coax cable networks.

The second pillar, delivering a gigabit to and into the home, is about ensuring the perfect connectivity throughout the home. Fixed Networks has been expanding its business, evolving into the whole-home Wi-Fi market with the Nokia Wi-Fi portfolio. Nokia Wi-Fi provides perfect coverage in every corner of the home, supporting CSPs in their goals to offer managed Wi-Fi services and deliver a superior customer experience. Third-party tests show superior performance of the Nokia Wi-Fi beacons. The first customers are signed up and have started offering the service to their subscribers.

As networks become ever more complex, given the diversity of technologies and deployment options, the third pillar of our strategy looks at simplifying and automating operations. Virtualization plays a key role in this. Moving functions to the cloud makes networks easier to manage and scale. With our software-defined access network solution, Nokia takes a pragmatic approach. Our strength and competitive advantage lie in the fact that our virtualization

solution offers a smooth migration path for service providers to gradually evolve their legacy equipment to a software-defined network combined with the coexistence with legacy systems that CSPs may decide not to evolve. We launched our fully open and programmable fixed access network slicing solution, and our Multivendor ONU Connect, the industry's only fully open, virtualized solution that resolves PON CPEs multivendor interoperability (one of the biggest pain points for fiber operators) and signed up five new customers.

Enabled by Nokia's advanced automation and analytics, Nokia launched the Fixed Access Health Index for service providers, a new metric for measuring and benchmarking the quality and performance of fixed access networks.

Competition

The competitive landscape in fixed access for CSPs has two major key players, Nokia and Huawei, who have the bulk of market share. ZTE, in third position, has been impacted by the U.S. components ban. Smaller players like Calix and Adtran in North America and Fiberhome in China have limited footprint and have a market share smaller than 10% and no comparable breadth of portfolio.

Nokia continued to be the market leader in copper access and one of the market leaders in fiber access, growing its market share. Nokia is the only vendor with a leading market share in all regions worldwide, and the only Western supplier in China.

Fixed Network's strategy of Growth through diversification is paying off. Diversification in portfolio is opening growth opportunities in cable, whole home Wi-Fi, fixed-wireless access and virtualization. Geographical diversification has delivered breakthroughs in countries like South Korea, India and Japan, with good growth opportunity. Market diversification is opening new business opportunities in new segments and with non-traditional customers.

Nokia remains a clear, front-of-the-pack leader in the race to deliver state-of-the-art fixed networking solutions.

2018 highlights

Nokia continued to be the market leader in copper access and one of the market leaders in fiber access, growing its market share. We are the only vendor with a leading market share in all regions worldwide, and the only Western supplier in China.

For Fixed Networks, our strategy of growth through diversification is paying off. Our portfolio diversification is opening growth opportunities in cable, whole-home Wi-Fi, fixed wireless access and virtualization; our geographical diversification has delivered breakthroughs in countries like South Korea, India and Japan, with good growth opportunity; and our market diversification is opening new business opportunities in new segments and with non-traditional customers.

We believe that Nokia remains a clear, front-of-the-pack leader in the race to deliver state-of-the-art fixed networking solutions.

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Global Services

Market overview

The Global Services business group's market includes network infrastructure and professional services for mobile networks, in addition to managed services for the fixed, mobile, applications, IP and optical domains.

Business overview and organization

The services, solutions and multi-vendor capabilities of our Global Services business group help CSPs and enterprises in the transport, energy and public sectors (TEPS) navigate through the evolving technology landscape, network complexity and data growth. We work with them to improve end user experience while providing support in day-to-day network planning, implementation, operations and maintenance.

Our Global Services offering allows Nokia to differentiate in the 5G market while helping operators prioritize their 5G investments and bring 5G-based services to the market faster. Nokia 5G Acceleration Services portfolio helps CSPs prepare for 5G business cases and assess the technical choices, plan and design the end-to-end deployment and manage the complexity of multi-vendor and legacy networks.

Our other key focus area in Global Services is empowering CSPs to transform to digital service providers. We are building a new digital architecture for the full life cycle of network design, deployment, operations and technical support – both for legacy and cloud-based networks. We tap into advanced analytics, powered by Nokia AVA, our cognitive service delivery platform, to help boost network performance, operational efficiency and customer experience. Software robots speed up network upgrades – for example, 11 000 eNodeBs were upgraded in one night with 100% accuracy for a large tier 1 operator. We also help digital service providers to seize the possibilities of IoT and enter new markets using Nokia Worldwide IoT Network Grid (WING), which provides seamless connectivity across geographical borders and technologies. We enable our customers to enter new markets rapidly and with low risk through pay-as-you-grow or revenue share models where, for example, WING and Nokia AVA's Analytics Services are provided as-a-Service (aaS).

We have invested heavily in automation, data science and artificial intelligence. Our digital field force is empowered by augmented reality and video support from our Global Delivery Centers. In 2018 we completed the first successful deployments on our crowdsourcing platform. Our engineers process 6 million trouble tickets each year using artificial intelligence and help ensure the best experience for more than 1 billion subscribers worldwide.

Global Services introduced a new organizational structure effective in August 2018 to accelerate its strategy execution, drive efficiencies in the established base businesses, such as network deployment and technical support, and capture new business opportunities, for example in analytics and Industrial IoT.

Competition

In a market segment that combines products and services as well as managed services, Nokia competes against Huawei, Ericsson, ZTE and Cisco, while for the service-led businesses like cognitive network analytics services and IoT and systems integration, we see other competitors such as Netcracker, HPE and IBM emerging in addition to Ericsson and Huawei.

The launch of Security Risk Index and Managed Security Service ensure communications service providers can protect their networks against all threats. In addition to addressing their own security needs, communications service providers can white label Managed Security Services to enterprises under their own brand, which offers revenue

potential in the fast-growing enterprise security market.

Nokia Cloud Collaboration Hubs were opened in Singapore, Irving, Texas, and Reading, UK. The hubs are execution centers where multivendor cloud services from strategy and design to execution and delivery are provided.

Nokia expanded its offering for smart cities and public safety by launching Advanced Command Center, which enables better decision making by strengthening situational awareness, and improves emergency response by utilizing video communications, IoT, analytics and automation. In addition, IoT for Smart Cities, Sensing as a Service, and S-MVNO for Public Safety expand Nokia's offering for verticals.

Analytics services gained traction with customers including Telenor Pakistan, Ooredoo Myanmar, EE UK, StarHub, 3 Indonesia, and Nokia AVA was rated the leading Telco AI Ecosystem by Analysys Mason.

Nokia WING, a managed service for global IoT deployments, was selected by AT&T, Tele2 and Marubeni Corporation to provide seamless connectivity across geographical borders and technologies.

To help operators rollout 5G technology, Nokia introduced Cross-domain Architecture and Site Evolution Services and launched Nokia 5G Digital Design, a unique, patent-pending concept, that will dramatically revolutionize the way networks are designed.

2018 highlights

Analytics services gained traction with customers including Telenor Pakistan, Ooredoo Myanmar, EE UK, StarHub and 3 Indonesia, and Nokia AVA was rated the leading telco artificial intelligence ecosystem by Analysys Mason.

Nokia WING, a managed service for global IoT deployments, was selected by AT&T, Tele2 and Marubeni Corporation to provide seamless connectivity across geographical borders and technologies.

To help operators roll out 5G technology, Nokia introduced Cross-Domain Architecture and Site Evolution Services and launched Nokia 5G Digital Design, a unique patent-pending concept that will dramatically revolutionize the way networks are designed.

The launch of Security Risk Index and Managed Security Service helps to ensure CSPs can protect their networks against threats. In addition to addressing their own security needs, CSPs can white-label Managed Security Services to enterprises under their own brand, which offers revenue potential in the fast-growing enterprise security market.

Nokia Cloud Collaboration Hubs were opened in Singapore, Irving (Texas) and Reading (UK). The hubs are execution centers where multi-vendor cloud services from strategy and design to execution and delivery are provided.

We expanded our offering for smart cities and public safety by launching Advanced Command Center, which enables better decision-making by strengthening situational awareness, and improves emergency response by utilizing video communications, IoT, analytics and automation.

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IP/Optical Networks

Market overview

The primary market for our IP/Optical Networks business group includes routing and optical technologies and related services sold to CSPs. This market includes technologies such as IP aggregation, edge and core routing, mobile packet core, wavelength division multiplexing, and packet optical transport networking solutions. We also have analytics and end-to-end SDN solutions.

A growing portion of our IP/Optical Networks revenue is derived from adjacent markets, which include customer segments like webscale companies and enterprises. In the enterprise segment, we address verticals like TEPS and support hyperscale networking for health care, finance and retail enterprises. We address these mission-critical markets with our IP, optical and Nuage Networks portfolios.

Business overview and organization

For our IP/Optical Networks business group, we provide the highly reliable and massively scalable networks that underpin the digital world's dynamic interconnectivity. Our portfolio of robust and innovative software, systems and services play across multiple domains, from programmable IP and optical transport networks for the smart fabric to analytics and software-defined capabilities for the programmable network operating system and more.

CSP networks are under tremendous pressure from cloud-based applications, ultra-broadband evolution and the Industrial IoT. Our IP and optical networking solutions reduce time to market and risk as CSPs launch new services, enabling rapid scaling to meet surging demands with optimal configurations. Our insight-driven network automation solutions help to further ensure that network services are delivered with consistent quality, reliability and security and that restorative actions are automatically initiated when any parameter varies beyond set limits. These carrier-grade attributes also address the needs of – and are valued by – our webscale, TEPS and large enterprise customers.

The IP/Optical Networks product portfolio includes:

§ comprehensive IP and optical wide area network (WAN) solutions that dynamically, reliably and securely connect people and things from any universal broadband access modality to any clouds and edge clouds at the lowest cost per bit;
§ advanced cloud-optimized IP service gateways for residential, business, mobile and Industrial IoT services and unique hybrid solutions enabling a converged services future;
§ analytics and carrier SDN solutions for insight-driven network automation that dynamically provide, optimize and assure network services and resources end-to-end, from access to the cloud and spanning IP and optical technology layers;
§ advanced data center automation and software-defined WAN solutions that configure network connectivity among clouds and to any enterprise branch office with the ease and efficiency of cloud compute using products from our Nuage portfolio; and
§ an extensive portfolio of professional services to accelerate the benefits of integrating new technologies to transform networks and leverage the latest innovations in SDN, virtualization and programmable IP and optical networks.

Competition

Our competitive landscape in this space includes Cisco, Juniper Networks and Huawei, in addition to various specialized players in optical such as Ciena.

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2018 highlights

The IP/Optical Networks business group launched the next generation of our Photonic Service Engine (PSE) family of super-coherent digital signal processors, underscoring Nokia's leading position in the industry and innovation pedigree. The Nokia PSE-3 will be instrumental in the evolution of CSP and webscale networks to meet the surging traffic demands of video, cloud and 5G by maximizing the capacity and performance of every link in their optical networks.

Telia Company selected Nokia's cloud packet core solution to profitably deliver enhanced mobile broadband, and to provide the massively scalable platform required as part of Telia's Next Generation Core.

Telefónica Spain selected our high-performance routing and Nuage Networks Virtualized Cloud Services to build an open, elastic and secure data center network, greatly expanding the agility, scale and efficiency of its cloud-based services.

We won a five-year contract with Polish PKP Polskie Linie Kolejowe to deploy a nationwide turnkey GSM-R and mission-critical backhaul network to enhance railway security and reliability throughout the country. Our largest-ever GSM-R contract will provide PKP/PLK with one of the biggest state-of-the-art railway communications networks in Europe.

We introduced the latest release of the Nuage Networks Virtualized Network Services (VNS) platform, SD-WAN 2.0, offering the most powerful and secure end-to-end network governance across a multi-cloud environment, with complete visibility and control from a single management interface.

Proximus announced as part of its migration to its Terabit IP Transport Aggregation Network, TITAN, that it was among the first in the world to deploy Nokia's next-generation 7750 Service Router 14S, the first routers equipped with multi-terabit processors – a technological leap in the industry.

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Nokia Software

Market overview

As service providers and large enterprises seek to modernize their businesses by leveraging 5G, they are propelling a clear growth market in telecommunications. The Nokia Software portfolio is designed to help customers accelerate their digital reinvention and power the Fourth Industrial Revolution. Our network-agnostic and cloud-native software solutions:

§ enrich and monetize digital experiences;
§ fuel operations through automation and intelligence;
§ increase network agility and advanced functionality; and
§ provide innovative emerging technologies.

In this business space we sell primarily to a CSP market and Nokia Software continues to expand into new vertical markets and emerging technologies.

Business overview and organization

The Nokia Software business has an important edge over traditional software vendors. Rooted in our deep understanding of our customers' networks, we bridge the gap between their business and their network with a level of intelligence unparalleled for our industry. Our mission is to help our customers operate in digital time – modernizing the slow, siloed and monolithic systems that weigh them down today with more agile, intelligent and lightweight solutions. By rebuilding our software applications on a Common Software Foundation, we are increasing innovation velocity while at the same time ensuring that our products are easier to deploy, use and maintain. Our modern software solutions are based on five key principles: extreme automation, actionable insight, high trust, cloud-native, and multi-vendor/multi-network capabilities.

The Nokia Software portfolio contains:

§ Digital experience and monetization: enables service providers to identify and act upon the small windows of digital time where the opportunities to enrich and monetize are the most impactful. Our portfolio includes solutions for omni-channel customer engagement, customer experience network analytics, fixed and mobile device management, and policy and charging. Today we have more than 400 digital experience and monetization customers, we are the market leader in both fixed and mobile device management and we have the industry's first cloud-native 5G charging solutions.
§ Digital operations: helps service providers simplify, automate and optimize their service and network operations. Our portfolio includes solutions for service fulfillment, assurance, orchestration and network management. We have more than 500 digital operations customers globally, hold leading market positions in NFV MANO and service assurance, and have been recognized as the "one-stop shop for Operations Support Systems" by Analysys Mason.
§ Digital networks: software that creates an elastic, programmable and secure cloud-based foundation to address performance and reliability requirements. Our products include one of the industry's first cloud-native session border controllers, a portfolio of active security solutions, and market-leading mobile network management solutions. As of 2019 Nokia's cloud core portfolio of products and services is included in this portfolio in an effort to improve customer focus.

Competition

Nokia is #1 in sales of telecom software products and is one of only two large players in the market that are stable and growing, according to Analysys Mason. However, this market remains highly fragmented, with more than half of the market served by niche players or in-house custom solutions. As such, we see significant opportunity to increase our

market share.

Our competitors fall into two categories: independent software vendors (ISVs) and network equipment providers (NEPs). The main ISV competitors are Amdocs, Netcracker and Oracle. This is an area where we see increasing competition from niche players. The main NEP competitors are Huawei and Ericsson, selling software as part of large infrastructure deals.

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2018 highlights

As part of Nokia's strategy to build a software business at scale, the Nokia Software business group has been sharply focused on building a specialized software sales force, expanding and modernizing our portfolio, and transforming our delivery and support capabilities. We are excited to see the impact of these small and large changes as we model our balance sheet, go-to-market, R&D and services on those of traditional software companies.

2018 product innovations include:

Unveiled the latest version of our Cognitive Analytics for Customer Insight software, bolstering our Customer Experience Index (CEI) with machine learning and intelligent automation to improve accuracy of predicting customer satisfaction and provide intelligent, digital-time recommendations for next-best automated and human actions to address subscriber issues.

Launched a new cloud-native Enterprise Session Border Controller (eSBC) that brings secure, ultra-high-quality IP voice and video services to enterprise customers.

Acquired SpaceTime Insight to expand our IoT software portfolio and accelerate vertical application development.

The new release of our CloudBand NFV and orchestration solution gained significant market traction, propelled by new cloud management capabilities improving service delivery and significantly reducing operating costs, as 5G deployments get underway.

Enriched our NetGuard security, operations, augmented intelligence, network and experience capabilities to support Nokia's 5G Future X network architecture.

Operational and organizational highlights include:

Strengthened our dedicated software sales force and recruited experienced software sales people across the globe.

Continued to drive the adoption of a Common Software Foundation to make our software easier for customers to integrate, deploy and use; strengthened our DevOps capabilities to get features to market faster; and standardized performance and reliability testing to ensure our products exceed telco-grade standards.

Increased the value of our service practice with a Common Delivery Framework, investment in key skills like data science, NFV on-boarding, security and monetization.

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Nokia Enterprise

Market overview

In 2018 Nokia successfully addressed the enterprise customer segment. Recognizing the growth potential of our business within this segment, we created a new business group, Nokia Enterprise, effective January 1, 2019. Our Enterprise business group addresses the mission- and business-critical networking requirements of asset-intensive industries such as transportation, energy, manufacturing and logistics – as well as governments and smart cities. The business group also supports hyperscale networking for health care, finance and retail enterprises and webscale players.

Business overview and organization

Nokia has a strong track record of helping enterprises modernize the communications networks they rely on to supervise and manage a range of operations, employing technologies across the IP, optical, microwave, fixed and mobile access domains. To date we have deployed more than 1 000 such networks across our key target vertical markets.

Today a range of enterprises are looking to harness major technology shifts in areas such as ubiquitous connectivity, analytics, cloud and the Industrial IoT to digitalize and automate critical processes and drive massive gains in business and industrial productivity.

Enterprises can benefit from digitalization, better asset management, improved processes, deeper levels of network security and new business models that will arise from pervasive connectivity.

High-performance networking is at the nexus of these trends, addressing the demand for pervasive connectivity with smart network infrastructure (increasingly wireless) that seamlessly connects everyone and everything, everywhere. Our proven enterprise portfolio provides the foundation for more than 1 000 mission-critical networks, incorporating technologies from across Nokia's Access, IP/Optical Networks, Software and Global Services portfolios, coupled with enterprise-specific products for digital automation, analytics and IoT.

This end-to-end portfolio supports the Future X for industries network architecture developed by Nokia Bell Labs, a blueprint for future industrial networks that intelligently combines high-performance, ubiquitous access and intelligent IP/optical networks with agile multi-cloud-enabled solutions, analytics-driven digital value platforms and business applications – with security capabilities embedded at all levels – to support industrial automation.

We are also driving the adoption of multi-cloud, IoT and automation with strategic investments in emerging technologies such as SDN, data center and SD-WAN applications and more. Notable developments in 2018 include the launch of the Nokia Digital Automation Cloud – our plug-and-play private wireless connectivity and automation platform designed for Industrial IoT applications; and the combination of Nokia's 2018 acquisition of SpaceTime Insight with the company's home-grown scene analytics innovations.

The Enterprise business group targets a select group of industries, which includes the following:

Transportation, energy and public sector (TEPS)

We expect our networks to be the foundation for next-generation smart grids that effectively match energy generation with demand and help power utilities explore new energy distribution models. We provide oil, gas and mining companies with private LTE networks to bring new levels of performance to a range of mission-critical operations,

protecting lives and increasing productivity.

For railway, highway, aviation and maritime industries, we build operational technology networks that support railway signaling, airport communications, air traffic control, digital signage and toll collection, and on-board broadband and infotainment.

Nokia's technology helps first responders save lives, supporting traditional two-way radio communications, while laying the foundation for advanced control centers and the data-rich mobile broadband services to enhance situational awareness and operational intelligence.

As cities seek to become smarter, Nokia offers a platform-based approach to support the connectivity, data sharing and usage control capabilities needed for smarter parking, lighting, traffic management and other municipal services. And we are partnering with governments and new network providers to bring broadband to remote, under-served communities.

Hyperscale enterprise

Nokia offers hyperscale enterprises a comprehensive solution set to help them meet their data needs while addressing stringent compliance, privacy and security requirements. Nokia solutions enable the connection of enterprise branches to clouds, both public and private, to enable their users to use their business applications from anywhere, over any broadband network. Nokia delivers IP, optical and SDN solutions to enable this connectivity.

Webscale companies

The webscale companies are a select group of enterprises that handle millions of transactions per day, demand hyper-efficiency in content delivery and support exceptional online experiences. We enable these companies to intelligently and instantaneously scale their services through automated cloud-based global service delivery platforms with robust cybersecurity features by leveraging our intelligent IP and optical networking solutions.

Competition

The competitive landscape for the enterprise space is broad and includes many specialized players focused on specific markets. The primary players active in supplying high-performance networking and mission-critical fixed and mobile communications technologies across a range of market segments include Nokia, Cisco, Juniper, Huawei and Ericsson.

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2018 highlights

- Uptake of private LTE for enterprises accelerated in 2018, with projects including a deployment with China Unicom of a smart manufacturing solution at a BMW facility; a rollout for the Brazilian power distributor Elektro to strengthen the company's power grid reliability and operating efficiency; and an installation at the Port of HaminaKotka, the biggest in Finland, with Ukkoverkot.
- Nokia solidified its leadership position in private LTE for mining, supporting the digitalization and automation to make mines safer, more productive and sustainable. In 2018 Nokia demonstrated these capabilities for both underground mining vehicles and open-pit, ultra-class mining trucks and automated haulage systems in collaboration with key industry leaders including Sandvik and Komatsu.
- We launched a variety of innovative smart city projects, including an agreement to power BSNL's Smart Telecom Pole project, providing connectivity integrated with smart LED lighting, environmental sensors and more; a collaboration with Dell EMC for delivery of goods using semi-autonomous barges in the Dutch city of Delft; and a joint USD 2 billion CAD program with Smart City Capital, LLC to foster smart city projects in Canada.
- In the transportation arena, Nokia announced its largest-ever GSM-Railway contract with Polish PKP Polskie Linie Kolejowe and launched a jointly developed solution with our partner Altran to optimize and streamline the maintenance of rolling stock for railway operators.
- Nokia has expanded its push into the health-care segment with continued ground-breaking cloud advances at University of Pittsburgh Medical Center and Oulu University Hospital.
- In the webscale space, Nokia and Tencent are collaborating to accelerate 5G webscale research and applications to benefit millions of internet users in China.
- Nokia's Nuage Networks has built on its strong performance in the next-generation SD-WAN market with recent contracts with Cogeco Peer1 and e-QUAL. This is further building on top of the SD-WAN services being offered by more than 50 service provider partners globally, including BT, Telefónica, Cox, Telus, NTT Netmagic and Etisalat.

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Nokia Technologies

Market overview

Nokia Technologies is focused on licensing Nokia intellectual property, including patents, technologies and the Nokia brand, building on Nokia's continued innovation and decades of R&D leadership in technologies used in virtually all connected devices used today.

Business overview and organization

Following the sale of our Digital Health business in 2018, Nokia Technologies has exited the direct-to-customer market and is now focused on licensing.

- Our Patent Business continues to grow its successful patent licensing and monetization activities, which drive most of Nokia Technologies' net sales.
- Our Technology Licensing business is focused on licensing innovative spatial audiovisual technologies to smartphone and camera manufacturers.
- Our Brand Partnerships business works with our exclusive licensee for the Nokia brand for phones and tablets, HMD Global, which has launched 12 new Android smartphones and five new feature phones during 2018.

In addition, our Intellectual Property organization manages the Nokia patent portfolio, working with all other Nokia businesses.

Sales and marketing

Our Patent Business is responsible for monetizing our intellectual property by making our innovations available to the markets through licensing activities and transactions. Nokia Technologies currently has more than half of the mobile phone market by volume under license.

Nokia Technologies also continues to engage in global sales and marketing activities supporting the technology licensing of our innovative audiovisual solutions such as OZO Audio.

Nokia Technologies sees further opportunities in licensing its proprietary technologies, intellectual property and brand assets into further markets such as Internet of Things and related industries.

Research and development

The applied nature of our R&D in the Finland-based Media Technologies Research Lab in Nokia Technologies has resulted in various relevant and valuable inventions in areas that we believe are important for emerging consumer experiences, such as audio standardization.

Patents and licenses

For more than 20 years, we have defined many of the fundamental technologies used in virtually all mobile devices and taken a leadership role in standards setting. As a result, we own a leading share of essential patents for GSM, 3G radio and 4G LTE technologies. We are a leading contributor to the development of 5G standards and declared more than 1 400 patent families for the standard during 2018, with more to follow. We expect to also have a leading position in 5G standards essential patents.

As part of our active portfolio management approach, we are continuously evaluating our collective assets and taking actions to optimize the size of our overall portfolio while preserving the high quality of our patents. At the end of 2018, our portfolio stands at around 20 000 patent families, built on combined R&D investments of more than EUR 126 billion over the last two decades.

We continue to refresh our portfolio from R&D activities across all Nokia businesses, filing patent applications on more than 1 300 new inventions in 2018.

8 At Mobile World Congress in February, Nokia Technologies launched its Patient Care Platform to enable doctors to remotely monitor patients with their smart devices. The platform, which is being used in a trial by the UK's National Health Service, aims to better prevent and manage chronic health conditions and drive timely and targeted patient care.

During the year, Nokia signed a number of patent licensing agreements, including with Apple, Huawei, LG Electronics and Xiaomi. Our agreements with Apple and Xiaomi also include broader business collaborations.

Our exclusive brand licensee for phones and tablets, HMD Global, launched six new Nokia branded Android smartphones and five new Nokia branded feature phones during its first year of operations. The new products have achieved outstanding net promoter (NPS) scores.

2018 highlights

Following the strategic review of options for the Digital Health consumer products business announced in February 2018, the sale of the business was closed in May 2018, following which Nokia Technologies was focused on licensing.

During the year, Nokia signed a number of patent licensing agreements, including the extension of our agreement with Samsung, as well as a new agreement with China's OPPO. We also joined the Avanci licensing platform, to increase licensing choices for automotive companies.

Our exclusive brand licensee for phones and tablets, HMD Global, launched 12 new Nokia branded Android smartphones and five new Nokia branded feature phones during its second year of operations. According to Counterpoint Research Q3 2018 figures, HMD Global is now a top ten smartphone manufacturer globally and among the top five in more than 30 markets including the UK.

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New patent filings in 2018

1 300+

R&D investment over the last two decades

~EUR 126bn

Patent licensees

100+

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Nokia Bell Labs

Nokia Bell Labs is the world-renowned industrial research and innovation arm of Nokia.

Over its 93-year history, Nokia Bell Labs has invented many of the foundational technologies that underpin information and communications networks and all digital devices and systems.

This research has resulted in nine Nobel Prizes (including one in 2018), two Turing Awards, three Japan Prizes and a plethora of National Medals of Science and Engineering, as well as an Oscar, two Grammys and an Emmy for technical innovation. Nokia Bell Labs continues to conduct disruptive research focused on solving the challenges of the new digital era, defined by the contextual connection and interaction of everything and everyone.

With Nokia Bell Labs, we search for the fundamental limits of what is possible, rather than being constrained by the current state of the art.

We look to the future to understand essential human needs and the potential barriers to enabling this new human existence. We then use our unique diversity of research intellects, disciplines and perspectives to solve the key complex problems by aiming to discover or invent disruptive innovations that have the power to enable new economic capabilities, new societal behaviors, new business models and new types of services – in other words, to drive human and technological revolutions.

Our research is focused on key scientific, technological, engineering or mathematical areas that require ten times or more improvement in one or more dimensions. We then combine these areas of research into the Future X network architecture, which aims to bring these disruptive research elements together into industry-redefining solutions. These innovations are brought to market through our business groups or through technology and patent licensing. Nokia Bell Labs also engages directly with the market and customers through our consulting practice to help define the path to the future network with business model innovation and the optimum techno-economics.

This model of defining future needs and inventing game-changing solutions to critical problems while advising the market on the path forward has been the constant mission of Nokia Bell Labs.

Nokia Bell Labs is structured into three functional areas to optimize how we create a foundation to disrupt and transform the future:

§ The Chief Technology Office defines Nokia’s technological and architectural vision and drives industry standards and initiatives.
§ Nokia Bell Labs Research understands key challenges in the future vision and invents solutions that are ten times better than what is currently possible.
§ Bell Labs Consulting advises the industry on the economics of our vision and how to efficiently achieve this future goal from the current starting point.

Arthur Ashkin wins The Nobel Prize in Physics 2018

Arthur Ashkin, a former Bell Laboratories researcher, was awarded the 2018 Nobel Prize in Physics “for the optical tweezers and their application to biological systems” on October 2, 2018.

Arthur Ashkin shares the prize with Gérard Mourou and Donna Strickland, “for their method of generating high-intensity, ultra-short optical pulses.” The Royal Swedish Academy of Sciences administers the Nobel Prize for

Physics and said they were awarding this year's winners "for groundbreaking inventions in the field of laser physics."

Arthur Ashkin was born on September 2, 1922 (age 96) in Brooklyn, New York. He received a B.A. in physics from Columbia College in 1947 and a Ph.D. in nuclear physics from Cornell University in 1952. Ashkin worked at the Columbia Radiation Lab from 1942 to 1945 while in the Army. In 1952, he joined AT&T Bell Laboratories and started working in the microwave field and then switched to laser research.

Arthur Ashkin invented optical tweezers that grab particles, atoms, viruses and other living cells with their laser beam fingers. As is always the case at Bell Labs, the breakthrough came as a byproduct of research in the fundamentals of communications – in this case, optical communications research into non-linear optical systems. Out of his work on advanced laser optics came the ability to use optical 'pressure' from high powered lasers to control microscopic particles. A major breakthrough came in 1987, when Ashkin used optical tweezers to capture living bacteria without harming them. The optical tweezers he pioneered are now widely used to investigate the machinery of life.

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2018 highlights

The 2018 Nobel Prize in Physics was awarded to Arthur Ashkin for his invention of Optical Tweezers while working at Nokia Bell Labs.

Nokia Bell Labs demonstrated 5G wireless access speeds of more than 10Gb/s using a pioneering low-cost, massive-scale antenna array system at 90 GHz, as well as mission-critical control of industrial robots over 5G networks with millisecond latency.

Nokia's PSE 3 chipset is the world's first to implement probabilistic constellation shaping (PCS), a technique pioneered by Nokia Bell Labs, which pushes theoretical limits by increasing optical network capacity up to 65% while reducing power by 60%.

Nokia Bell Labs created the World Wide Streams (WWS) platform as the world's first global-scale network foundation for sharing, transforming and publishing live data streams generated by the billions of emerging IoT devices.

The Future X Lab in Murray Hill, New Jersey was created to showcase Nokia's portfolio and Nokia Bell Labs' research innovations for the 5G Future X network, with unprecedented levels of automation and support for advanced network slicing with latency, bandwidth, reliability, scalability and optimized economics, for all future use cases in the industrial automation era.

Bell Labs Consulting is publishing the sequel to the highly successful Future X Network book, focused on applying the Future X vision to all the major industrial segments, and describing how productivity will be massively enhanced in the coming industrial revolution.

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Operating and financial review and prospects

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Principal industry trends
affecting operations

Business-specific trends

Networks business

We are a leading vendor in the network and IP infrastructure, software, and the related services market. We provide a broad range of products, from the hardware components of networks used by communications service providers and increasingly by customers in other select verticals, to network agnostic software solutions, as well as services to plan, optimize, implement, run and upgrade networks. Our Networks business is conducted through six business groups: Mobile Networks, Fixed Networks, Global Services, IP/Optical Networks, Nokia Enterprise and Nokia Software. These business groups provide an end-to-end portfolio of hardware, software and services to enable us to deliver the next generation of leading networks solutions and services to our customers. We aim for all six business groups to be innovation leaders, drawing on our frontline R&D capabilities to deliver leading products and services for our customers, and ultimately ensure our long-term value creation. For more information on the Networks business refer to “Business overview—Networks business” above.

Industry trends

The network and IP infrastructure, software and related services industry has witnessed certain prominent trends in recent years, which have also affected our Networks business. First, the increase in the use of data services and the resulting exponential increase in data traffic has resulted in an increased need for high-performance, high-quality and highly reliable networks. This trend is one of the leading drivers for the start of the 5G cycle, which has been accelerated by communications service providers, as evidenced by our growing order book. The continuing increase in data traffic has, however, not been directly reflected in communications service providers’ revenue. Consequently, there is an increased need to be efficient and cost competitive for both communications service providers and network infrastructure and services vendors.

Second, we are witnessing continued consolidation among communications service providers, driven by their desire to provide a wider scope of services, especially through the convergence of disparate network technologies across mobile, fixed, and IP and optical networks. In order to improve networks in terms of coverage, capacity and quality, communications service providers are continuing their transition to all-IP architectures, with an emphasis on fast access to their networks through copper, fiber, LTE and single RAN access and new digital services delivery. We are also seeing similar trends with cable operators, who are investing in the deployment of high-speed networks. Our end-to-end portfolio of products and services can be utilized to address both the fixed mobile convergence and the transition to all-IP architectures.

Third, we see an increasing demand for large high-performance networks in some key areas outside the traditional communications service provider space, which we define as select vertical markets. Webscale companies and extra-large enterprises - such as Apple, Facebook, Google, Alibaba and Amazon - are investing in cloud technology and network infrastructure to build these high-performing, secure networks. In addition, other target vertical markets such as energy, transportation and the public sector are investing to build carrier-grade, mission-critical networks.

The first three pillars of our strategy are aligned with these industry trends for our Networks business. We continue to execute well on our strategy, with a particular focus on high-performance, end-to-end networks, expansion into new select verticals and building a new network-agnostic software business. To accelerate this momentum and increase customer focus as the 5G era beings, we announced plans to realign parts of our organization according to our strategy on October 25, 2018. More information about these plans can be found in “Business overview—Our strategy”.

Pricing and price erosion

In 2018, we did not witness a dramatic change in the overall competitive environment in our industry. We did witness some pricing pressure from a small number of large customers funding their 5G entry within their existing budget plans.

Product mix

The profitability of our Networks business is affected by our product mix, including the share of software in the sales mix. This is particularly evident during large technology cycles, as initial deployments consist of a larger portion of hardware and services and less software. This ratio shifts more towards higher-margin software further into the cycle, as additional capacity and features are deployed. As the initial phases of deployments tend to be lower margin, this is offset by the ongoing deployment of previous generation technologies, which tend to be higher margin.

Products and services also have varying profitability profiles. For instance, our Ultra Broadband Networks and IP Networks and Applications reportable segments offer a combination of hardware and software, which generally have higher gross margins, but also require significant R&D investment, whereas the Global Services reportable segment has offerings that are typically labor-intensive, while carrying low R&D investment, and have relatively low gross margins compared to the hardware and software products.

Seasonality and cyclical nature of projects

Net sales in our Networks business are affected by seasonality in the spending cycles of communications service providers, with generally higher sales in the fourth quarter, followed by generally lower sales in the first quarter. In addition to normal industry seasonality, there are normal peaks and troughs in the deployment of large infrastructure projects. As an example, the 5G technology cycle has accelerated over the past year, as commercial deployments started in 2018 and are expected to continue in 2019 and beyond. The timing of these projects depends on a number of factors, including new radio spectrum allocation, network upgrade cycles and the availability of new consumer devices and services, which in turn could affect the net sales of our Networks business.

Continued operational efficiency improvements

In 2018, our Networks business continued to focus on operational improvements across its business groups, in an effort to complete the cost savings program put in place following the acquisition of Alcatel Lucent. Upon completion of the Alcatel Lucent integration as of the end of 2018, we are now moving to the next phase of restructuring, where we will focus on optimization and ensuring that we are lean in every part of our business. In order to continue to make our Networks business more efficient, higher-performing and positioned for long-term success, we aim to further strengthen our productivity, efficiency and competitive cost structure through strong operational discipline.

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Accordingly, on October 25, 2018, we announced a new cost reduction program where we intend to target substantial savings while continuing to make further investments to drive future growth and higher returns. The savings are expected to come from a wide range of areas, including investments in digitalization to drive more automation and productivity, further process and tool simplification, significant reductions in central support functions to reach best-in-class cost levels, prioritization of R&D programs to best create long-term value, a sharp reduction of R&D in legacy products, driving efficiency from further application of our common software foundation and innovative software development techniques, the consolidation of selected cross-company activities and further reductions in real estate and other overhead costs.

Cost of components and raw materials

There are several important factors driving the profitability and competitiveness of our Networks business: scale, operational efficiency, pricing, and cost discipline. The costs of our networks products are comprised of, among others, components, manufacturing, labor and overheads, royalties and licensing fees, depreciation of product machinery, logistics and warranty and other quality costs.

Nokia Networks' profitability can be affected by changes in the sales volume, as well as the requirement to source large volumes of components on short notice, which can impact the cost of sales, or in cases where component shortages emerge, the net sales.

Nokia Technologies

Nokia Technologies is focused on pursuing new licensing opportunities for our valuable intellectual property, including patents, innovative technologies and know-how, and the Nokia brand.

The Nokia Technologies strategy consists of: 1) patent licensing, where we license standard-essential and other patents in the Nokia portfolio to companies in the mobile devices market and beyond; 2) technology licensing, focused on licensing proprietary audio visual technologies to enable licensees to build more innovative products; and 3) brand licensing, enabling licensees to leverage the value of the Nokia brand in consumer markets.

Following a review of strategic options for Nokia's Digital Health business, which used to be a part of Nokia Technologies, in May 2018 we announced and closed the sale of this business to Eric Carreel, co-founder and former chairman of Withings.

Monetization strategies of IPR

Success in the technology industry requires significant R&D investment, with the resulting patents and other Intellectual Property Rights (IPR) utilized to protect and generate a return on those investments and related inventions. We believe we are well-positioned to protect, and build on, our existing industry-leading patent portfolio, and consequently to increase our shareholders' value.

We see a number of means of monetizing these opportunities: on the one hand, we seek to license our patent portfolio, and new technological innovations that can be integrated into other companies' products and services. On the other hand, we also engage in brand licensing to leverage the Nokia brand in consumer devices.

In patent licensing, the main opportunities we are pursuing are: (1) renewing existing license agreements and negotiating new license agreements with mobile phone manufacturers; and (2) expanding the scope of licensing activities to other industries, in particular those that implement mobile communication technologies such as automotive and consumer electronics. Following the sale of our Devices and Services business in 2014, we no longer

need patent licenses for our own mobile phone business, enabling the possibility of improving the balance of inbound and outbound patent licensing.

In brand licensing, we will continue to seek further opportunities to bring the Nokia brand into consumer markets, by licensing our brand and other intellectual property. We continue to work with HMD Global, our exclusive licensee for the Nokia brand for phones and tablets, who has launched 12 new Android smartphones and five new feature phones during 2018.

In technology licensing, our newest business, the opportunities are more long-term in our view, but we will look at opportunities to license technologies developed by Nokia Technologies which can be integrated by licensees into their products and services.

General trends in IPR licensing

In general, there has been increased focus on IPR protection and licensing in the market, and this trend is expected to continue. As such, new agreements are generally a product of lengthy negotiations and occasionally through arbitration or litigation, and therefore the timing and outcome may be difficult to forecast. Due to the structure of patent license agreements, the payments may be infrequent, at times may be partly retrospective, and the lengths of license agreements can vary.

Additionally, there are clear regional differences in the ease of protecting and licensing patented innovations. We have seen some licensees actively avoiding making license payments, and some licensors using aggressive methods to collect them; both behaviors have attracted regulatory attention. We expect discussion of the regulation of licensing to continue at both global and regional level. Some of those regulatory developments may be adverse to the interests of technology developers and patent owners, including us.

Research, development and patent portfolio development

As the creation of new technology assets and patented innovations is heavily focused on R&D activities with long lead-times to incremental revenues, we may from time to time see investment opportunities that have strategic importance. This generally affects operating expenses before sales reflect a return on those investments.

Financial markets trends

We are a company with global operations and net sales derived from various countries, invoiced in various currencies. Therefore, our business and results from operations are exposed to changes in exchange rates between the euro, our reporting currency, and other currencies, such as the U.S. dollar and the Chinese yuan. The magnitude of foreign exchange exposures changes over time as a function of our net sales and costs in different markets, as well as the prevalent currencies used for transactions in those markets. Significant changes in exchange rates may also impact our competitive position and related price pressures through their impact on our competitors.

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To mitigate the impact of changes in exchange rates on our results, we hedge material net foreign exchange exposures (net sales less costs in a currency) typically with a hedging horizon of approximately 12 months. For the majority of these hedges, hedge accounting is applied to reduce income statement volatility.

In 2018, approximately 25% of Group net sales and approximately 30% of Group total costs were denominated in euro. In 2018, approximately 45% of Group net sales and total costs were denominated in U.S. dollars and approximately 10% in Chinese yuan.

The average currency mix for Group net sales and total costs:

	2018		2017	
Currency	Net sales	Total costs	Net sales	Total costs
EUR	~25			