

Mobile is Global -project

Background material for "5G/6G Worldmap 2030" scenario work

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Introduction

In the *Mobile is Global* project, the Research Institute of the Finnish Economy (ETLA) and the CKIR unit of Aalto University School of Business examine how new geopolitical challenges affect innovation activities and growth prospects in Finland and Europe. The aim of the project is to identify the strategic areas of the international 5G/6G ecosystem that require policy measures, and to present recommendations for action, particularly for decision-makers in innovation and technology policy.

To support the project's research work, scenarios will be prepared during spring 2025 under the working title "*5G/6G Worldmap 2030*". The scenarios are thought-provoking stories about how the world may change over the next five years.

As background material for the scenario work, approximately 40 experts from different fields in Finland and abroad were interviewed between autumn 2024 and spring 2025. The material obtained from the interviews has been compiled in this report. The interviews were conducted anonymously, and all interviewees were asked the same seven questions:

What do you think will certainly happen by 2030?

Are you worried about anything?

What would you like to know?

What would be the best future for Finland, Europe, and the world?

What would be the worst future for Finland, Europe, and the world?

What important decisions should Finland and Europe make in the near future?

What would be a good strategic question for this scenario work?

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What will certainly happen by 2030?

The future is difficult to predict

Things will certainly happen that we cannot predict or assess in advance.

Prioritization will become more difficult.

The number of things about which we do not yet know enough will increase. Some actors are playing games, but because we do not know about them, we also do not know how to prepare for them. There will be more unpredictability and surprises than before.

Nothing is certain.

Trump has created a situation in which it is impossible to say anything with certainty. Deals are made even with the devil, as long as they are good for America. Previously, there was a strong confrontation between the United States and China, but now it is no longer certain whether even that is how Trump sees it. In scenario work, it is very difficult to rule out any options.

There are no existential threats.

I understand the climate concerns and I think we need to do something about them. But these are emotional, not rational, a loss of faith. I don't believe in existential threats, and that includes AI.

Industry will undergo a transformation

Finnish business and industry will undergo a transformation.

For example, forests will be seen differently from how they have been seen so far.

The winners will be the actors that make the best use of data and new technologies.

The key words are new operating models — most often a multi-sided platform — the controlled maximization of data use, and the utilization of new technologies.

The shift will be from automation to autonomy.

Manual operations will move at an accelerating pace first toward automation and then toward the next industrial revolution, namely autonomy.

Digitalization is not going to go away.

We will have lots of data that need to be analysed and combined in a controlled environment. We also need access to that information, so need for secure, controllable, reliable, and dependable connectivity will be stronger. There will be several different ways to fulfill the connectivity needs. Users have to find a solution that they are comfortable with. For example, who owns the network? Is it public or private? What is the cost?

Companies' understanding of the importance of data will increase.

Most of the success of the largest companies by market value is based on the utilization of data, especially consumer data. The largest Finnish companies are already quite

advanced in using data. Some SMEs are experimenting with it, but some may not yet understand its benefits.

Digitalization and wireless technologies serve as the foundation for other application areas, so investment in them will continue to increase.

Digitalization will be made more sustainable, more energy-efficient, and more secure.

The use of digital technologies and artificial intelligence will continue to intensify.

Electricity consumption will increase.

More and more electricity will be needed as the importance of human outputs for the survival of the planet increases.

Substantial public funding will be invested in the semiconductor industry in competing countries.

Recently, for example, Japan announced that by 2030 it will invest at least USD 65 billion in public funding in a national artificial intelligence and semiconductor programme¹.

Legislation related to the digital environment must be developed quickly.

The cyber environment, meaning the digital technological environment, is changing rapidly, and the legislation related to it must be developed — preferably even proactively.

Telecommunications markets will change

We are rapidly approaching the point where no part of the globe will be without mobile network coverage.

The need for wireless technologies will grow.

Digitalization will advance everywhere in the world, but the level and timing of implementation will vary. For example, in Africa, digital services will not yet be in widespread use in the near future, whereas in some more developed countries their use is already very extensive. The need for wireless technologies — mobile connections, devices, and so on — will grow in both business and private use.

Internet traffic will increase.

Society's dependence on the internet will grow.

We do not yet understand how dependent our society is on telecommunications, especially in crisis situations. If the internet does not work, we do not have electricity or much else either. We must protect telecommunications and also ensure that, in exceptional situations, telecommunications can be restored as quickly as possible and maintained at least at some level.

¹ For example <https://www.cnn.com/2024/11/13/japan-is-ramping-up-efforts-to-revive-its-once-dominant-chip-industry-.html>

The amount of data will continue to grow.

If we consider IP-based calls to be data, then soon all telecommunications will be data.

Satellites and satellite communication — NTN, Non-Terrestrial Network — will arrive faster and more forcefully than we are currently able to estimate.

Communications market will change.

New players will enter the connectivity business, like hyperscalers. They are already actively laying submarine cables, and they will expand further into connectivity, for example, through acquisitions. That is likely to cause political resistance in some EU Member States.

The European telecommunications operator market will change.

Europe's current model, in which operators' investments keep society competitive, does not work. There are too many operators and they are too small, so they do not have the same economies of scale as the large operators in China, India, and the United States.

Networks will also become differentiated according to their purpose of use.

Network technology has been shared, meaning that all users have had the same network. At some point, technological neutrality and interoperability will have to be dismantled, and solutions will have to be made that are optimized only for a specific purpose.

Operators find it difficult to justify investments in new network technology.

Revenues from new services, such as network slicing and selling subnet services as a separate business, will not dramatically increase operators' turnover.

Tenders to build networks will be decided by financing, not technology.

In regions outside the blocs, financing is an absolute prerequisite for winning tenders to build networks. Such regions include, for example, the markets of Africa and Latin America. In Chile, for example, the sale of rights to build a 5G network generated revenue for the state. In practice, someone made large losses, but it was not the network builder; it was the background financier.

China will have a significant role as a telecommunications actor.

I do not believe that the whole world will turn away from China, and for many countries that is not even desirable.

Chinese technology will capture more markets.

Chinese equipment and expertise will become the benchmark for others. Others will try to catch up with them and copy them.

Security and cybersecurity will become more prominent

Security of communications is not going to be easier.

Security needs to be taken into consideration in all types of communication. For example, submarine cables form another complex communications infrastructure, which has been attacked several times recently. In mobile communications, discussions about security are going to intensify. In 6G standardization security needs to be factored in and it will influence also the discussions around 5G.

Information security and security of supply will become more prominent.

We will go to a much more decentralized world.

Companies and people want more control over their own data. They want to know where it is. They don't want it to be "somewhere in a cloud".

The importance of protecting telecommunications will increase.

Self-sufficiency, security of supply, and security in telecommunications networks, as well as the protection of communications and information transmission, will play a much larger role than they do at present. Information and information transmission are now instruments of power politics, and we have been backed into a corner. Europe, and through it Finland as well, must seek new kinds of solutions.

Security policy has changed.

Data networks are at the centre of security policy in many ways.

Cybersecurity will cease to be a separate issue.

There will no longer be security and cybersecurity as separate things.

Network security and resilience will become more important than before.

The current resilience of networks and the telecommunications sector as a whole is weaker than desired, and more investment will have to be made in it in the future.

5G and 6G will advance

5G and 6G technologies will develop

There will be no decisive breakthrough during the next 3–5 years.

Nothing happens by itself. Resources, the right kinds of encounters, and regulation are needed so that the right technologies find each other in a business environment that produces sensible business.

5G and 6G technologies will develop.

The things currently in laboratories will scale forward, and 5G in particular will scale commercially. Computing power will improve, components will become better, and data transmission will be compressed into a smaller space.

Technology will develop.

5G and 6G are development steps that will be taken in any case; only their timeline remains open. We often overestimate development in the short term and underestimate it in the long term. Artificial intelligence, for example, has been discussed for more than 10 years, but after generative AI emerged in early 2023, development has been extremely rapid.

5G will gradually continue to develop.**5G technology will be deployed.**

5G will spread and be widely deployed in Europe and around the world.

The use of 5G/6G will increase.

In particular, areas that currently do not have good wireless connections will probably leap directly into the 5G/6G world.

5G and 6G are infrastructure for the modern world, and their importance will grow.

The role of digital infrastructure is more important than many realize. This will be highlighted especially after the recent presidential elections in the United States. Behind the Trump administration there will be many kinds of background whisperers from Silicon Valley and elsewhere. 5G and 6G are also part of geopolitics and security policy, and they will increasingly remain so. In Finland, this can be seen, for example, in the work of the 6G working group appointed by the Ministry of Transport and Communications and in the quantum strategy work launched by the Ministry of Economic Affairs and Employment. Geopolitics and security policy are constantly present.

Investment will be made in the development of 6G.

5G enables many things, but over the next five years, different actors in China, the EU, the United States, and elsewhere will invest in 6G. Technological competition will intensify because 6G has so much potential and so many major opportunities. What remains uncertain is mainly how radically 6G technology will change the world and how quickly it will begin to be commercially exploited.

6G will be designed to be robust.

When 6G comes, it will be critical for our defensive capabilities. It will be designed to work also under other circumstances than peacetime and against hacker attacks, intrusion and sabotage. Also, the operators will not be able to pick and choose whatever they want, when they build the networks.

Nothing will prevent the arrival of 6G.

In Finland, operators use speed-based pricing, and customers can use as much data as they want. Finnish operators therefore have a good reason to invest in new networks, because customers are willing to pay for better speed. If the customer is given the best speed and billed for data usage, the operator has no interest in investing in a faster network, because it does not generate any additional revenue. The pricing model is a surprisingly decisive factor, and it has slowed the deployment of 5G in many countries.

Development is evolution ...

There will be a transition from 5G to 6G.

New mobile technologies have appeared roughly every 10 years. Usually, even-numbered generations correct the mistakes of the previous generation or fulfil the value promise at a level of functionality that enables industrial investments and the user experience that was originally sold and promised. In other words, the interval between major industrial investments is closer to twenty years.

3G was a disappointment, but 4G works at the level users expect. 5G has again been a disappointment in terms of customer acceptance and investments. 5G was never originally made for all mobile internet users everywhere in the world. It was made for densely populated urban centres and other places with enough paying customers, meaning residents, industry, and other users.

There will be corrective investment rounds for 5G networks.

On national level there might be additional investment cycles addressing problems and concerns in the existing 5G networks. There could also be adjustments to the network investments that are already decided, but not yet implemented. At the moment, EU does not regulate how countries should implement and run their networks.

The deployment of 5G will continue, and at some point there will be a transition to the 6G phase.

However, the development and deployment of technologies will take place in a very different global world than before.

5G is a transition phase toward a clearly new 6G.

5G has been more like 4G Plus, but in the short and medium term, 6G may offer interesting opportunities, especially when combined with generative AI and edge computing. 6G may bring entirely new applications to these areas.

From the consumer's perspective, 6G is an evolution of 5G.

There may be discontinuities among operators, equipment manufacturers, and other actors, but these will not be visible to consumers. Calls and data will move as before, perhaps with small changes and restrictions. Connectivity is now so valuable that no one wants to stop it or significantly disrupt it. For example, mobile networks in Ukraine continue to operate even though there is a war going on.

5G and 6G technologies will converge with each other.

End users will not necessarily notice the arrival of new technologies. A G-number may change in the upper left corner of the mobile phone, but users will not see what is happening in the background.

There will be one 6G standard in the world.

The basic technology of 6G will be standardized. The ways in which the standard is implemented and applied may differ across continents and markets, but in principle, devices will interoperate. There may be differences in what else happens in the network, or who controls information, cybersecurity and AI, or what AI does. Three alternative paths to 6G have been identified. One approach is to rely on the 3GPP standardization base and the support of mobile operators and equipment manufacturers — Nokia, Ericsson, and similar companies. Another approach is the Open RAN path promoted especially by Americans. A third path may be more disruptive, for example some combination of the two previous approaches or neither of them. Geopolitics has not, at least so far, been very visibly or strongly present at industry events. Of course, camps can already be observed: “like-minded countries” are in their own groups, and then there are the others, which limits who people want to do things with.

Finland will keep itself at the forefront of 6G.

We understand the issues, know how to invest in the right things, and keep ourselves as a world-class player in 6G and in the “beyond 6G” systems that come after it, where resilience will be discussed a great deal. Finland's success strengthens Europe.

... or revolution

The importance of open standards will be challenged.

This is not a good thing for Finland.

The competitive situation in 5G will become more difficult.

6G is still in the innovation phase, but in 5G there is an interesting competitive setting between Ericsson, Nokia, and Asian competitors. The situation will become more difficult, but in some ways it will also become clearer. Hopefully fragmentation among Western actors will also decrease.

In 6G, technological complexity will rise to a new level.

6G will bring new technology and enable business models that have not existed before. 6G can be described as the world's largest AI pilot or implementation, because a 6G network, which in the future will include several billion devices, cannot be controlled by anything other than AI. Both classical and generative AI will be used in communication between the network and its various systems. Generative AI and large language models are also linked to the business model of the 6G network — that is, to all the things that can be done using the network. AI can be used automatically, for example, to carry out new kinds of video image analysis, which in turn produces new business innovations, reduces network load, or lowers its power consumption, which benefits sustainable development.

There will be more disruption and diversity than before.

This applies to technologies and to the field of actors. Regardless of whether O-RAN advances or not, we need new kinds of actors to ensure interoperability and that the full potential of the network can be utilized. The integration of data and content into networks will further complicate this issue.

A period of uncertainty lies ahead.

Because there are different implementation paths on the 6G roadmap, it is likely that there will be a period, or periods, of uncertainty ahead. What is the future, and through what stages will we get there? When will the value proposition of 6G be at a level that enables the use of the technology, for example in industry or smart cities, in a way that also makes sense in terms of return on capital?

AI will enter mobile networks.

What remains unclear is where AI will enter, how it will be implemented, and how security aspects will be handled.

New kinds of mobile devices will enter the market.

New platforms are now being sought on which 6G applications can be run. Devices similar to today's mobile devices will include more AI, but entirely new types of devices may also enter the market, making more efficient use of 6G, generative AI, virtual reality, and edge computing.

The timeline for 5G and 6G

It will take at least five years before the benefits brought by 5G begin to be seen on a broader scale.

The direction of development is clear, but the deployment of 5G will not happen as quickly as may currently be believed and hoped.

The technological development of 5G and 6G is proceeding according to plan.

The standardization train is moving, and we already have dates for version releases, technological decisions, and the deployment of frequencies. We do not yet know everything, but we nevertheless have a view extending five years ahead. Surprises may come, for example, from quantum technology, but otherwise development is quite predictable.

6G will be delayed.

There will be more political involvement as we need to build a system that is not only commercially great, but also great in terms of security.

6G will enter the market by 2030.

6G will bring new technical capabilities, and 5G will also develop through new releases. Future communications networks will be capable of better positioning, will better support the development and applications of AI, and will monitor the environment more effectively. Connections in remote areas will improve, among other things through satellite connections, which will become part of this new whole.

EU takes an active role in guiding the deployment of 6G networks.

Regarding 6G, EU will be more regulatory and take an active role in mapping out risk sources in hardware, software, and management of the system. EU will put political pressure on operators to support certain choices on vendors and technologies. Co-investing in networks will be made more attractive, as it will reduce the number of different implementations. It would also make security issues easier to handle. There might be specific calls for regional networks for Scandinavia and other regions.

Key applications and services

Many will benefit from the new versions of 5G and from 6G.

The future of new mobile technologies is promising and full of new technology.

No radically new application areas will be found for 5G/6G.

Selling larger amounts of data using current operating models does not change the big picture for 5G/6G. Nor will the market differentiate significantly; in other words, the new operating models offered by 5G and 6G will not enable new kinds of service-level agreements to be implemented on a broad scale.

There will be demand for 6G.

5G will not remain the last G, even though some equipment manufacturers, customers, and stakeholders have recently expressed doubts about 6G. By the turn of the next decade, 6G networks will be launched, and by then at the latest it will be noticed that there is a need and demand for them. This train will certainly keep moving for at least the next five years.

There will be a shift from isolated experiments to more extensive utilization of 5G. For example, private 5G networks will become more common.

At present, 5G testing in different verticals is very isolated, and the starting point varies enormously. Some individual actors may be quite far advanced in digital transformation in which 5G plays a central role, but the mainstream is still only in the early stages of utilization.

In industry in particular, actors will begin to make use not only of 5G connectivity itself but also of other 5G-related capabilities, such as edge computing and the digital services built on top of it.

The benefits brought by 5G are already evident and concrete, and they can trigger other investments and new activities. 5G and 6G represent the same broad change and the continuum of digital transformation. Industrial actors typically pursue two things to which 5G is centrally linked: improving productivity and meeting sustainability-related goals. These goals guide companies' decision-making.

AI will create new application areas.

Data can be collected, transmitted, and aggregated faster. With AI, data can also be analysed and conclusions drawn from it more quickly. These are also key enablers for other technologies.

The Apple world and the Android world will remain separate.

Regulators are pressuring Apple and Google to open their interfaces. Some progress may occur, but even in the future it will not be possible to buy Android applications from the Apple Store, or vice versa.

Geopolitical tensions will increase

Geopolitics is turbulent

Geopolitics are going to be shaken up.

Geopolitics is turbulent.

Which existing tensions will materialize, and where will they lead? China is a system of its own, and for a long time it has pursued technological development and the related commercial activity very strategically, with its own interests first. Security and the national perspective are becoming more prominent among other actors as well. With Trump's rise to power, the United States has shifted into a new gear. How will the EU act in this situation, given that it sees itself primarily as a regulatory market area? The choices made by the Global South and emerging economies will affect how much power and market share companies from different countries or alliances of like-minded countries will gain.

The era of the rules-based world order is over.

The new world order is based on "topical based entities", meaning that a selected group of like-minded countries decides to cooperate around a specific topic. An example is the

Quantum Development Group², whose founders seek mutual understanding and synergies in the development of quantum technology. Similar coalitions are likely to be established for cables and satellites as well.

The authoritarian model of governance will expand globally.

The geopolitical and geostrategic competitive setting will persist.

Competition between Chinese interests, Chinese equipment suppliers, and Western, so-called trusted, equipment suppliers will continue, and its intensity may even increase in many markets. The question is which suppliers and technologies future telecommunications networks will be built on.

Geopolitical tension will persist.

The development of key technologies will have to be restricted more tightly within one's own bloc than before. This is difficult for universities, but also for companies developing dual-use technologies.

Geopolitical competition will intensify.

After Trump's election, geopolitical technology competition has intensified. In the EU as well, with the Draghi report and the new Commission, more attention is being paid to critical technologies, competitiveness, and resilience. This will also be reflected in 5G/6G.

The world will become divided into blocs and more differentiated

Bloc formation will advance.

Globalization will not necessarily end, but the world will divide into camps.

Bloc formation will advance.

The blocs are Europe, America, and Asia. In Asia, India and China are quite independent, so perhaps it is better to say China. Everyone is thinking about matters from their own perspective, and Trump has already set an example.

The bloc formation of the world will accelerate.

Bloc formation with like-minded countries, confrontation between blocs, and making choices will continue, and it is very difficult to see any rapid change through which the world would start returning toward globalization. There is a clear fear that bloc formation will accelerate during Trump's term. Finland has been a small, harmless country that was able to play in many directions and be friends with everyone, but now that is becoming quite a burden.

The bloc formation and differentiation of the world will continue.

Development is moving forward. Asians are strongly pursuing development within their own circles. Hopefully Europe will not fall between the cracks, but will be able to link

² Member states are Australia, South Korea, Denmark, Japan, France, Germany, Finland, UK and USA.

itself with the rest of the Western world, such as the United States. In 2030, we will operate in blocs and will no longer be one big, happy global family.

The world will divide and the game will get tougher.

Authoritarian countries, such as China, will gain significant market share because they are able to steer investments and technology choices more effectively than countries like Finland, which operate under different rules.

Global polarization between China, the United States, and the BRICS countries will tighten.

The importance of the countries of the Global South will increase.

The Global South³ includes all countries that do not belong to the camp of like-minded Western countries or to the BRICS camp that directly and actively opposes them, including India, Russia, and China. We easily underestimate the sympathies of the Global South toward the BRICS camp. India is an interesting BRICS country in the sense that it plays its game in both directions. In the 2020s, the United States has tried to pull India away from the Russian and Chinese camp, and perhaps some slight positive movement in that direction can be seen.

Americans, Europeans, and Chinese are playing different games.

The Americans have a playbook, the EU has a rulebook, and China is playing the long game, meaning that it has a different time perspective.

The decoupling of East and West.

The bloc led by China and the bloc led by the United States and Europe are moving further apart from each other. The situation will not improve in the coming years, because the new U.S. administration is more eager than its predecessors to promote decoupling, and China, too, has prepared for the situation to continue as it is. Bloc formation also applies to technological development, so the West and the East are developing different standards, for example in telecommunications technology. As markets diverge, companies will have to consider which markets they operate in.

The Global South will seek to benefit from the Eastern and Western blocs.

The key question is how the Global South will align itself: will it turn east or west? At least at the moment, it appears that these countries are seeking to pick the best elements from both sides. China has secured its position by investing in the infrastructure development of countries in the Global South and by offering them investments and loans on better terms than Western actors. The EU, too, must think more strategically about how it uses its expertise in critical technologies for global influence. The EU has its strongest expertise in connectivity, but in other sectors it lags behind other centres of power.

The regional differentiation of network technologies will continue.

The regional division of network technologies will become clearer than it is today. Geopolitics will determine what kind of basic network can be used in a country or part of a country. We will have one region where networks come from so-called trusted

³ The Global South = South America, Africa and most parts of Asia.

suppliers, another region where networks come from Chinese suppliers, and finally regions where suppliers compete for market share.

Trade war.

The most likely scenario is a trade war between three blocs: China, the United States, and the EU, possibly also involving Japan and Korea. China is highly protectionist, the United States is unpredictable, the positions of Japan and Korea are unknown, and Europe does not really know what it is or what it wants to be. The trade war will affect everything, including technologies and content. It will be quite a storm, and many think tanks are already considering how things might turn out.

Relations between the United States and China will be tense

It is important for the United States that China is unable to challenge its hegemony.

For Americans, the relationship with China is fundamentally a matter of hegemony, not merely an economic struggle, even though society's economic capacity is also seen as part of security. During Trump's first term, China's technological capabilities surprised the Americans, and now all means are being used to prevent China from being able to threaten the United States globally.

The United States and China will decouple from each other.

This "decoupling" will lead to technologies, platforms, and supply and production chains becoming divided. At the same time, the United States and Europe are also diverging from each other. Decoupling between the major digital powers will also affect 5G/6G issues.

Relations between the United States and China will remain tense.

The threat of a trade war between the United States and China, and the U.S. effort to isolate China in high technology, have continued for two presidential terms already and will deepen during the next term. This will make it more difficult for Chinese actors to compete in certain key sectors, especially semiconductor manufacturing. That, in turn, will be reflected in the telecommunications industry, because it will be more difficult for Chinese manufacturers to produce competitive 5G equipment — and especially 6G equipment — if they do not have access to the advanced semiconductors required for them.

The United States is seeking new positions and following new operating models.

Trump's presidency will be very confusing and aggressive in many ways. Underlying everything is the confrontation between the United States and China, which will also affect, among other things, investment decisions.

China wants a resolution to the Taiwan situation.

Many scenarios have been presented regarding the situation between China and Taiwan. Xi Jinping has said that Taiwan will be part of China in 2049. Because of Xi's age, however, this will take place already within the next 10 years. Military confrontation is one possibility, but China will probably try to achieve the outcome it wants by other means. The big question is how the United States will respond. The United States wants

critical semiconductor production to be located in the United States, and already TSMC is asking Washington how it should act: what it can sell, to whom, and on what terms. For Taiwan, local semiconductor production provides some kind of security guarantee. In this respect, the situation will continue to tighten.

Taiwan's semiconductor factories will not end up in China's possession.

Taiwan plays a central role in the international semiconductor industry. If China tries to incorporate Taiwan, the semiconductor factories in Taiwan will not be transferred to China in working order. Even the threat of a Chinese attack would be enough to cause an enormous global crisis: trade embargoes, logistics problems, and more.

Partnerships will change

We are in a new kind of negotiating situation.

The old gentlemen's agreements, practices, and ways of operating that have been used for decades are being rewritten. European and Finnish actors must be stronger than before in negotiations. But we have the opportunity to play our cards right if we know how to do so sensibly.

The choice of partners is more important than before.

Countries, and companies as well, must identify who their partners are and who their competitors are. Partnerships will become more strategic, and they must be built more intelligently and creatively. Relationships, however, are not black and white; there will remain layers and grey areas where cooperation with competitors is also possible. Not all cooperation is strategic. What is strategic, for example, is what information is shared, with whom, and how. One must be alert about this and not leave it to individuals' own responsibility.

Negotiating partners and their intentions are changing.

For a longer period, we have had a status quo type of situation in which things progressed fairly smoothly because we agreed on what we were trying to do. Now the parties are recalibrating the situation for geopolitical and economic reasons.

New partner choices.

A major transformation is under way, and the search for the new cooperation partners needed for it has already begun, both visibly and behind the scenes.

Europe still has a good negotiating position.

In technology-sector discussions, people often start from the assumption that Europe is naive, lagging behind others, and does not understand how this game should be played in the future. Europe does have chips it can use, but they must be put in the right order. At present, we lack a common line, and not enough time has been spent building one.

Europe becomes more self-sufficient.

When 5G was launched, people didn't think that Russians would start a war in Europe. That sounded like such a stupid idea because of the values, trust, and opportunities lost. Now we are only five weeks into the new administration in the U.S. and things look already quite bad. We don't know what will happen, for example, from security standpoint. Europe must become more self-sufficient. Our critical infrastructures must

be able to handle conflicts and they must be more actively taken care of, coordinated, and protected.

Technology competition will accelerate and intensify

The pace of technology development will continue to be very high.

Mobile communications are affected by convergence of communications: telecom, edge, cloud, AI and the huge demand for data processing and storage.

Technology competition will intensify.

Technology competition affects all disruptive technologies. Trump's new term is beginning, the rhetoric is tough, and we will soon see what actually happens.

The connection between technology and geopolitics will become closer.

The strengthening of this connection creates a certain degree of predictability, but above all it produces developments that are difficult to assess.

In the coming years, the most important geopolitical issues will be linked to technology policy.

The weight of technology will increase from the perspective of societal functionality and geopolitics. The global technology struggle is only just beginning, and the only uncertainty concerns the speed of change.

Technology blocs will decouple from each other.

Technology blocs will diverge, meaning that we will have a U.S.-led world and a China-led world. What Beijing wants has not changed, but because of Trump the situation now looks confusing. Some of Trump's actions make it easier for China to achieve its goals, while others make it more difficult, such as restrictions on the sale of semiconductor components. China wants a different kind of technology infrastructure than the United States. The differences are large, but the systems are not completely disconnected from each other; in the future, we will still be able to use the same phone in China and in the United States.

Technological decoupling and fragmentation will advance.

In practice, these will be visible as sanctions imposed by countries on one another. It is difficult to see the situation easing in the near future. The benefits of global standards are known, but now actors are playing their own games and thinking about what will have the greatest impact and how to cause more damage to others than to themselves. This began already during Trump's first presidential term, but he may see it as a way to get to make deals.

Dual-use technologies are coming

Next-generation telecommunications networks are a key theme for NATO.

NATO has defined nine key technologies of the near future, and one of them is 6G, meaning next-generation telecommunications networks. Key questions include technology development, the sharing of innovations, and defining a common will among member states.

The use of civilian-based systems in military applications will increase.

Civilian-based dual-use technologies, such as 5G and 6G, will complement current military systems, but the extent of their use and levels of integration will vary. In Ukraine, too, arrangements have largely been unintegrated. For example, Starlink handles one specific task, namely information transmission, but it is not part of the military system. Over the next 3–5 years, integration will not yet be extensive. Soldiers may receive terminals that transmit information, but they will not necessarily be integrated into a higher-level system.

The war in Ukraine will also have effects in the 5G/6G world.

However, the most critical military data traffic is not primarily linked to 5G/6G infrastructure, and its data is not threatened in the same sense as civilian data.

War accelerates the development of new technologies.

In a difficult situation, investment is made in developing weapons, but spillover effects may also improve the civilian world.

Are you worried about anything?

Only worrying itself is worrying

No, I am not worried.

I have a very optimistic view of the world. We are constantly moving in a better direction. The path may not be straight, but the direction is clear.

No, I am not worried.

Of course there are risk factors and issues that need to be addressed, and then we need to start building something new through them. If one door does not open, then we try another route. We need to maintain a realistically optimistic attitude. In discussions, people often forget that similar periods of transformation have occurred before, and we have always moved forward from them. Things happen in cycles, and they can change. We are too sensitive to uncertainties and weak signals. Now we need to share information with a broader group and think together about what we should address and what should be prioritized.

I am not worried.

Awareness of risks has increased, and efforts have been made to reduce the threats they pose. Risks must and can be managed. The new situation and diversification will also give rise to new kinds of solutions or services for everyday needs and the practical challenges faced by companies. Not everything needs to be linked to the defence industry or to China and Russia.

The fact that everyone is worried about everything all the time.

There is no need for everyone to be worried about absolutely everything right now. In the early stages of the war in Ukraine, business leaders wanted information about what was happening at the front. In reality, they should have been thinking about what the changed situation meant for their business.

Changes are worrying.

Many changes will take place in this area, and they may move either in a good or a bad direction from the perspective of Finland and the world.

Finland has problems

Lack of self-confidence.

European and Finnish decision-makers suffer from a lack of self-confidence, and this has also spread to the business and research sectors. We approach things pessimistically with a “chin down and toward new disappointments” mentality: we are not good for anything, and we cannot do it. We have relied too much on the idea that someone else will take care of things, someone else will provide the resources, and someone else will build the opportunities. We lack the hunger to act, and that is a major obstacle to building competitiveness. We need global partners, but we do not dare to seek partnerships from a different kind of world than the one we are used to.

Is Finland making the wrong choices?

One of Finland's weaknesses is that we follow one thing and build a system of locomotive companies around it. If that locomotive runs into an obstacle placed on the tracks, the whole train ends up in the same pile. At the moment, NATO and dual-use technologies seem to be such magic words.

Finland lacks a clear technology strategy.

6G alone is not as valuable as it is as part of an ecosystem that, in addition to ultra-fast telecommunications connections, includes the LUMI supercomputer in Kajaani and the Helmi quantum computer in Espoo. Finland needs a national-level technology strategy that ties these areas of superiority together and brings expertise, resources, and capital to Finland.

Finland's innovation and regional policy has become bogged down.

Competence plays an extremely important role in how Finland succeeds as part of the global world. Is competence development in good shape? Is innovation policy in good shape? Are regulation, environmental issues, and the broader operating environment in good shape? Unfortunately, it seems that the field of competence, education, research, and innovation in Finland has become highly politicized and bogged down, and it is unable to make decisions that serve the interests of Finland as a whole. As a consequence of regionally weighted support policy, we also have a large number of companies that are not genuinely viable. Such measures do not move Finland forward, and we truly cannot afford this.

Maintaining Finland's competitiveness in global technology competition.

Poor productivity growth in Finland.

For example, in Eurostat surveys, Finland is among the leading countries in the use of artificial intelligence, but Finnish companies are not able to make use of it in a way that is reflected in productivity growth. SMEs and service-sector companies in particular should seek to make better use of data.

Finland has an almost endless faith in startup companies.

Finland typically funds only the early-stage development of startup companies. In the subsequent commercial, production, and industrial phase, companies often move abroad or into foreign ownership, and the Finnish economy does not receive income flows or export revenues. What we are left with is a couple of startup millionaires who may use services a little more than ordinary citizens, but that is all.

Too narrow a perspective.

The views of young and hungry companies receive too little attention.

Why do large Finnish companies not buy Finnish startup companies?

By buying a startup, a large company would acquire technical and other IPR, and at the same time it would gain a team that creates positive disruption for the large company, irritates its organization, and forces it to change its ways of working. Most startups fail, but the successful ones are mostly sold abroad. Finland loses the IPR and future profits, but the biggest problem is that the intellectual capital and experience do not become available to Finnish companies.

Companies are leaving Finland.

In the new geopolitical situation, the United States will protect its own markets. The tariffs Trump has floated for the EU are not particularly large for Finland, but they will influence Finnish-origin international companies to shift the focus of their operations more inside U.S. borders. Can operations located in Finland genuinely compete in international markets? Which operations will remain in Finland and which will move to the United States?

In Finland, high technology is under-politicized.

In technology policy and telecommunications policy, we have a gap in political steering and in the formation of political will, which is why action is erratic. France, for example, has a high-level playbook that combines trade policy, defence policy, foreign policy, security policy, and technology policy. They have clear objectives and have considered how to pursue them. In Finland, technology is seen only as technology, and people think that humanity needs various tools and that Finns are good at making them. Why is Nokia not more successful? What is the fate of IQM? How will different technologies succeed? Such questions are part of technology diplomacy and political decision-making.

The competitive setting is not fair to Finland.

Finland is the world's best-trained and best-prepared athlete, but still does not succeed in competitions. Have we prepared in the wrong way — that is, educated and developed society in the wrong way? Or is it that the competitive setting is not fair to us? Americans and Chinese use protectionism and various support measures that make it difficult for us to succeed, even though in theory we have all the capabilities.

VTT supports European defence-industry companies through EDF projects.

VTT cooperates with large European defence-industry companies in several EDF development projects. However, the results of the projects and the business benefits remain entirely with the client companies, because VTT is not involved in their end products — tanks, aircraft, and so on. VTT receives almost 100% funding for its salary costs from the projects, but it does not accumulate revenues from the final solutions developed in the projects. The Finnish state indirectly supports large European companies when EDF projects include VTT's self-financing share.

Europe has problems

The EU is not awake.

I do not believe that the EU, during the current funding period and the political term that has just begun, will be able to make changes as large as the changed situation would require. Decisions will increasingly be made through bilateral relations, for example with the United States, and in that case the EU will continue to lose its own influence. At the same time, the opportunities of Finnish sectors and companies that rely on EU exports will deteriorate.

Europe has been sidelined.

Why was Europe sidelined in social media and the use of data? Why have big tech companies emerged in America and not in Europe? Can large technology companies still emerge in Europe?

Europe's future role in telecommunications networks.

Europe's role in telecommunications networks depends on only a few large companies. The financial success of these companies is a key issue for Europe and also for Finland. If Nokia were not in Finland, Finland's and Europe's interests in this field would be quite different. And if the focus shifts from telecommunications to the data world, Europe has hardly any specific competitive advantages.

Europe may lose its current strong position in mobile telecommunications.

In mobile technologies, Europe has had — and still has — a strong position, but it may weaken radically and quickly. This would affect the network equipment industry in Finland and Sweden in particular, but also European operators and European technology policy as a whole. EU decision-makers do not understand that even small negative decisions can easily upset this delicate situation. A strong position in mobile telecommunications creates value for Europe and European actors, and it also ensures that Europe retains some degree of control and does not become a slave to some other system. If the European position weakens, in the long term welfare will flow elsewhere, perhaps to America.

Europe's future in telecommunications.

If the EU does not increase its support for Nokia and Ericsson, they may leave Europe or shut down their radio network units. The EU does not act in a unified way. It has a good values-based 5G Toolbox, but its implementation varies between different EU countries.

The poor investment capacity of European operators.

In the United States, operators have on average 100 million customers; in China, about 350 million; in India, roughly the same; and in Europe, 4.5 million. Are European operators able to invest sufficiently in new network technology?

The EU's messages are not coherent.

The EU has the Market Act and the Digital Services Act, which are officially about regulating market forces, but in reality they regulate a few U.S. actors. Or else the aim is to shut Chinese and American actors out of the EU market and give the whole playing field to European actors. But at the same time, the EU emphasizes that it is democratic and open.

Europe has mutually contradictory goals.

The EU emphasizes its own sovereignty in many areas. In telecommunications, this means that Europe must have access to an entirely European technology stack covering both hardware and software. On the other hand, Europe emphasizes the market economy, democracy, privacy protection, and openness, for example in data sharing. In practice, however, large data platforms such as Google and others seek access to all open data and use it in their own business. How can Europe combine its priorities into one coherent package?

Slow productivity development in Europe.

According to reports⁴, productivity is much higher in the United States than in Europe, but that is not due to manufacturing industry. It comes from the fact that the United States has large platform economy companies that scale first in the U.S. internal market and then rapidly globally. In addition, a large share of the most successful U.S. companies were founded by children of immigrants⁵. They want to prove themselves and know how to take advantage of the opportunities offered by the United States.

Europe's dependencies on China and the United States.

Europe is dependent on the relationship between China and the United States and vulnerable if the situation turns into a crisis. In addition, Europe lags behind China and the United States in key technologies, and it appears to be falling further behind all the time.

Pressure on regulation of Artificial Intelligence.

EU thinks that AI needs to be properly framed and controlled. There will be tensions between Europe and the new administration of the U.S. President Trump has hinted that he would challenge those constraints and boundaries. There will be pressure on the European regulators from big players supported by the US administration.

The EU does not sufficiently support the product development of European leading companies.

Europe should support local top-level innovation, as other countries and regions do. The playing field is not level if only some actors receive support. European equipment manufacturers should receive public support for product development so that they can develop 6G networks within a reasonable timeframe. The risk is that, due to a lack of support, there will be no European 6G network technology available in the future.

How will Finland and Europe do in the race against others?

China is investing enormously in the development of artificial intelligence, with the chatbot DeepSeek⁶ as the latest example. Europe is losing to Taiwan in the production of more advanced, cutting-edge semiconductors. The example of DeepSeek shows that it is possible to succeed even without top-level semiconductors. Does Europe nevertheless have opportunities to succeed through new innovations and advanced, though not cutting-edge, semiconductors?

What happens to equipment manufacturing when all value shifts to data?

As the level of automation rises, the value of the product shifts to data and its utilization. Artificial intelligence combines platforms, data, language models, and their exploitation, and so far we have seen only fractions of a per mille of this. Europe has probably already lost the platform game, but it still has opportunities in the exploitation of data and

⁴ For example https://www.ecb.europa.eu/press/economic-bulletin/focus/2024/html/ecb.ebbox202406_01~9c8418b554.en.html

⁵ <https://immigrationimpact.com/2023/08/29/immigrant-fortune-500-companies-gdp/>

⁶ For example [https://en.wikipedia.org/wiki/DeepSeek_\(chatbot\)](https://en.wikipedia.org/wiki/DeepSeek_(chatbot))

language models. That is a huge opportunity, but if Europe does not succeed in it, the benefits will go to a company that is not European.

EU-funded projects do not produce concrete results.

What has been the impact of EU-funded research projects? Many research reports have been produced, but nothing so significant has emerged on the market that the results would be visible among the world's 100 largest companies. In the United States, the starting point is that a project must produce an innovation that is commercially ready enough for the U.S. federal administration to buy it for some purpose. And consortium members are selected on the basis of competence, not geographic location — for example, distance from Washington.

5G and 6G do not meet expectations

Does 5G produce concrete benefits?

How good a business does 5G generate? Has it fulfilled its promises? Somehow it feels that 5G and 5G Advanced are progressing more slowly than may have been hoped. What are the expectations for 6G?

Will the 5G market grow large enough?

With 5G and 6G, the industrial internet can be made to work properly and cars and aircraft can move autonomously. But this requires use cases for 5G/6G that force investment. Right now, it seems that 4G is, in practice, quite sufficient.

5G/6G may become an extremely fast but dumb bit pipe.

If there is not enough demand for the new features of 5G/6G, operators may end up selling only connectivity and data, and that is bad for them. It is also bad for network infrastructure suppliers, because they will not have new sales arguments for their products.

There may not be enough new and interesting use cases for 6G.

Operators do not want to invest in 6G networks if no new use cases and modes of use can be found for 6G that generate new revenue for operators. If 6G is marketed with the same arguments as 5G, it is just a new, fast modem in which operators do not want to invest sufficiently from the perspective of developer companies.

Finland's lead in 5G/6G technologies will shrink and disappear.

Oulu is now, in practice, a global 6G hub, but in Finland the vectors of technology development and business development are not pointing in the same direction. Although we have several 6G projects under way, we cannot guarantee Finland the kind of first-mover advantage that others cannot catch up with.

Will the deployment of 6G be delayed?

6G will be implemented incrementally on top of 5G, but its timetable is uncertain. Operators have been disappointed with 5G, because it has not increased ARPU⁷ from end customers at all, or only very little. Will 6G bring enough new and attractive

⁷ ARPU = Average Revenue per User

application opportunities for companies and consumers? When will operators be ready to make major network investments in 6G? A delay in the deployment of 6G would be bad news for network equipment suppliers.

6G is not here yet.

The technical standard for 6G will be finalized by the turn of the decade, but after each new release it takes 6–12 months before the first product or service based on it is on the market. After that, it will take several more years before large industrial pilots are up and running, and only after those will decisions and industrial investments be made. It would help network equipment manufacturers a great deal if they knew when operators will start investing in networks, what kinds of features will be wanted, and at what price the services are intended to be sold.

6G is a difficult technology.

6G is a technically challenging and complex whole. In addition to radio-technology challenges, the system must also take into account other new issues, such as artificial intelligence, cloud computing, edge computing, system-on-chips, and information security, and build them into a functioning whole.

Companies believe the hype around 6G and hold back in their investments and R&D, waiting for the promises of the “next G”, even though they could implement their solutions with existing technology already now.

In the early 2000s, many mobile games were developed even though 3G — that is, a fast network connection — did not yet exist. At the time, games used text messages and WAP. When 4G arrived, it was promised that it would revolutionize everything, but it became only a faster bit pipe. In the early 2010s, it was again promised that 5G would revolutionize everything. Will the same happen now with 6G? In other words, marketing promises too much, and in practice what arrives is again only a faster bit connection.

Bundling hype technologies together.

In public discussion, for example, 6G and artificial intelligence are bundled together on fairly thin grounds, without articulating in any detail what is magical about combining them and what it will achieve.

The future of funding for 6G development.

Will we be able to fund the development of 6G technology and its successors sufficiently? Wireless technology is one whole that also includes cybersecurity, edge computing, and quantum technology. If academic funding is not obtained for these, there will be no research projects either, and that expertise will quickly be taken from our hands.

Will American companies commercialize the results of Finnish 6G researchers?

Finnish 6G researchers engage in research cooperation with American universities and companies. How do we ensure that Finnish and European expertise and know-how do not, through cooperation, go to the United States for free, where they are commercialized more effectively than in Europe? American companies use the public support they receive to develop solutions for industries in which they can compete globally.

6G markets will fragment

6G will split into several competing standards or implementations.

4G was a beautiful solution because it was based on one global standard. It produced enormous global benefits, although they were distributed. It is possible that 6G will split either into several standards or into several different implementations of the same standard. This may lead, for example, to global roaming not working.

The boundary conditions for the use of 5G/6G differ between countries.

North America, Europe, and China have different approaches to artificial intelligence, information security, and privacy protection. Due to different usage restrictions, the radio bands in use may also differ between these main markets. As a result, companies will have to vary their products and will not be able to fully exploit economies of scale, and the deployment of new technologies may slow down. In this way, we move closer to the era of 3G.

6G technology will fragment.

5G networks are not a genuinely global market, because some countries have excluded China's Huawei from their markets, and correspondingly European actors — Nokia and Ericsson — have little access to the Chinese market. China can also influence system procurements in other Asian countries. 6G may also fragment technically because of sphere-of-influence thinking: actors want to ensure that different solutions are not technically fully compatible.

The path to 6G is still unclear.

How and when will we get to 6G? What kinds of choices will customers and end users make? With whom will companies conduct R&D cooperation? When will 6G be mature enough to be utilized? What kinds of business models will be used to exploit it?

Competition between the United States and China will accelerate the divergence of 6G standards.

The United States and China want to be on different sides when competing for technological dominance, and to build blocs around themselves that support them. This will accelerate the erosion of the global 6G standard. The U.S. bloc includes the EU and NATO, while China's "chaos quartet" includes Russia, Iran, and North Korea.

The fragmentation of markets will increase the need for regional product variants.

If 6G markets fragment because of protectionism, different markets will require regional products, typically different frequency variants. The number of options will decrease, because not all manufacturers will make all possible variants. In addition, devices will be more expensive, because volumes will remain small due to the variants.

Standards will erode

The politicization of standardization

If standardization drifts into a strict OECD versus BRICS situation, how can we ensure that standards serve Finnish companies and Finnish society? Today, only two people

from Finland participate in ITU meetings, whereas China sends 200 people, of whom 100 are from China Mobile.

Do Western actors sufficiently support the emergence of global telecommunications standards?

Over the past 5–10 years, China has taken an increasingly aggressive approach to global standardization work, where 5G/6G issues have been at the forefront. The danger is that standards that are unfavourable to us will gain ground in markets that are still, for the time being, unallocated — for example in the Global South. This represents “the power of infrastructure”, which spreads through standards.

Do Finland and Nokia have enough weight in 6G standardization?

In earlier mobile-phone technologies, international standardization and especially frequency cooperation have played a decisive role. Can Finland as a state and Nokia as a company push for decisions that help the rapid deployment of 6G technology?

IPR and intellectual property rights.

The development of 5G/6G is also linked to intellectual property rights. Does the current IPR system meet the requirements of new technology? Or does it reflect the world for which it was originally developed? Should it be changed?

Standards and the companies developing them will lose their market position.

In traditional standardization, only the interfaces are open and documented, and what happens between the interfaces is left to equipment manufacturers to decide. In Open RAN, the structure and functionality between the interfaces are also opened up. This may be a bad thing for equipment manufacturers that have been involved in developing standards, such as Nokia and Ericsson.

Decision-making will become politicized

The game will become political.

The political influence of a small country such as Finland is limited in Europe and quite marginal in NATO globally. It is not good for us if decisions are made on grounds other than commercial ones.

Extreme polarization.

The United States could, for example, announce that if you buy Chinese technology, then you will not buy anything from us. Such extreme polarization would be highly harmful on the technology side.

The best may not necessarily win.

Nokia is a significant 5G/6G company, but will it be left alone? In European projects and choices, it may happen that the state level is used to promote one's own industry. In 5G/6G, too, it could happen that a French company emerges and starts exporting 5G/6G to NATO countries thanks to strong political support, even if it has no background in the field. How much can Finland support Finnish actors and ensure that development is favourable to us?

The financing competition in mobile networks.

Will dumping in mobile networks drive small countries and their technology actors out of the market? Will only those actors with the greatest financial resources be able to sell their own solutions, even if their technology is inferior and even dangerous? How can we ensure that the most important criterion in choosing a network supplier is not price — that is, where the network can be obtained most cheaply or even for free?

Consolidation of the European operator field through regulation.

In 2024, there was discussion about promoting consolidation of the operator field in Europe through regulation rather than through market-based transactions. One idea was to organize European frequency auctions, in which only those with sufficient money would be able to participate.

Chinese network technology is a risk

China's techno-authoritarianism.

As part of its broader objectives, China is promoting techno-authoritarianism⁸, which is its view of what the technology world of the future should look like. China works actively through, for example, the UN, the ILO, and the ITU, which defines technology standards. In 2018, Xi Jinping established directly under himself, among others, the Central Cyber Space Affairs Commission, the Military Commission, the Economic Commission, and policy commissions. Xi personally leads all of these and is thus able to keep all the essential threads in his hands. Technology is one part of changing the world order, and through technology China has been able to penetrate the economies of many countries, especially in the Global South, where Huawei and ZTE are market leaders.

Telecommunications networks can also be used for harm.

When new technologies and innovations are discussed, the focus is mainly on new opportunities. But they can also be used for harm. Telecommunications networks are now part of society's basic infrastructure. It is truly worrying if actors involved in developing and building them want to use them to advance their own political goals or for various covert activities.

Chinese capital.

There is a great deal of Chinese capital in the European gaming industry. If a trade war

⁸ China's techno-authoritarianism — for example, [Human Rights Watch](#): In 2016–2017, China introduced national security legislation that obliges companies to keep their data in China and under the control of Chinese companies, as well as to provide access to that data to the Communist Party and the security authorities. The police collect information on people through, among other things, mobile applications, biometric data, and artificial intelligence. The central bank has introduced digital currency, which makes it possible to monitor citizens' spending. China restricts and controls the use of the internet within its borders. The official objective is to reduce bureaucracy, corruption, and abuse of power, but this takes place at the expense of free elections, an independent press, and an independent judiciary. China spies on citizens in China as well as in countries that have adopted Chinese technology, such as Ecuador and Kyrgyzstan. Chinese technology and platform companies, such as Huawei, Baidu, TikTok, Alibaba, and Tencent, cooperate with state intelligence organizations regardless of who owns them.

breaks out between China and the United States, what will happen to this capital? Will it prevent American capital from entering Europe? What does it mean for technologies?

The enormous corporate subsidies granted to Chinese companies.

The market-driven operations and international competition of Chinese companies are financed with enormous public subsidies. China's interests are also the interests of Chinese companies, so in the development of new technologies they may also have security- and military-related objectives and goals. Will China harness new technologies to gain military advantage? We do not know everything China is developing.

The position of Chinese network equipment suppliers.

In Finland, operators have adopted Chinese technology, which involves various dependencies and risks.

The use of Chinese network technology is dangerous.

The use of Chinese network technology in critical infrastructure involves several risks. The most important is that choosing a Chinese network supplier means a long-term strategic and political commitment to an aggressively acting country that does not respect human rights. All information that passes through a network using Chinese technology also ends up in China, where it is freely processed using AI and quantum computers. If a country uses only Chinese network technology, there is also the risk of a so-called killer switch possibility, meaning that the country can be driven into chaos by shutting down networks for all users. This message has not got through even in the EU; in many countries, the 5G Toolbox has not been fully implemented. For example, the Spanish company Telefónica has had eight mobile networks built in Latin America purely with Chinese technology.

What effect will export restrictions have on China's technology development?

Will export restrictions, tariffs, and trade war slow the development of key technologies in China? Or will China be able to turn them to its own advantage?

Open RAN technology

The progress of Open RAN technology.

The official justification for O-RAN is "vendor diversification", meaning bringing new competitors and cost competition into the sector, even though the sector's profitability is currently close to zero. However, the most important reason for promoting O-RAN may be that it gives intelligence agencies easier access to networks and the data flowing through them. Combining the products and technology stacks of several suppliers into one integrated solution is theoretically possible, but in practice it is not easy. If a Porsche is fitted with a Toyota gearbox and Peugeot tyres, it no longer works like a Porsche.

American companies will replace the 6G radio network with their own solutions.

In the visions of American companies that are central to cloud services — AWS, Alphabet, Apple, Microsoft — the 6G radio network is only one channel for using cloud services. At present, the most important channel for mobile devices is the wireless local area network connected to a fixed network, because as much as 80% of mobile data

passes through it. If O-RAN functions even tolerably as a radio network, it may capture market share from other 6G solutions. In addition, broad interoperability of networks is not very important in business use.

Escalation of the geopolitical situation

A new world order

Who is the enemy?

In movies, James Bond typically has one enemy with a lot of power, which is embedded in things and technologies that we don't understand. In business and in politics there are often many actors. Some of them are enemies, some might be enemies, but we don't know and the situation may change rapidly. Also, in Bond movies the powerful things are usually massive, but in real life they are quite small.

Fake news and conspiracy theories.

It was once claimed that mobile devices cause cancer. In 2020, builders of 5G masts were assaulted in France and England because 5G was claimed to spread coronavirus⁹. For young people, social media — mainly TikTok — is the most important source of information¹⁰. How did we end up here?

There seems to be just one truth at a time.

It happens all the time: there is a statement of “truth” and people jump on that train. If that happens to be actually true, then that's good. But if it's just somebody's opinion, then that might be quite more difficult.

Escalation of the geopolitical situation.

Economic and political power are always connected to each other, but if their relationship is too close, it affects the geopolitical situation. Now their connection is also polarizing the Western alliance from within, an alliance that represents about one third of the world's states.

There are many tensions in geopolitics.

There is a war under way in Ukraine, which China indirectly supports. The United States is withdrawing from the international rules-based system and is making demands even of its own allies, on whom U.S. power has to a large extent been built. On whose values and objectives will new technologies be developed?

We are entering a period of turmoil.

It will be chaotic, in part because the old order has collapsed and the new order has not yet emerged to take its place. Trump is a symptom of that, not a cause. The dilemma, particularly for Europe, is that the new powers have very different views of how things should work. Turkey, Brazil, India, China, maybe also South Africa have distinct views

⁹ For example <https://www.npr.org/2020/04/19/838195056/5g-conspiracy-theories-trigger-attacks-on-cellphone-towers>

¹⁰ For example <https://www.teenlife.ngo/teens-media-and-information-sources/>

that don't necessarily fit in with the order we inherited after 1945. We have talked about having a multipolar world for years. Now it's here, but we have not done any preparations for it.

Turbulent geopolitics.

Recently there have been rumours that Ericsson might move its headquarters to the United States, or that Nokia might sell its mobile networks business. Such rumours reflect the convergence of technology, geopolitics, and economic challenges.

The rules-based economic system is eroding.

The rules-based economic system has been in place since the Second World War, and the United States has benefited from it the most. Now it is eroding. Will a new consensus be found at some new level, or will the future be even more divisive? This will also affect 5G and 6G technology.

The intensification of cultural differences.

Some countries in Africa, Asia, and Latin America feel that Western countries have been imposing Western values and culture on them for 200 years, while their own history and expertise have been pushed aside. In addition to values, this is about a sense of independence. How can we repair the situation and create a win-win situation for both sides?

How Finland and Europe position themselves in the new world situation.

Will they genuinely strive to create wellbeing and prosperity, or will they follow the development of the world situation like spectators watching a tennis match?

What is Finland's position in a changing world?

What is the position of Finnish companies? Finland is well positioned and allied, at least from the perspective of defence and national security. Such alliances also give rise to technological groupings, in which actors must make choices.

Trade war has unpredictable effects and consequences.

Trade wars and sphere-of-interest thinking slow the market entry and deployment of new technologies.

The United States and China are building their own spheres of interest. They are on a collision course and heading toward a trade war, as a result of which the market entry and deployment of new technologies and networks may slow down. For example, semiconductor manufacturing technology that would allow Chinese actors to make the most advanced system-on-chips is currently not being supplied to them. This delays the arrival of Chinese solutions on the market.

Decoupling.

The formation of two different worlds or blocs is not in Finland's interest. Finland is an export-driven country, so we need good trade relations with both East and West on many levels. Decoupling is also a bad thing from the end user's perspective, because different regions require different terminal devices.

Markets are shrinking.

Companies do not seem to be very worried about the way the situation is developing, even though market shrinkage and fragmentation are a major concern especially for global actors. Is it that global actors believe that, in the end, they have more to gain than

to lose? China has already, in practice, driven Western network suppliers out of its market.

Bloc formation has a negative impact on Finnish companies.

The bloc formation of the world is not only a 5G/6G issue; it affects absolutely everything. Naturally, my primary concern is how Finland and Finnish industry will cope. Tariffs and other lighter forms of bloc formation can have dramatic effects on some companies, not all of which are 5G/6G companies.

Bloc formation is accelerating.

We are living through a sad time in geoeconomics and geopolitics. The golden age of globalization was associated with global standards, the opening of markets, and the rise of Nokia mobile phones. Now we are moving in almost the opposite direction. Bloc formation opens opportunities for countries and companies to play their own games. It may be that many companies are too optimistic in imagining that they will manage amid sanctions and export restrictions. What is certain is that the cake will shrink when we move from globalization to a closed model.

The alliance of technology and politics

What effects will President Trump's administration have?

U.S. policy may be highly unpredictable in this area as well over the next four years, because individual companies and even individuals may have a disproportionately large role in arranging future telecommunications connections. People are coming into significant roles in President Trump's administration who, for example, believe that wireless radio networks are harmful to health. In addition, the nearly USD 50 billion broadband investment project for sparsely populated areas launched by President Biden is to be shut down¹¹ and replaced with the Starlink system developed by Elon Musk's company SpaceX.

The concentration of technological and commercial power.

Technological and commercial power has become concentrated in a few companies and the handful of ultra-rich oligarchs behind them. In telecommunications, too, the set of actors is limited, but above all power lies with those who have the ability to collect, aggregate, and mine data, and with those who control digital platforms. They also have an influence on the future of the entire digital infrastructure, of which wireless data transmission is a key part. I am especially concerned that values such as democracy, the rule of law, the international rules-based system, and individual rights are not on these actors' agenda.

Concentration of power in the ICT and media industries.

Power concentrates to just a few players: companies, countries, and even individuals. Sometimes they're combined. For example, in telecommunications there are basically

¹¹ For example "High-Speed Internet for All" (<https://www.internetforall.gov/>) and "Broadband Equity Access and Deployment Program" (<https://broadbandusa.ntia.doc.gov/funding-programs/broadband-equity-access-and-deployment-bead-program>)

only three companies: Nokia, Ericsson, and Huawei. There aren't too many major providers for cloud solutions and even fewer for social media. Geographically the concentration is even stronger, because most major players come from the U.S. or China. And even companies that sit in the middle are often very dependent on the U.S. market.

Society's dependence on global technology companies.

How much do GAFAM companies¹² influence everything that happens in the world? Are we already in an ultra-oligarchic situation where only a few individual people control key parts of infrastructure and decide how people communicate and what they watch on their mobile devices?

The technology world has gravitated toward the right wing of the political spectrum.

The technology world is a world of engineers and businesspeople whose reference groups are in Silicon Valley and the United States, especially now under Trump. We are left with a major political gap in those circles where, in addition to business opportunities, more attention might be paid to the societal and civil-society impacts of new technologies.

Market closure.

Do the major network actors want to do everything themselves? If the United States and China decide that everything must be done in the United States and China, what does that mean for European actors? Can Europe respond to this challenge?

Relationships between the leading countries

How will U.S. democracy develop during Trump's second administration?

In the 5G/6G context, the United States is in a fairly good position, and through that the American cluster and industry are extremely strong. The United States also has enormous power through the market values of large platform economy companies and its own activities. The United States, like others, seeks to reshape the rest of the world in the image of its own market. Europe succeeded in this with 2G, and now it will succeed for whoever has the best expertise and the greatest power to do so.

Deteriorating relations between the United States and China.

How far will the United States take its efforts to isolate China? The poor relations between these two countries create difficulties for many electronics manufacturers, because Chinese suppliers are closely involved in value chains and almost all products contain Chinese components. The newly elected president of the United States is unpredictable and may do something completely crazy.

The United States' relations with other countries, especially China.

This topic is a general concern in early 2025. Much depends on how closely Western countries are able to work together to develop markets and standards, and on how shared their interests are.

¹² GAFAM = Google, Apple, Facebook, Amazon, and Microsoft.

Relationship between China and Russia.

Russia is in such a terrible shape. They lost the Cold War and cannot get over it. China is the senior partner in that relationship. Will China play a more active role in guiding Russian affairs? They'll try, but it will be hard, because the Russians are anti-Chinese.

The tightening of relations between China and Taiwan.

The Chinese have developed their economic bubble by taking on debt, and at some point they will have to make similar decisions to those Japan had to make. I do not believe this will happen through a major economic crisis, because that fits poorly with the Asian mentality. The adjustment will be made within society, but it may take 20 years. China's official growth forecasts may be 4–5% per year, but in reality the next 10 years there will be zero growth. This may lead China to want to resolve the Taiwan question soon — for example during Xi's administration — because in 10–20 years the situation would be worse from China's perspective. What will the Americans do then?

The possibility of war

The possibility of war.

It would be better for humanity and the world if we lived in a world of globalization and cooperation, but that option does not seem to be available now. A possible new Cold War involves concerns, but also opportunities. During the first Cold War, there were investments and economic growth in both the West and the East. The division of the world may lead to systems being renewed and competition between two systems entering the market. That, too, may be a good thing, but if I could choose, I would not choose this path of development.

War scenario.

I have tried to think that the escalation of crises into a full-scale war is so unlikely that it is not worth thinking about. Or that if war escalates, it would not escalate in Finland's case. After all, wars are going on in the world all the time.

The threat of war is worrying, but my ability to influence it is limited.

It is entirely possible that Russia will attack Finland — not necessarily in full force — and Finland must prepare for this. The security authorities know what they are doing, and the Defence Forces know how to worry about the right things, so I do not need to worry about everything. My ability to influence the situation is limited.

The West's ability to produce weapons and ammunition is limited.

The war in Ukraine has made it clear that the ability of Western countries to produce weapons and ammunition is relatively limited. In addition, old stockpiles have been used extensively in Ukraine.

A crisis in the Middle East.

An escalation of the situation in the Middle East would have very significant negative effects on the Finnish economy.

The war between Russia and Ukraine.

Will the current kind of state of war continue, or will it begin to spread and expand? An expansion of the war would affect many things.

Information security challenges

The strong growth in the amount of data and the related information security challenges.

The technical side is not what worries me so much, but as data volumes grow, we need to be truly vigilant and even brutally realistic about issues related to information security.

How data is processed in 5G/6G networks.

Data is one of the most important creators of value. What kinds of new opportunities do 5G and 6G offer for data processing? Who collects the data, and who makes use of it?

Vulnerabilities in digital infrastructure.

How is data taken care of? How can data, in a technical sense, be utilized in real time in the desired use cases? All technical components — from the device level to algorithms, software, and applications — must be increasingly energy-efficient. The requirements for information security and energy efficiency should run through the entire chain.

Finding the right level of information security.

Information security can be increased by introducing new solutions and methods, but the whole must be such that it takes into account the needs of the end customer and the business model. Information security cannot be so strict that it prevents business.

Technology risks

Technology risks.

For example, in the gaming industry, actors are technology-agnostic, meaning that they use existing technologies, but there are still risks associated with them.

Convergence in communications.

Artificial intelligence is a very big concern to me because of far-reaching impact on all areas of life. AI is related to mobile communications: you need connectivity to deliver these services. I hope there will be boundaries to the use of AI in Europe. They need to be implemented and it will affect also the connectivity side.

The major telecommunications manufacturers are not in a strong financial position.

Telecommunications services and connectivity are key enablers of digitalization and its progress. At the same time, almost all major telecommunications manufacturers seem to be struggling with business growth and profitability.

The operating model for spectrum auctions.

Finland has had a very enlightened spectrum policy. Finland has not charged operators unreasonable amounts, but winners have been given coverage obligations. This kind of operating model should also be adopted in other countries so that network investments can get under way. Operators will not invest if their money has been taken from them through spectrum auctions, and without frequencies there is no business.

Can Nokia turn the new geopolitical situation to its advantage?

Connecting all devices to the network.

Do we understand well enough how extensively network-connected devices are part of

our everyday lives, right down to the individual level, and what kinds of dependencies and risks this creates? Mossad's recent attack on the phones and pagers used by Hezbollah is a practical example of how a systematic actor can use ordinary, everyday devices as weapons. Preparations for that operation had begun 10 years earlier.

Anything that is connected, can also be hacked.

There are cyber risks related to all connected solutions. Those can be easily utilized by anyone with bad intent: individuals, organizations, or countries. Right now I'm most worried about countries.

The control point of telecommunications services may shift from operators to cloud providers.

How will regulators respond to this? Telecommunications services will not deteriorate, because even new actors do not want to break the traditional interoperability of the telecom sector. Calls, for example, will still go through, but their control point may shift from telecom operators to cloud providers. A large share of customers have already started using cloud-based messaging services, such as WhatsApp, instead of operator-based SMS and MMS. At the same time, the value and control of such services have shifted elsewhere.

Sustainable development, the energy efficiency of solutions, and electricity consumption.

At present, data centres in the telco sector consume enormous amounts of electricity. This has been known for a long time, and work has been done to address it, but digital infrastructure must be made more sustainable, more secure, and less electricity-intensive.

Discussion about the energy use of new technology.

In Finland, too, there has been discussion about data use and new technologies consuming so much energy that their use should be restricted. Demonizing and slowing down technological development also slows productivity growth.

Privately owned satellite-based systems.

Traditional satellite systems have been the arena for state-level players. A privately owned satellite network has been in extensive use in Ukraine, and we have already seen how the owner can shut off the whole system. Going forward, Europe will most probably build its own satellite communication system, China is already doing it and maybe there will be others. If there is no co-ordination and co-operation, number of satellites will increase rapidly and the space will be crowded. Satellites can also be used as weapons, attacking and breaking satellites that belong to other networks or mimicking other satellites to steal the communications. In late 1980s we spoke about space force, but this is on another level that could disturb the communications.

Interference with international telecommunications and satellite communication will become more common.

In civilian telecommunications, interference has not previously had to be considered; the challenges and problems have mainly related to information security. 5G and 6G are dual-use technologies, and they bring new capabilities into the picture, such as environmental monitoring and positioning. In addition, 6G is linked to satellites. If these begin to be challenged and interfered with, the development, maintenance, and updating

of the system will become extremely expensive, as new solutions will constantly have to be invented. Such cat-and-mouse games will also undermine the usability of the system.

Exclusion will increase when not all people have the ability to use the latest solutions.

Semiconductor value chains have poor resilience.

Semiconductors play a critical role in 5G/6G networks, because they determine, among other things, the intelligence and power consumption of the system. Only a few suppliers are able to manufacture the semiconductors needed in 5G/6G networks. Building resilience in the value chain may be a project lasting 5–10 years.

What would you like to know?

What will happen to Finland?

Is the Finnish political decision-making machinery awake?

Is Finnish political decision-making functional also in crisis situations? Does it have the capacity to look in enough directions? Does it have the ability to cooperate with the right parties, including business and industry? Global and outward-looking companies constantly monitor what is happening in the world. Their dialogue with political decision-makers should be in good shape. At the moment, our eastern neighbour Russia is one obvious threat to Finland, but it must not take too much attention and capacity away from other things happening in the world.

Are enough companies viable in their own business?

In Finland, we have companies that are sleeping like Sleeping Beauty, and then we have systems that keep these sleeping companies alive. Instead of creative destruction, Finland keeps companies on life support that are not genuinely viable.

How does Finland build and maintain security and security of supply?

Awareness of how Finland builds and maintains security and security of supply would reassure people: we have a strategy according to which we operate.

What should be prioritized and what should be de-prioritized?

It feels as if decision-making in Finland is erratic: first something is important, but then suddenly it is no longer important. If we genuinely want to achieve something, where should we direct our resources, which are limited in any case? Which technologies should we invest in? What kinds of solutions should be made in Finland? Where and how should public money be allocated?

What will Nokia look like in five years?

Will we have Nokia, and what will it look like? What will Nokia's role be in these markets?

What happens to Nokia?

The key issue for Finland is what happens to Nokia. It was a tech leader that is now far behind, and the outcome remains to be seen. One of the reasons Nokia is having so much trouble is because the Chinese play by different rules when it comes to supplying markets and we're kind of stuck with bad agreements on trade made two decades ago.

What will happen to Europe?

Will the EU stay together?

Will the EU become an even stronger actor, or will it fragment?

Will the EU develop toward a federation?

Will Europe's situation be clearer in a few years?

Europe faces major choices, but its Member States are not united in their positions. This

kind of wavering can even be politically dangerous, given Europe's dependence on the United States, for example in security matters.

What will the EU be like in 5–10 years?

Will it still exist? If we knew that the EU would collapse within 10 years, Finland should as quickly as possible deepen its cooperation with the United States and seek to become “the 51st state of the United States”. In that role, Finland would be better off than in the EU's collapsing open-air museum. The starting points are good: we are part of NATO and significant bilateral agreements have already been made with the Americans. The real question here is whether the EU will succeed in finding ways of operating that allow it to succeed in competition.

How will Europe's security situation develop?

Is there something Finland should do, or do differently? According to the Speaker of Parliament, we are already in the Third World War.

What position will the EU take on issues?

The EU has been conciliatory on many issues and has avoided escalating situations. Will this continue to be the EU's line — that is, will the EU remain on a path of muted responses?

Can EU affairs be made more practical?

At the moment, EU foresight work on the future is rather lofty and has very little use in daily operations.

Will Europe grow a backbone?

In one of EVA's recent scenarios, Europe grows a backbone, and it would be interesting to know whether this will happen. Somehow it feels as if the EU has voluntarily taken on the role of a punching bag or Mister Nice Guy. Of course, fear is also involved, because we are currently dependent on global relationships.

How will Europe and Finland maintain competitiveness in wireless communications?

How will Europe and Finland finance research into 6G and other future wireless systems? How will they support companies? Research alone is not enough; it must be turned into business, and that requires good accelerator programmes. Through NATO, Finland gained access to DIANA. It is a good model, it has a good brand, and through it Finnish expertise can be taken to other countries, but only a few companies can be admitted in each application round. How will the companies that develop, for example, dual-use-related solutions be funded and developed?

Will Europe be self-reliant in producing key technologies?

It has become important to build systems that don't make you dependent on other players. To what extent can we do that in Europe? One way is to use generic technology and then just program it, but you cannot do everything like that. For example, if I want to build a new computer, I could buy the chipset from Intel or AMD, but chips are designed by American companies and manufactured in Taiwan or China.

Will Nokia and Ericsson remain European companies?

There are currently three large and global suppliers of telecommunications equipment in the world: Nokia, Ericsson, and Huawei. Of these, two are European and one is Chinese

— there are no American companies. If American investors want to buy their way into these markets, Nokia and Ericsson are potential acquisition targets. But who would the buyer or buyers be? How would the EU respond, and would it impose restrictions on the transaction?

Will any mobile technology company remain in Finland or Europe?

Will Ericsson and/or Nokia, or their mobile networks businesses, be sold outside Europe?

What is Europe's role in the data and software markets?

Can Europe increase its expertise and role in these markets?

What kind of regulation should Europe pursue?

The United States is deregulating under Trump, so should the EU also start dismantling regulation? In Europe, for example in the digital sector, there are six or seven different regulations. Regulation this heavy can be a barrier to market entry for companies. It can hinder or prevent companies' operations to such an extent that they leave the EU, for example for the United States, where they can operate more effectively. What would optimal regulation look like?

How will EU regulation develop?

The EU has cybersecurity-related legislation, toolboxes, and other regulation. Will it be tightened? Or will regulation be linked in trade policy to tariffs and opportunities for technology transfer? Can Finland turn regulation to its advantage in terms of competitiveness?

What will happen to telecommunications networks?

What will be the significance of mobile network technologies in 10 years?

Will network technologies matter, or will only semiconductors be important? Will AI matter?

How relevant will 5G/6G be in 10 years?

Already now, global satellite operators such as Starlink offer fairly good connections almost anywhere. They bypass the traditional telecommunications market and are outside the traditional regulatory environment.

When will the growth of private networks begin?

Private networks can be used to implement networks that are considerably more reliable than other solutions. This is needed, for example, in industrial automation. If we knew that demand for private networks would rise, say, in 2026, we could stop all other experiments.

When will real-time capability be achieved in telecommunications networks?

Time Sensitive Networking (TSN)¹³ enables a low packet loss ratio in

¹³ For example https://en.wikipedia.org/wiki/Time-Sensitive_Networking

telecommunications networks. When will its growth begin, and will it take off explosively or more slowly?

Will the 3.8–4.2 GHz band be released for 5G use in Europe?

Europe is reserving the 3.8–4.2 GHz band exclusively for 5G use. Will this happen, or will some major operator appear at the last minute and prevent the band from being released?

Will operators be needed in the future?

Technically, it is already possible to offer broadband services through satellite connections, and traditional operators are not needed for that. American operators are already virtual operators that do not own towers, base stations, or software.

Will the operators be able to make money again?

How much is the EU willing to invest in the development of a European telecommunications system?

Will the EU support the creation within the EU of a 6G system that complies with EU norms and values?

What is the status of 5G/6G technology?

Timeline for implementation and deployment

What is the timeline for implementing 6G?

For example, when will 6G have around 10% penetration, meaning approximately 500 million users?

When will 6G actually be deployed?

Will 6G enter the market according to the promised timeline, around 2030? Will 6G generate good business?

What is the real schedule for 6G?

How can the deployment of 5G/6G be positively influenced?

The deployment of these technologies requires some kind of global consensus. Will such a consensus be reached, for example in technology? Finding consensus would support the development of 5G/6G business.

When will telecom operators start investing in 6G?

Telecom operators play a central role in utilizing 6G. Do they understand 6G sufficiently? Do they sufficiently understand end customers — B2C, B2G, or B2B — and their needs in the 2030s? Do operators want to change so that they can offer new kinds of solutions to industry, smart cities, ports, ships, satellite companies, industrial parks, or entire regions? What kind of actor will implement the radio network? Will it be a conventional operator or a new kind of micro-operator? Only around five European operators are involved in international RDI projects to learn, do new things, and ensure that they remain in the game also in the next decade. If operators do not get involved, it will make funding product development more difficult.

When will companies start investing in 6G?

6G will affect every industrial company, regardless of size. When will a critical mass — that is, a sufficiently large number of companies — recognize the opportunities brought by 6G, start studying them, and make investment decisions, for example in industrial automation? How long will industry wait for someone to bring it ready-made solutions? Those who ask questions and investigate usually also have a plan for how they intend to make money in the future. If industry and major end users do not get involved, it will make funding product development more difficult.

Standardization

On how open a basis will the 6G world develop?

According to which standard or standards will it be built? How will it change markets or the positions of different actors? Will 6G networks be built as end-to-end solutions by major players, or will they be implemented by a value chain involving a large number of smaller suppliers?

What will be the role of 3GPP in the future?

The 3GPP release train has been chugging along reliably for more than 20 years, and it has always been known that a new generation will reach consumers' hands roughly every 10 years. Will the train keep moving, or will there be delays or other hindering factors? For example, in terms of price and performance, Wi-Fi 7 appears to be an interesting alternative to a private network implemented with 5G.

Key technology choices

What is the best architecture for 5G/6G?

How can a resilient communications network be built using 5G/6G technologies — one that works on the battlefield and also takes system upgradability into account? Systems used for military purposes are large and expensive; even their terminals can cost tens of thousands of euros. Can they be built in such a way that they can benefit from the cost-efficiency of the civilian side?

Can the 6G network be implemented as a cloud service in terms of baseband processing?

At present, it does not make sense to implement the processing required by the radio network as a cloud service, because it is too expensive and consumes too much electricity. Will the situation remain the same in the future?

What will be the availability of key 6G semiconductor components?

6G equipment manufacturers design their own system-on-chips. These are highly advanced components and use the latest manufacturing technology. Their key manufacturers are in Taiwan, which wants to protect its own position and ensure that Western countries have an interest in keeping Taiwan independent. Recently, Taiwan's

Minister of Economic Affairs announced that TSMC may not manufacture chips using 2 nm technology outside Taiwan¹⁴.

How will the energy consumption of 5G and 6G networks develop?

Winning applications

What are the winning applications of 5G and 6G?

The winning applications of 5G and 6G are not yet known. There are candidates, of course — for example machine-to-machine communication and the Internet of Things — but we do not know for certain how they would be used or what benefits they would bring. If we already knew the winning applications, we could make informed decisions about the scale and timing of investments.

What are the most important services of 6G?

2G brought mobile phones, 3G brought internet access, and 4G brought video. When 5G arrived, operators were asked what services would come with it. The same kind of questioning will probably soon begin with 6G. For example, “Mobility as a Service” was a big thing a few years ago, and networks had an important role in it. Mobility was supposed to change completely, and Finland was supposed to be a pioneer in it, but it did not go anywhere. Operators are poor at inventing those services. Operators buy infrastructure from equipment suppliers and offer their customers more comprehensive and faster connections, and then the customers innovate.

In which use cases and applications are the benefits of 5G greatest in industry? And how can those benefits best be realized?

We are now considering all the things for which 5G, and in the future 6G, can provide solutions. Some targets are valuable, but at the same time difficult in terms of realizing value. The range is broad and the use cases are often individual, so the offering must be like a buffet from which the parts and features needed for a particular use case are selected. It would be good to find standardized and scalable industrial use cases that would allow us to get rid of the buffet, or at least put some things at a lower priority. In other words, if a solution worked, say, in the mining industry, it could work in the same way in a port or an elevator factory.

Dual use

What is the role of 6G in defence and security?

There is, of course, the dual-use technology perspective here.

Is 6G suitable for military use?

Will more combat-resilient waveforms be developed for 6G technology — that is,

¹⁴ <https://www.asiafinancial.com/taiwan-says-tsmc-not-allowed-to-make-2nm-chips-abroad-for-now>. TSMC had planned to start a 2 nm production line in Arizona when Donald Trump became the President of USA.

waveforms that would make 6G systems harder to detect and better able to withstand interference? If such features are not developed in the West, will they come from China?

What is the right way to handle information in a contested operating environment?

Recently, the importance of information has also become more prominent in military use. Everything is information, telecommunications is a way of transferring information, and cybersecurity is a way of ensuring that information remains intact and that no unauthorized party can access it. In this environment, 5G/6G is only one technology used to provide mobility.

How long will the growth in defence-sector investments continue?

At the moment, defence-sector investments in the telecommunications and cybersecurity sectors are the hottest topic. They also have a strong impact because they have brought new funding instruments into RDI activities, such as NATO/DIANA, the U.S. Department of Defense, and the European Defence Fund. Just a couple of years ago, the situation was completely different.

How can mobile communications and mobile networks be made part of the defence and security picture?

Could VTT act as a bridge-builder here and bring the actors to the same table? A Finnish Digital Defence Ecosystem between companies and academia is being built around VTT.

Other critical technologies

What are they?

Where is the world heading in terms of technological development?

What are the next major future technologies and solutions?

Electricity once transformed many things, and now it is said that artificial intelligence will be the next transformative force. But what comes after that? What are the key technological solutions of the future? What is the next electricity or internet?

Have we missed something important in technological development?

Are new combinations emerging at the intersections of the frontier technologies currently being developed that we have not yet identified? What are they? If we knew the answer, we could direct investments more boldly in these directions. Usually, the first movers capture the greatest benefits.

What do we do with an “Einstein in our pocket”?

Today’s mobile handsets have more processing power than supercomputers had 40 years ago, they have access to global repositories of knowledge, and they can process and synthesize data using voice commands. And all this fits in your pocket. What do we do with it?

What is the future of 6G, high-performance computing, and artificial intelligence?

Will these three sectors have advanced, for example by 2028, to the point that we have global standards in place? Finland as a technology hub would benefit if various forms of

business began to emerge around 6G, producing new and interesting technological solutions, products, and services. Artificial intelligence is only one use case for high-performance computing, but it is a good example of an area in which Finland has succeeded in building a reputation. It would be nice to receive an answer that says that an unprecedented growth spurt is under way in the Espoo–Oulu–Kajaani triangle.

When will the growth of autonomy begin?

Autonomy is achieved by combining AI and mobility. It would be important to know when this development will start growing rapidly. We are still at the proof-of-concept stage: there is a desire to increase the level of automation, and mobility has been identified as important.

What is the future of fusion energy?

Semiconductors

How will semiconductor markets develop?

For example, Taiwan currently has a strong role in the supply chains of critical semiconductors.

How good semiconductors can Europe produce?

Germany has invested in semiconductor development, and a large semiconductor factory is being built in Dresden¹⁵. Can Europe produce competitive chips using the latest manufacturing technologies? Or is Europe, in the name of strategic autonomy, investing in a factory that can only produce somewhat inferior chips?

Artificial intelligence

How will AI develop?

How much of the hype will generative AI and language models ultimately live up to?

Will their development continue at an even faster pace, or will it level off, for example because of a lack of training material?

How will AI develop?

How will humanity use AI in 10–20 years? What will it lead to, for better and for worse? What kinds of impacts will it have on people's everyday lives, national defence, or geopolitics? In the age of AI, the most significant battles will be fought in the digital world over human minds — that is, over emotions, perceptions, and understanding.

How will AI change 5G/6G networks?

Will AI make the 5G/6G world obsolete? Or will the 5G/6G world become even more important because of AI?

Will Europe miss the AI revolution?

In the 1990s, Europe had its own potential tech giants and European regulation killed

¹⁵ For example <https://www.dw.com/en/eu-greenlights-new-chip-factory-in-dresden/a-69994371>

them. At that time, Google, Microsoft and others were just starting their operations. Europe missed the whole digital revolution, will it miss also the AI revolution because of overregulation from Brussels?

Open RAN

What role will O-RAN play?

O-RAN, or Open RAN, is a system pushed by the Americans, with open interfaces. Who is responsible for integrating the components into a system? Will operators do it themselves? Who is responsible for the functioning of the entire system?

What is the future of Open RAN?

How did such an agenda emerge, who pushed it, and what will happen to O-RAN next? The Americans believed that with O-RAN they could create a new operating model and a competitive alternative to the large telecommunications companies.

How is the orchestration of Open RAN going to work in practice?

As we go towards more open architecture, many more actors will be involved. Will we have a truly open environment? Or will there be just a few players dominating this space, like an integrated Open RAN? Who will orchestrate the different players and be liable for the open and dynamic architecture? Security is a very important aspect, as openness broadens the threat surface. How will this work out?

Satellite networks

What is the role of satellite systems?

How large a role will satellite systems assume compared with terrestrial networks? Will they become a competitive alternative also for ordinary consumers?

Cybersecurity

Can we trust that 5G/6G networks are secure at the network and infrastructure level?

End-to-end encryption in digital communications is a key part of privacy protection. Recently, there has been discussion about dismantling it or even banning strong cryptographic encryption¹⁶. This would open up opportunities for state- and authority-level surveillance of private individuals. The fight over privacy protection will certainly continue, but it would be important for it to take place at higher layers and for the network layer to perform its task neutrally, as it has done so far.

¹⁶ Hungary proposed an amendment to the EU CSAM Regulation — Child Sexual Abuse Material — in autumn 2024, aimed at preventing the sexual abuse of children online. Under the proposal, a scanner would have to be installed in, among other things, popular messaging services to examine whether devices contain downloaded material involving child sexual abuse. In practice, the scanner would provide an external party with access to the data stored on the device.

What three measures can be used to secure the critical infrastructure of 5G and 6G networks and ensure their innovative development also in the future?

Will there be massive security risks in the future that are very difficult to respond to?

Even now, we have both assumed and real security risks related to networks and their exploitation, including risks caused by state actors.

What will the new world order look like?

What is the future of the decoupling between East and West?

The decoupling between East and West in critical technologies forces companies to make painful choices regarding their supply chains and target markets. It would be useful to know to what extent different markets will close or remain open to Finnish and European actors.

How will geopolitical positioning be organized in the future?

The old, familiar, and safe pattern is gone for a long time, and now we need to think about a new and as good as possible operating model.

What does a digitally connected, non-literate society look like?

The new digital technologies are something we have not encountered to such an extent before. They will change how people think, interact, and acquire knowledge. Societies will change, but is it a good change or a bad change? We have been in the era of written documents, but now videos, especially podcasts, are increasingly the preferred source of information. What happens, if our society is no longer literate? Already today, the first search engine suggestions are often videos, not written documents. Human brains are elastic and will change to match technology; culture will change with it.

How will different crises related to climate change escalate?

Will water shortages and storms cause major waves of refugees? This is not directly related to 5G/6G technology, but of course it also touches on it, because technology can be used to help and to drive change forward, if only there is political will and readiness to invest.

What will the world look like after the second information revolution?

Gutenberg brought the first knowledge and communication revolution to Europe. It wasn't a good thing immediately and there was a period of turmoil for 300-400 years, while governments and people adjusted socially and politically to the new reality. The answer was parliamentary democracy and institutions. Now we're in the second information revolution. It will be much quicker and faster, but the question is the same: how will our societies and governments adjust? What will the new world look like? We haven't started that discussion yet.

In which sectors will the largest companies by market value operate 10 years from now?

Technological transformations are unpredictable. Electric cars were advertised as the cars of the future in the early 20th century, but internal combustion engine cars

dominated the market for more than 100 years. About 10 years ago, the most valuable companies operated in the oil sector, but now oil has been replaced by data. What will be the most valuable sector, for example, in 10 or 20 years?

Can we break the concentration of power in ICT and media industries?

What will we teach to people?

Digital technologies will have a long term effect on how we think. What will it be like five or ten years from now? Already today the ability to write queries for AI platforms is a marketable skill in the business world. Teach people to take advantage of new technologies to think and create.

How do we organize social interactions?

The old approach may not work, and it is already visible in social media. Everyone is in the conversation, and how you create authority is different from what it used to be.

What will happen in geopolitics?

How will the geopolitical game be played?

At the UN, a group of countries, including China, did not support a statement condemning Russia's war of aggression in Ukraine. These countries represent about half of the world's population. Will these countries develop their own 6G standard? And will it be compatible with infrastructure based on the [ITU] 6G standard? If we knew that it was not compatible, it would speed up development work and the choice of partners. Officially, however, everyone says that they are aiming for one global 5G/6G standard.

How can trust in multilateral decision-making be restored?

Decision-making now seems to be a politicized power game in which everything affects everything else. Even in the standardization community, one can no longer trust the goodwill of other parties or assume that they want the best option to win. In what kinds of trust structures will future standards and operating models be developed? How can we build global trust if we do not even trust Sweden?

How will bloc formation and decoupling proceed?

Will the United States and China accept that other countries are also part of the game?

Or do they want to do everything critical themselves?

What will happen along the U.S.–China–EU axes?

The 5G/6G sector can no longer be treated as a purely technological issue; regulation and trade policy are also strongly involved. For example, the tariffs planned by the incoming U.S. President Donald Trump will also have a significant impact on this sector.

Will current tensions escalate?

Is there a culmination point in the current geopolitical tensions after which they will escalate in some unpredictable way? What is the probability of such escalations? For example, there are tensions in the South China Sea that are of particular concern to technology companies. On the other hand, crises and wars are also fertile ground for making various deals.

Will there be more problems in supply chains?

Europe needs to be able to produce systems and technologies that we are used to getting from USA, China and Japan. That way we can have more control. For example, the American administration blocked recently the sale of Swedish JAS Gripen fighters to Colombia on the basis that the engines come from an American company. Even if Saab could find another engine, it wouldn't necessarily help, because the fighter is full of parts and subsystems from several different countries.

Where is the United States heading?

Where is the United States heading?

China is easy to predict, but where on earth is the United States heading during Trump's term?

When will Trump and Putin be removed from power?

And who will their successors be? Trump is only just beginning his second term, but I am already waiting for that term to be over.

What kind of policy and sanctions policy will the United States under Trump pursue?

Has the United States shifted to nationalist "America First" thinking?

Has the role of U.S. foreign and security policy changed permanently, or at least for the long term, toward the pursuit of its own interests?

How will the large American tech giants act?

Do they also want to take control of the telecommunications market? This could happen either through consolidation or by developing new operating models in which everything is done on a software- and cloud-based basis. What will the telecommunications market look like in the future?

How do Big Tech companies use power?

American big tech companies are becoming significant wielders of power also on the political side.

Will the monopolies of global technology companies be broken up?

In the United States, at least Standard Oil and AT&T have previously been broken up through legislation.

How will the relationship between Finland and the United States develop?

Are Finland's and the United States' interests aligned over a 3–5-year horizon? Can we work together to develop and steer global markets?

What will China do?

Are the decisions of China's leadership driven by the pursuit of stability or by immediate interests?

Is China, for example, prepared to go to war over Taiwan?

How does China collect and process data?

It is generally known that China combines information from different sources. In what

way do so-called harmless platforms, such as Temu and Shein, collect this information from abroad? How is it synchronized in China?

How can China use technological backdoors?

Could China, for example, disrupt electric vehicle charging points built using Chinese technology? Could China shut down Elisa's network, which uses Huawei technology?

What does Chinese President Xi Jinping really think?

Xi Jinping could ruin everyone's life by attacking Taiwan. That does not seem likely right now, but it would still be useful to know what China has in mind. Which is more important to China: national pride and returning Taiwan to China, or the success of Huawei and other Chinese companies in international markets?

What is China aiming for?

What are China's long-term motives? Are they acting in good faith, or do they want to do business at any cost?

How will the situation between Russia and Ukraine develop?

What will happen in Russia?

Dictatorships always surprise us. Until the very end, they appear strong, until suddenly they are very weak and disappear. The events in Syria are a recent example of this: there was war there for more than 10 years, and then everything was over in a week. This could happen in Russia as well.

How will the war situation develop?

When will the war between Russia and Ukraine end, and when will Ukraine's reconstruction begin? What will happen with other conflicts? When will they be brought to an end? Are new conflicts about to begin?

What will happen in Ukraine?

What is Russia's future? Has it become stronger or weaker as a result of the war in Ukraine?

When and how will the war in Ukraine end?

On the other hand, if the war in Ukraine ends badly, I am not sure I would want to know that in advance.

When and how will the war in Ukraine end, and how will the Taiwan situation develop?

Can these conflicts, which are already under way or in a highly combustible state, be resolved peacefully? And will they be replaced or followed by trade wars?

How will the situation in Ukraine end? And where will it lead?

If Trump is of the view that the United States, as a great power, is entitled to decide the affairs of its nearby regions and neighbouring countries, then by the same logic China can take Taiwan and Russia can take the former Soviet territories. Will the treaty-based model turn into one in which large states decide matters among themselves over the heads of small states?

What is the best future for Finland, Europe, and the world?

The best future for Finland

A Finland of high-level expertise

Finland invests in education and competence.

Finland invests in education and research.

Education and research provide a sufficient and appropriate foundation for innovation in this field.

Finnish companies succeed through their strong expertise.

The United States and other advanced industrial countries need good partners. They lack labour, expertise, and competent companies. If we are able to maintain high-quality Finnish expertise and we have a few good companies, business opportunities may emerge both for 5G/6G companies and for companies that make use of them. In other words, this will have multiplier effects on new industries — such as AR and VR — as well as on more traditional industry, based on strong data transmission capabilities.

Finland finds a few niche areas in which it is truly excellent.

Through these areas, Finland gains such a global reputation that people talk about us — just as the Netherlands is now discussed in relation to microchips and ASML.

Two or three centres of excellence emerge in Finland.

Finland becomes known for having centres of excellence and surrounding ecosystems that attract top professors and researchers from around the world. International experts also want to come to Finland because the right people, expertise, and networks are here, and because the right things are happening here. These centres generate new business ideas and business activity that applies this top-level expertise.

An ecosystem around 6G, high-performance computing, and artificial intelligence emerges in Finland.

6G becomes intertwined with high-performance computing and artificial intelligence, and an ecosystem emerges in Finland that inspires companies and top researchers. The best experts in the world come to Finland, and Finland becomes a place where everyone wants to come.

Finland has a significant role in the development of the EU's critical technologies.

The European Commission has promised that five “AI Factory” ecosystems will be

established in Europe¹⁷. Hopefully, one of them will be built around the LUMI supercomputer in Finland. The EU will also invest in quantum technology, which is a critical technology for the EU and is linked to requirements concerning sovereignty and self-sufficiency. Interesting activity could develop around artificial intelligence and quantum technology once the benefits of quantum technology can be demonstrated.

Finnish innovation ecosystems renew industries.

Innovation ecosystems have a realistic worldview, the right understanding of market entry and market directions, and the ability to build scalable business in Finland. These ecosystems also include startups with a great many fresh ideas, and they are not burdened by the weight carried by larger companies, meaning the requirement to comply with the regularities of business life. Ecosystems and startups are freer and are able to take risks that other actors cannot take.

An innovative, investing, and applying Finland

Finland rediscovers innovation and productivity.

During Nokia's peak years in the 1990s, we had top-level research and top-level expertise. At the same time, markets opened up and regulation enabled business to scale. In a good future, Finland rediscovers innovation and significant productivity growth.

Finland gets its economic growth going.

Finland has long lived with the problem of low economic growth, but with digitalization and artificial intelligence we become clearly better than other countries. But what might be our next technological leap of pioneering leadership?

New technologies are rapidly adopted in industry.

If we want to move production from China to Europe, we need more production with fewer people, so the level of industrial automation must be increased. In a good future, Finnish industry rapidly adopts autonomous solutions that also make use of artificial intelligence and mobility.

Finland succeeds as a rapid adopter of new things.

With clean and inexpensive energy, Finland attracts large companies to locate their data centres and other operations in Finland. Finland finds a few niche areas where it is at the forefront of development — as an inventor and creator of something new. But Finland succeeds best by being a very fast adopter of new technologies and solutions. This is the best world, but it is also challenging, because competition is extremely intense. We would have to compete not only with Western companies, but also with Chinese, Indian, and all other companies.

¹⁷ "AI Factories are dynamic ecosystems that foster innovation, collaboration, and development in the field of AI. They bring together the necessary ingredients – computer power, data, and talent– to create cutting-edge generative AI models. They serve as hubs driving advancements in AI applications across various key domains, from health to energy, and from manufacturing to meteorology." (Source: <https://digital-strategy.ec.europa.eu/en/policies/ai-factories>)

Industrial investments exceed depreciation.

In a good future, companies invest boldly in the automation and autonomization of production. In a fully autonomous factory, labour costs are close to zero, so its largest costs are raw materials, energy, and logistics. In that case, the location of the factory is not of great importance.

Finland succeeds in renewing the value added of its industry.

We have had good times during which we should have considered what else we could do besides selling existing products and services and refining them. However, we have focused more on buying back our own shares than on future investments. Now that the economic situation is weaker and less money is available, strategic measures are too simplistic. In a good future, Finland succeeds in bringing together siloed elements and reorganizing them so that we achieve more with the same amount of money.

Finland has successful, high-productivity companies.

These companies can afford to hire high-value-added or high-productivity people to make high-quality products for competitive markets where customers are demanding and well-informed.

Finnish manufacturing industry knows how to make use of the opportunities brought by key technologies.

IoT, data transmission, and data processing have advanced in huge leaps in manufacturing industry. Even the promises of 5G are still partly unutilized, so there is certainly a great deal to do here.

Finland makes a competitiveness leap with 5G and 6G.

5G and 6G enable IoT, the Internet of Things, and machine-to-machine communication. Finland is at the forefront of development in at least some segments.

Finnish companies know how to make extensive use of data moving in 5G/6G networks and gain productivity growth from it.

In Finland, we demonstrate that by doing the right things in the right way in a 5G/6G environment, we can genuinely and broadly improve companies' productivity and respond to sustainability goals faster, more efficiently, and more extensively than before.

In Finland, strong, tested, and proven expertise and capabilities have been developed, enabling us to show the world how this can be done. Maximizing the carbon handprint and minimizing the carbon footprint are combined with improving actors' productivity across different industrial sectors.

Finland implements the EU's "Factories of the Future" vision.

This means intelligent process industry that uses fast internet connections, sensors and the data they produce, and analytics. The EU also has the "Zero-X Digital Manufacturing Initiative" — Zero Waste, Zero Defects, and Zero Breakdowns — as well as circular economy goals: Re-manufacturing, Re-purposing, Re-cycling, and Re-furbishing. Their aim is to create high-value-added companies in Europe with a solid sustainability framework.

A Finland of new Nokias

Startups support the growth of Finland's economy.

In Finland, innovative startups and research institutes that create new startups or spin-off companies are supported. Several “new Nokias” have emerged from them.

New startup activity emerges in Finland around key technologies.

Finland has top-level expertise in two key technologies: ultra-fast data transmission and ultra-efficient data processing. This is a unique opportunity for us. In a good future, startup activity emerges in Finland around these technologies and their combinations, producing several companies with a market value of more than one billion euros.

Finland has a strong global position in new key technologies.

Finland has maintained its strong position in wireless technology and is a pioneer in security, quantum technology, and the cyber world. We also have innovative satellite companies.

Finland is a leading country in mobile technology.

Finland is a leading country in mobile technology, and Nokia is a leading developer and pioneer of mobile technology. Finland is the world's most digital state, making highly advanced use of new technology, for example in service development.

The defence industry becomes Finland's new Nokia.

The defence industry includes all security technology, including the nine future key technologies identified by NATO. Of these, Finland has significant economic opportunities especially in three areas: next-generation telecommunications networks, space technology, and quantum technology. These will create a good future for us, and we must invest in them.

Nokia achieves a significant position in military communications.

The solutions offered by Nokia may be soldier-specific — for example, terminals produced in millions of units, generating billions of euros.

Finland develops into a leading developer and implementer of connectivity solutions needed by the defence sector.

The 5G/6G continuum has its own place, but taking Finland's geopolitical position into account, we should also ensure that we do not put all our eggs in the same 6G basket. For example, the U.S. Department of Defense has a Future G project¹⁸ that examines how public mobile networks can be made suitable for military use. The project seeks communications solutions that are based on common core technologies but provide functionalities and features that are not relevant in consumer use, such as interference and detectability. These include, for example, hiding the signal, identifying false base stations, and various device-to-device solutions.

New markets for dual-use technologies.

A Finland focused on resilience and defence technology.

Finland has a great deal of expertise in critical technologies, but the focus of their

¹⁸ For example <https://rt.cto.mil/futureg-home/>

application has been on the business side, with security-critical infrastructure as an example. Until recently, the use of dual-use technologies has not been considered very strongly from the perspective of securing resilience or on the security and military side. However, Finland has a growing number of defence-sector companies that can make use of such expertise in their own business. In addition, the United States has shown clear interest in Finnish expertise related to security and the geopolitical competition taking place in that field, where technology plays a major role.

Finland builds new pillars for itself from green energy and the productive use of data.

Growth can most easily be achieved from green energy because it is concrete and people understand it. Its value added is, however, fairly small, but through it we can attract data centres to Finland and learn to develop the technologies needed in this competition. A more significant opportunity would be if we were able to build special expertise in Finland around data and its productive use. At present, services account for about 70% of Finland's economy, and their productivity is poor. Fixing this is a major opportunity.

Clean energy.

Finland has succeeded in making the transition to clean energy and is able to offer clean energy for new creative industrial activity, for example through 5G/6G security applications.

Finland achieves a significant position in space communications.

Finland is proactive in space communications — that is, in how the space segment is connected to 5G/6G terminals. Expertise already exists at Bittium, and it would be good for Nokia to have it as well.

A united and determined Finland

Finland remains a highly united country.

Polarization, discord, and the division of society are among the worst threat scenarios for Finnish society, and if we avoid them, we have a good future ahead of us.

A change in mindset in Finland.

Finland used to be regarded as a technological pioneer, but now people are gloomy and say that Finland is a loser country that has had no growth for 17 years. In a good future, we find such broad-based success that it helps us rise out of this situation.

Finland creates its own future.

Finland has world-class capabilities in next-generation communications technologies, but what is now needed is a change in attitude and a winning mindset, like the Norwegians and Estonians have. Development work requires hundreds of millions of euros, but even more important is how it is implemented and what kinds of alliances we are able to create. The United States is one direction and NATO is another. Nokia should even consider forming alliances with Ericsson in some areas. We need to create new and attractive concepts and promise that such solutions will be available from us, say, in five years. In this way, we can reserve market space for ourselves.

Finland succeeds in defining a key role for itself in the “American model”.

In the American model, data and the data economy dominate the telecom network.

Through good bilateral relations, Finland has succeeded in creating a significant role for itself in this model, both as a country and through individual companies. This is not only preparation for a risk, but in any case also a significant part of the future.

A startup spirit in societal decision-making.

The basic principle of current politics — setting up a working group, reflecting on matters for a few years, and then making decisions — no longer works. In a good future, we have the courage to make decisions and advance them systematically. Sometimes they will be right and sometimes wrong.

Finland develops its economy systematically and with a long-term perspective.

Finland is the only EU country whose economy did not grow in 2019–2024, and this is because we have lacked the courage to make choices, meaning that change always happens through crises. When things are going well, people think that nothing needs to change. We also lack long-term thinking: decisions are always made one government term at a time, or in companies one strategy cycle at a time, and issues that have already been reviewed and decided are warmed up again. Sometimes it might be good to go back and look at everything that has already been tried, identify what has worked, and invest in those things instead of starting new ones.

Finnish companies take major steps toward a real-time economy.

Finland is able to attract more capital.

Finnish companies have clear growth visions.

A “national awakening” has taken place in Finland, and companies have the will to do things with a new level of ambition. Companies know how they want to grow and what their business needs mean. It is cheaper for companies to define their own future and needs themselves than to accept them as given from the outside and then carry out massive integrations and customizations in their IT systems.

Standardization as Finland’s strategic tool.

Finland has understood that, in the new geopolitical situation, standardization work is also carried out as a political game. Finland has also succeeded in reviving its standardization expertise.

A Finland of strong partnerships

Cooperation in Finland’s neighbouring regions works.

Risto E. J. Penttilä has proposed a new “Kalmar Union” to increase Nordic cooperation. Another direction would be that we succeed in shaping the European Union more toward supporting cooperation between Member States.

Finland has good bilateral relations with the United States.

Through NATO membership, Finland has succeeded in creating good bilateral relations with the United States. Finland has done the right things and made the right moves, and it is in a good position in discussions and deal-making, not only in telecommunications but also on the security side that is strongly linked to it.

Trade between Finland and the United States develops favourably.

Finland is able to maintain and develop trade with the United States, and no additional tariffs are introduced to complicate trade and development.

Bloc formation may also help Finnish industry.

A crisis situation and bloc formation may, in a certain way, also help Finnish companies, and Nokia in particular. Thanks to bloc formation, they can export their products to the United States and to other countries in their own bloc that are considered friendly.

A Finland of a successful Nokia

Nokia succeeds in the race for 5G and 6G networks.

When 6G goes out into the world in 2030, Finland is in the front row.

Finland's level of innovation and academic excellence is high, we understand the key technologies, and their exports are growing. Then we have succeeded.

Nokia succeeds in its own strategy.

It seems that Nokia has been seeking its own role and new growth opportunities also in matters related to dual-use technologies, security, and defence. Potential competitors at the same level as Nokia can be found in Sweden, South Korea, and China. Geopolitics further narrows down who is able to play in different markets. In that sense, it is extremely important that Nokia succeeds in the United States and in like-minded countries and markets in the same camp.

Nokia remains a Finnish company and continues to succeed.

In addition to a faster bit pipe, 6G has other new features as well, such as sensing. It would be good if strong, unique 6G network-related expertise emerged in Finland around Nokia, universities, and domestic telecom operators, and if domestic industry knew how to apply it.

The best future for Europe

Europe's future is Finland's future.

These two things cannot be separated from each other. In many ways, the issues crystallize around Europe's technological competences and its role in global markets. The development of competences is more EU-driven.

The EU remains united.

Finland and the EU reduce their dependencies on China and the United States.

From a geopolitical perspective, the EU should make choices similar to those made by the United States — that is, it should seek to bring industry to Europe. When industry is strengthened, dependencies decrease. Finland and Sweden have plenty of critical raw materials. Finland also has Arctic technological expertise. New future markets will emerge in these areas.

An economically strong Europe

The EU provides a strong home market.

The EU has a strong internal market and home base from which we can compete in global markets with global giants.

The European Union strengthens its role as an economic actor.

Europe strengthens its technological expertise and, through that, is also better able to sell its own value base to the world.

Europe becomes vibrant.

For Europe to become vibrant, it must acknowledge that the playing field has changed, identify its own strengths, and build success on them. By correcting weaknesses, Europe will never reach a leading role. For example, dreaming of a single market is about correcting weaknesses, and it will not make Europe any stronger than the United States, which has long had a large and unified internal market.

Europe as a technology leader

Europe acquires a strong position in key technologies.

In a good future, Europe manages to step up its game in key technologies, including chips, cloud, artificial intelligence and connectivity. In connectivity, Finland has a very important role.

Europe strengthens its role as a technology leader.

In the transition to 6G networks, European actors are technology leaders. In the 6G value chain, the role and presence of European actors in global markets is strong.

The EU becomes an innovation leader.

The EU's improved position also improves Finland's position.

The EU finds its place in different areas of high technology.

Europe is able to renew its ways of operating.

European actors, especially Nokia and Ericsson, remain highly significant developers of mobile network technology, and their role even grows. The centre of gravity in network development does not escape outside Europe. This development creates new opportunities for the broad field of expertise that draws on Nokia's history and for Finnish companies.

Large gaming-sector actors emerge in Europe.

At present, all the largest gaming-sector actors come from outside Europe. Europe is a content producer, but it does not get its own commission from the global consumer market; instead, Apple, Google, Tencent, and other major players take it. It would be good if large gaming-sector actors emerged in Finland or Europe that are close to end customers — consumers — in the value chain and can also act as distribution channels. A direct connection to consumers would enable many functions that are currently difficult because the route is too complicated. The key position is held by the actor through whom the money flows.

Europe successfully challenges current satellite operators.

The European IRIS² system¹⁹ is implemented and becomes a credible competitor to current satellite solutions, such as the American Starlink. Finland is a space technology country larger than its size would suggest, and it succeeds in making maximum use of its expertise.

A digital and secure Europe

Finland helps Europe strengthen its digital competitiveness.

It would genuinely be possible to build a broad whole here that offers solutions for strengthening the competitiveness and, above all, the security of Finland and Europe. Finland can act as a pioneer country, mobilizer, and facilitator in this matter. We are able to make use of all the business and cooperation opportunities we have around the world of digital communications. In addition, we have a commissioner responsible for these issues and competent people in many other institutions as well.

Europe becomes a pioneer in digital services.

GSM was originally built by CEPT, the association of European postal and telecommunications administrations. They had strong national positions, no mutual competition, trust in one another, and a shared dream of the eternal success of the postal service, on top of which they built a new telecommunications world. It was not a single market: each nation-state built its own networks, but the technology choices were common for reasons of cost and compatibility. Because borders between states were kept open only in a controlled way, interfaces and new concepts such as roaming were needed. This created a European-style federative system that other states could also join. Europe could now do the same in digital services: take all the new services that have not yet been digitalized — transport, healthcare, education, and so on — and organize them according to Europe's current systemic model on the basis of cooperation between nation-states. This list of opportunities is almost identical to how the AI Act defines high-risk services.

A European cooperation front for security of supply and security.

Finland begins to advance broad cooperation between European business and academia, linked to the broader security picture, defence, security of supply, and the development of transport systems. All of these are part of a resilient society, but their development requires a strong mobile network. In defence, dual use is the watchword of the day, and in this field too Finland has a very strong business sector that is already linked to the world, but perhaps not yet recognized to the extent it currently should be. This brings the whole of Finnish digital and mobile network expertise into this cooperation.

Europe is able to secure its own digital infrastructure.

Europe is able to secure its infrastructure and the related services against various security threats. In Europe, there is an understanding of where threats arise, how they are managed, and how they are mitigated locally and in global markets. Europe is also

¹⁹ For example https://defence-industry-space.ec.europa.eu/eu-space/iris2-secure-connectivity_en

able to respond to market changes and has the capacity to build new business on top of its own expertise.

The best future for the world

A stable, free, and secure world

There is peace in the world.

A return to the world of globalization.

China and the United States make a deal, and the division of technologies and markets either reverses or is not as sharp as it currently appears. There are fewer geopolitical disputes in the world.

A return from isolation to globalization.

Finland and other small countries do not benefit from isolation as much as they benefit from open markets and globalization.

Free markets without additional tariffs.

A safe and resilient world.

There are no major upheavals and the risks do not materialize.

A good future is built on the principles of trust and sustainability.

It is built on interoperability and open markets, with the Global South also involved. In the 1990s, Europe opened up the automotive industry market, was innovative, and developed ambitious emissions targets. Later, however, the idea emerged that car manufacturers could take control of the entire value chain, including customers. Domestic markets were protected in a protectionist way, but the world did not wait for Europe; it moved past it.

What is the concept of progress?

In the early 1900s people had a very positive view of technological progress. The world would be better, there wouldn't be war, there wouldn't be diseases. Something happened in the mid 20th century that changed people's views to be much gloomier. We had two global wars, nuclear weapons, and the Cold War. Today the leading cause of death globally is obesity and obesity related diseases, in other words, a disease of abundance unparalleled in human history. Is a good future that obesity is the leading cause of death in all countries in the world, but we worry about AI and climate change?

The countries of the “free world” cooperate.

In a good future, the countries of the “free world” that are interested in democracy and security decide to cooperate, and they win the competition in developing, commercializing, and sharing technology. Together with like-minded and secure partners, they are best able to support free competition and develop things that others can buy. Thanks to cooperation, they have a clear advantage over other geopolitical groups. Free competition is also the best possible future for Finnish industry, because then it is up to industry itself whether it succeeds or not.

The financing competitiveness of the “free world” is in good shape.

When financing competitiveness is in good shape, actors in the free world are also able to compete in other markets.

What would a perfect world look like?

Is it enough, if we have perfect access to all knowledge, amazing computing capabilities, but lack the political will to ensure a just distribution of the results?

Maintaining dynamism creates a good future.

Dynamism also makes it possible to acquire innovations from others and thereby helps renew companies' core business.

Relations between the leading countries ease

Relations between the leading countries ease.

Technology areas are so strongly linked to competition between the leading countries that if there were a significant turn toward détente and warmer relations, Finnish companies would have access to more markets and supply chains. In other words, globalization, which progressed well in the 1990s and early 2000s, would resume its progress.

Geopolitical tensions ease.

For example, in the EU, an open discussion on sovereignty and autonomy could reduce the likelihood of nightmare scenarios materializing if it makes clear that we are independent and cannot be made vulnerable. This is especially true if, at the same time, we state that we are improving preparedness and building our own defence capability.

Trump is unable to permanently break the institutional structure of the United States.

The geopolitical position of the United States is preserved, and the transatlantic alliance actually strengthens.

The United States remains a partner of the EU and Finland.

The biggest challenge is whether the United States is willing to cooperate with the EU and Finland. Without the United States, the future looks much more difficult. The big question is whether the United States is a friendly partner or the worst bully in the sandbox.

China's government becomes more liberal.

A very radical turn takes place in China, and its government becomes significantly more liberal. In a more radical alternative, there is a transfer of power in China and its communist regime crumbles.

China chooses stability.

The analysis of China's leadership is that China's interest lies in a stable and prosperous world in which China has its own role. The leadership has the courage to turn China toward a more open and more democratic society.

A positive turn takes place in Russia.

The Putinists fall from power and are replaced by a more Western-oriented bloc.

Russia loses in Ukraine.

This marks the beginning of the decline of authoritarian regimes and, at best, a domino effect that would raise the role of democracy and an open market economy in the world.

The situation in the Middle East stabilizes.

A broad, unified, and global 5G/6G market

A high-speed 5G network covering the whole world, which people and companies can make use of.

Globalization lifted 1.5 billion people out of poverty into the lower middle class, and connectivity will bring about the next great transformation. In India, for example, UPI — the Unified Payments Interface²⁰ — has been developed, enabling all people to be provided with a virtual identity document that they can use when dealing with banks or voting.

A broad, unified, and global 6G market.

There are plenty of interoperable devices and services from multiple suppliers, as well as plenty of use cases and customers who need new services and are willing to pay for them. Operators have a reason and the means to invest in new networks.

A world with a more balanced power structure.

In a good future some of the promises, ideas, and potential associated with developments in ICT are realized. For example, people have access to all information all the time, and they can manipulate the information in any way they want. There is also more balance between people, companies, and countries. But it is hard to see that future happening now.

A peaceful division of markets.

The very best outcome would be that tensions ease and we return to a global and open world. However, that is not very realistic, so we must find some intermediate form, such as a peaceful division of markets. We can adapt to that, and commercial advantages can also be found in it. Europe has nearly half a billion inhabitants, and if the democratic West is included, it forms a market that would be large enough for Europe and Finland as well.

The availability of critical semiconductor components remains good.

In the future, too, 5G/6G networks are secure and reliable at the infrastructure level.

There is one global standard for 6G, and Finland is involved in developing it.

Finland is a leading country in developing and deploying a globally winning standard and offering solutions for it. In its time, NMT was an excellent solution for Finland and the Nordic countries. It had one standard, and the Nordic market area was globally the largest in the world, so NMT became a leading and competitive market.

²⁰ For example <https://www.npci.org.in/what-we-do/upi/product-overview>

6G is implemented on the basis of an open and regulated standard.

Historically, it has been good for Finland that communications standards have been open and regulated. The 6G continuum represents this line in its purest form, and thanks to it, leadership in wireless communications remains in Finland.

Developing countries become new markets for 5G/6G.

The desire of developing countries to develop creates new markets for 5G/6G. Because of bloc formation, Huawei and other Chinese manufacturers, for example, may be forced out of these markets.

Frequencies in the 6–24 GHz range are allocated globally for 6G.

If there is any activity in those frequency bands that is not critical, it is cleared away. Sufficient 6G bands are reserved for aviation solutions.

6G becomes the backbone network of digitalization.

6G is able to provide massive connectivity: 10 million devices per square kilometre. Everything that runs on electricity is connected to the network. One new use case is, for example, real-time and comprehensive monitoring of the environment and its condition.

Interesting use cases are found for 6G.

Examples could include solutions for the defence industry and the energy sector, the digitalization of industry, and all kinds of digital automation, such as robots.

Good use cases are found for 5G/6G.

Thanks to good use cases, 5G and 6G gain more wind beneath their wings.

A breakthrough for 6G in security applications.

Finland achieves a breakthrough in security applications in close cooperation with Sweden and the United States. The Finnish defence industry renews itself and rises to a significant position in the Finnish industrial landscape.

Communication systems are modular and robust.

They are seamless, very reliable and self-correcting: if a cell doesn't work, we can make another cell do its work. Cheap, high capacity networks that are more dynamic than today. You can change a critical base station quickly and easily. Application security is built into the network. Application layer is very safe against attacks, so it's secure also for application developers. Capacity allocation is very dynamic: you get capacity from those networks that are available where you are. It enables flexibility, takes away inefficiencies and makes it possible to design solutions in different ways.

5G and 6G enable various industrial applications.

Thanks to connectivity, we are able to operate ports, hospitals, and roads more cheaply, more efficiently, and more environmentally friendly than ever before. Finnish companies, including Nokia and Kalmar, have been involved in building a 5G network in the Port of Los Angeles that is used to operate the entire port²¹. Straddle carriers operate

²¹ For example <https://www.private5g.com/factory-like-automation-in-ports-with-private-cellular-networks-shifting-from-chaos-to-orderly-workflows/>

without drivers, and truck waiting times have decreased from six hours to a few tens of minutes.

There is more AI.

We have more AI around us, in the infrastructure and in the systems that we rely on, like in cars and in traffic systems. AI works for us and help us. It is cheap and available when we need it. 6G infrastructure supports a wide variety of things that connect through it. Information flows freely without patches and translations. 6G integrates and connects things like secure identity for people, companies and things. System is safe, multi-functional, and flexible.

Sustainable development

The energy efficiency of digital solutions has been significantly improved.

Artificial intelligence, especially generative AI, high-performance computing, and quantum computing play a central role in future digital solutions, and today they consume enormous amounts of energy. Their use also highlights the need for fast telecommunications connections. As a result of development work, a reliable and energy-efficient digital infrastructure has been created.

We have tackled climate change.

Sustainability in energy consumption.

The future of mobile communications, combined with cloud, edge and AI, consumes a lot of resources: energy, water, land, etc. and the growth seems to be exponential. In a good future this issue has been tackled. For example, recently China announced that its Deepseek AI is far less resource intensive than the earlier systems from America. So, teaching AI does not require billions of euros, there's a smarter way.

What is the worst future for Finland, Europe, and the world?

The worst future for Finland

Finland ends up in a war

Russia attacks Finland.

Finland declines

Finland becomes a declining nation.

No new growth can be created in Finland. As a result of significant brain drain, Finland's expertise withers, its vitality is depleted, and the country's official language is changed to English. The smart people leave, and all that remains is a nature reserve where casinos can perhaps one day be established, following the Las Vegas model. The remaining inhabitants are lifestyle Indians living throughout the forests. Finland becomes strongly divided into one to three growth centres and the rest of the country. Income transfers are not a sustainable way to operate in such a situation; the system collapses.

Withdrawal.

Finland turns inward.

Finland does not believe in itself or in its opportunities. The conditions for business are flattened through national and EU-level legislation that does not promote renewal and moving forward.

The continued withering of the Finnish economy.

Finland has not had proper growth for a couple of decades, capital has been consumed, and cuts are being made in the economy. As the economy withers, Finland becomes a subsidiary economy, where the remaining crown jewels and natural monopolies, such as electricity grids and water utilities, are sold off when there is nothing else left to sell.

Finland is no longer an attractive operating environment for companies.

Finland does not have enough of the expertise needed by industry, nor the willingness and understanding to support industrial activity. International companies put countries out to tender when looking for locations, and operations increasingly move outside Finland, for example to the United States. Within the EU, there is fierce and unhealthy competition over state-provided corporate subsidies, and Finland does not do well in that either.

The value-chain position of Finnish actors deteriorates.

For the gaming industry, the worst future means that Finnish actors become subcontractors to American, Chinese, or Asian companies. Finland does not create its own IP or creative content.

Finnish companies are forced to compete using a cost-efficiency model.

Finnish companies do not gain access to high-value-added activities, so they slide toward a cost-efficiency model. They will lose that game to Asian competitors.

Finland does not invest in expertise and innovation**Wrong choices in education and research.**

Education does not invest in expertise that creates a new future. Instead, investments are put into things that merely project the present situation into the future — or, in the worst case, project history into the future.

Finland does not understand the true significance of natural resources.**Finland is unable to maintain expertise.****Loss of talent.**

Finland withers as experts leave for the world and do not return, because they want to be where things are happening. The 6G standards are created somewhere else, and Finland is not involved.

The Finnish government starts driving major cuts in public RDI funding.

Such cuts quickly lead to Finland losing its competitiveness.

Finland fails in managing innovation.

Roughly speaking, a company can be managed either by cutting costs or by taking risks and investing in innovation. In a bad future, not enough innovation emerges in Finland that can be refined into new business.

Research funding fails.

For example, the 6G Flagship programme, which currently has funding until 2026, does not receive further funding. No new research results emerge, and no new spin-offs are created. Finland becomes dependent on technologies from other countries, because China and the United States will not wait for Finland. Innovation declines in Finland, jobs are lost, and the economic situation weakens. Finland becomes more exposed to all kinds of vulnerabilities.

Finland and Europe do not act in a united way.

Turning inward, inside one's own borders and one's own ideas, is the worst possible option. Suspicion continues, and everyone thinks in mercantilist terms: "I must have more chips than you." There is much talk about the United States isolating itself from the rest of the world during Trump's term and doing things differently than before. However, that does not mean that everyone else must follow the same model and think only from their own perspective. Finland cannot afford such behaviour; we must continue cooperation and remain on an open path.

Finnish companies do not get involved in EDF projects.

On the military side, the EDF²² is the first phase of joint European procurement. Its

²² EDF = European Defence Fund, for example https://defence-industry-space.ec.europa.eu/eu-defence-industry/european-defence-fund-edf-official-webpage-european-commission_en

projects develop Europe-wide defence technology solutions. The work usually begins with a research project, followed by a development project and possibly a follow-up project. The project and consortium are in the same pipeline, meaning that the winner or winners are selected at a very early stage. If Finnish companies are not part of the winning consortium from the beginning, they will not be able to join later with any contribution. The EDF will launch 5G/6G-related projects, and it would be important for Finnish companies to be involved in them. This requires support and ownership from the defence administration, the Ministry of Economic Affairs and Employment, and other ministries.

Innovative companies are sold abroad too early.

Large companies are not able to form in Finland, because all good and innovative technology companies, such as Silo AI and Wolt, are sold abroad too early.

Startups do not grow from Finland into global markets.

In Finland, the startup business model is to establish a company, sell it, receive a few tens of millions, and live well. Startups are a good way to create innovation, but refining innovation into products for global markets requires a great deal of money and resources. DeepSeek shows, however, that conquering the world is possible with fewer resources as well, if there is enough enthusiasm and brilliance.

Finland is passive

Finland does not act proactively.

The worst future is one in which we simply wait to see what happens.

Companies delay their digitalization decisions.

Industrial digitalization does not advance, because companies are not yet forced to digitalize their operations. Investors are not interested in digitalization, and public funding is not available for it. The international owners of Finnish companies do not invest in digitalization and digital factories in Finland, but somewhere else. Company management is not interested either, so not enough investment is made in digitalization, and business as usual continues. Research has shown that this is also a consequence of the scarcity of digitalization expertise among corporate management.

Finnish companies do not have a clear growth vision or a sufficiently high level of ambition.

Companies delay decisions on adopting and utilizing new technology for too long and do not set targets with a sufficiently high level of ambition. They do not have a clear growth vision of what they want to do, for example, in 10 years' time, and what they must do now so that they can then be competitive and profitable and succeed against competitors coming from outside.

Finland does not dare to invest enough in the right things.

We do not dare to make decisions, and we do not dare to renew ourselves enough and thereby develop people's expertise. The world is currently changing very rapidly, especially ways of working, technology, and the security situation. A bad future comes from staying where we are and not being ready to renew ourselves.

Industry does not dare to invest enough.

Not investing, but saving, is a strategic decision — but then the future is dark and deterioration continues. And if the investment rate is increased only slightly, for example so that it covers industrial depreciation, that will not produce any very radical change either. In that case, we will not be able to make use of the opportunities we have and will settle for the role of follower.

6G does not lift Finland off the ground**No global standard and market emerge for 6G.**

The more local or regional standards there are, the more expensive network and user equipment becomes in relation to their volume and use. It might be enough for Finland to be part of a bloc that covers half the world, but it would be very bad for Nokia if it could not sell its products to the other bloc. The divergence of hardware and software markets from each other would also be a bad thing.

6G talent and patents are taken abroad, above all to the United States.

Finnish expertise and IPR do not end up in Finnish companies or companies operating in Finland, but leave the country to where the capital is. Because of brain drain, no cross-pollination between key technologies emerges in Finland, and the development of expertise remains dependent on public funding. Expertise becomes siloed in universities and higher education institutions, and the actual business benefit is captured by foreign actors. The air bridge between Finland and the United States is already quite strong in 6G. Americans are interested in 6G and see it as part of national security.

The EU and Finland fall behind in 5G/6G and in the use of data.

Productivity growth remains weak.

Initial trust in 6G is lost.

For end-users 6G is more or less like 4G or 5G, but with higher throughput. We start trusting it, but it turns out to be an extremely efficient intelligence governing system, which others use for their own purposes, either by design or by breaking in. The users have to decide, whether they abandon the system or restrict how they use it. So, initial trust, but then turns out it wasn't actually secure.

The network equipment market closes.

The United States and China decide that they want to make all critical parts of the network themselves. Both countries begin pressuring small countries to move their operations inside their own borders. For a national economy and industry like Finland's, such a situation is almost impossible unless Europe can respond to it in some way.

The importance of network technology declines because of AI.

AI is controlled by the United States and China, so Finnish companies can at best become small suppliers whose margins are defined elsewhere and that have no significance on the international playing field.

Finland without Nokia

Nokia gives up its mobile network business.

In addition to tax revenues, Finland would lose critical expertise, because over time the R&D operations located in Finland and their centre of gravity would probably be moved somewhere else. This would also be a loss for the country's image, because Nokia is a truly significant standard-bearer for technology leadership in Finland.

Nokia does not continue in this business.

If the 6G network business is not interesting and profitable enough for Nokia, Nokia also cannot serve as the locomotive for related projects in Finland.

Nokia is sold abroad.

The negative spiral is not broken.

Nokia is sold off, and nothing comes in its place.

Nokia's research and development move out of Finland. No special 6G expertise emerges in Finland, and even the existing expertise slowly withers into insignificance.

The worst future for Europe

Europe withers

The EU breaks apart.

This may happen technologically, but it may also happen geopolitically if a serious dispute or trade war emerges between Europe and the United States.

Europe moves from one dependency relationship to another.

In Europe, people think that dependence on someone else is a better solution than building one's own future and implementing one's own playbook. This would be the mother of all crash landings.

Europe is not active.

Europe does not understand the change in the world, does not seize opportunities, and is unable to respond to market challenges. Europe remains waiting for the good old days to return so that we can once again operate freely in all directions.

Finland and the EU are unable to support and attract growth companies.

Growing and scalable companies move their operations to countries that offer them the right kind of support for growing their business.

Europe is unable to make even reasonable use of data because of overregulation.

One important area is consumers' rights to public services and the data collected from them. Telecommunications networks collect enormous amounts of information about every user: movement, calls, messages, and so on. How and on what terms can consumers obtain this data that belongs to them? The Digital Markets Act requires that this should be the case, but do telecom operators act accordingly? Another area is data collected on employee performance. Strictly interpreted, this is misuse of the employee's personal data, but it could also be used for their benefit. Good performance could be

grounds for a pay rise or bonus. On the basis of such data, employees could also be offered targeted training or services related to health and wellbeing at work. There are also numerous examples in areas such as transport, environmental sustainability, and so on.

Europe loses its position in telecommunications

Europe loses ground.

Europe has lost the race on key technologies, including mobile connectivity, to both the U.S. and China. The winners collect the pieces and build even stronger positions on the European market: Asian players in mobile connectivity and American players in cloud and in AI.

The European telecommunications sector becomes marginalized.

In telecommunications, Europe and Finland currently have globally significant expertise, technology leadership, and competitiveness. In a bad future, Europe loses its leading position.

European network equipment suppliers disappear from the market.

The EU does not provide enough support to Ericsson and Nokia, so they either discontinue their radio network businesses or move their headquarters to the United States. After that, there is no European alternative in the market.

The EU introduces a binding 6G Toolbox for Member States that is not in Finland's interests.

The EU's 5G Toolbox contains a great deal of room for manoeuvre, which Finland, among others, has made use of. If the EU decides to build a 6G Toolbox, it will probably be quite similar to the 5G Toolbox. It was made on companies' terms, and their interests are the same as before. But the 6G Toolbox could also contain binding regulation that is not in the interests of Finland or Nokia. If Finland were to block Chinese manufacturers from the 6G market, as Sweden and Estonia have done, China could close the Chinese market to Nokia.

Europe does not sufficiently safeguard the position of standard-essential patents related to 6G.

The EU's recent *Digital Networks Act* White Paper states that protection for standard-essential patents may not need to be as strict in the future as it is now. If this happens, Europe's — meaning Finnish and Swedish — crown jewels may be taken for the global common good. In practice, however, the benefits derived from them would be captured by Chinese and American actors, not European ones.

The worst future for the world

We are already in the bad future.

We have failed in a couple ways. In the developed countries we have broken the social contract by creating immense wealth for a new nobility while distributing it very badly in most places. We also have authoritarian leaders, who have territorial ambitions and who act on them, meaning more wars.

Lack of universally accepted facts.

We are on a path towards a very dark future, where no truths or facts exist. Without universally accepted facts it will be very hard for us to address global problems, like peace, global conflicts, and climate change.

Market bloc formation**Decoupling.**

In geopolitics, the principle of openness and democratic ways of operating are abandoned.

Strong polarization of markets.

Two or three blocs emerge in the world, with a strong “either-or” situation between them. Such a situation impoverishes everyone and endangers the functionality of devices across blocs.

Market fragmentation, for example in standardization, would be bad for all actors and sectors.

Traditional standardization models no longer work, and competing schools of thought and standards begin to emerge in the market. Ultimately, all industrial sectors suffer from this.

Market bloc formation.

Since the 1990s, Finland has cooperated with everyone and in all directions. In a bloc-based world, this may become a burden. For Finns, bloc formation is a bad thing, because we then have to choose sides. For example, Finland’s accession to NATO was a clear choice cutting across the whole of society. Finland is no longer neutral in any sense, and this is seen by many foreign actors either as a positive or a negative thing.

Bloc formation.

Geopolitical forces drive regions apart. Supply chains break. Companies have difficulties obtaining the components and services they want, and they start producing the things they need themselves.

An isolated and siloed world.

We create individual subsets of communication systems around the world.

U.S.- and China-led bloc-based technology development.

In a bloc-based world situation, Finnish industry has fewer export opportunities.

Protectionism.

“America First” thinking in equipment and system procurements goes too far.

What helps 5G/6G actors is that the United States does not have a single domestic telecommunications equipment manufacturer.

Large actors dominate markets.

They dictate the terms that subcontractors must follow, because there are no other buyers. A similar situation has existed, for example, in furniture: a subcontractor may have supplied Ikea with a hundred thousand chairs, but if Ikea does not place a follow-up order, it is difficult for the company to get orders from others.

Individual companies and individuals gain a significant role as owners of telecommunications infrastructure.

For example, the Starlink service of Elon Musk's companies challenges telecommunications operators and tries to steer critical traffic away from operators and into infrastructure owned by Musk.

The China threat

China becomes the technology leader in telecommunications.

European companies lose their competitiveness. Even European actors prefer to work with Chinese suppliers rather than European ones.

China has an even greater role in the European economy.

Actors who advocate rapprochement with China rather than North America rise to power in Europe. Chinese technology plays a significant role in Europe's technology choices.

China succeeds in achieving a breakthrough in quantum technology.

With the help of the new technology, China gains supremacy because it is able to break all passwords and encryption.

A world of wars

Geopolitical risks materialize.

All vulnerabilities materialize, systems have to be renewed, and this causes major costs and disruptions to supply chains. There is arm-wrestling and disagreement over interpretations among Western countries. Finland's competitiveness suffers, and key companies are in difficulty.

The realization of some unexpected or surprising culmination point.

If, for example, the Taiwan crisis were to escalate and semiconductors were no longer available, the result would be a global crisis and recession from which no one could escape. People and states do, however, think rationally, so they understand that everyone would lose, which hopefully reduces the likelihood of such crises materializing. Telecommunications is a shared interest, so no one should do anything foolish to it — and yet ships sail around the Baltic Sea and the China Sea dragging anchors behind them.

Geopolitical tensions escalate into open conflict.

The worst option is that tensions between the United States and China, or between Russia and Europe, escalate into open conflict and the world shifts to a war economy. This option cannot be ruled out, considering what Russia has recently done in its neighbouring regions and how China has strengthened its own sphere of influence, especially around Taiwan and in the South China Sea. An incident there could drive the United States into conflict with China.

A world of wars.

In the worst future, cutting-edge technology is harnessed for military use. Since the 20th century, the defence industry has been a world of long and expensive procurement

processes with a great deal of politics involved. In the war in Ukraine, drones and other off-the-shelf technologies have changed this world. Previously, acquiring a new weapons system was a five-year process in which the Pentagon put major defence-industry companies out to tender. Now technology companies ask the Pentagon what they would like to get this week. And when the Pentagon replies that a new air-defence system would be nice, they answer: “Coming up — you’ll have it in three months.”

Wars in Finland’s neighbourhood or in the Taiwan Strait.

Wars may cause an investment recession for products other than those of the defence industry. For companies that make investment goods, such as telecommunications networks, a halt in investment would be a very bad thing.

The Third World War.

It has also been said that war is a very good time for technology, because a great deal of innovation is needed then. Things are developed for the defence industry that later move into civilian use.

A conflict that directly affects Finland or the EU.

A Russian armed attack, a war between China and Taiwan, or a trade war between the United States and the EU would in practice be reflected across the entire world. Even the strengthening of the above-mentioned tensions would be enough to make things difficult, especially if the EU fails to renew itself and improve its economic and technological competitiveness.

The war between Russia and Ukraine is prolonged and expands.

Russia wins and Ukraine loses.

This would also be China’s wish. In its proposal for a world order, China has brought forward a security architecture in which Europe belongs to Russia’s security sphere of influence. China is not trying to influence Putin so that the war would end in a way favourable to Ukraine. Russia becoming stronger with China’s help and support would also be a bad future for Finland.

Ukraine loses and Taiwan is forcibly annexed by China.

If both of these scenarios materialize, the future will be truly bleak.

Full-scale war.

This would of course be the worst possible future. In that case, the focus would be solely on the defence industry and other industries that support survival. It would then be pointless to think, for example, that many elevators would be sold to China. On the other hand, telecommunications networks are needed there as well to maintain society’s ability to function, so this would not necessarily be the end for 5G/6G, even if organizing business could be difficult.

China attacks Taiwan.

As a result of the attack, global semiconductor production is severely disrupted. One possible time is in 2029, when the administration changes in the United States at the end of Trump’s presidential term and a momentary power vacuum emerges before the next administration takes office. China has already built and tested floating ports that allow it to move troops and equipment quickly to Taiwan. We now have four years to prepare.

Technology risks materialize

Technology hostility.

No common interoperability platform emerges.

Instead, monopolies and de facto standards emerge that are controlled by some company. The same situation arises as now exists on the platform side and in social media: someone dictates the technology, content, and prices, and others are left only with the role of subcontractor. Some parts of such solutions can be developed and manufactured in Finland, but the terms and rules of the game come from elsewhere. New solutions that do not directly serve the interests of the monopoly cannot enter the market. In an anti-ecosystemic supply chain and operating environment, the benefits of diversity are lost.

Key technologies and platforms are not unified.

There are no common worldwide, common single solutions. For example, there are two or three solutions for 6G: one driven by the United States, perhaps with Europe, and another one driven by China. There are also several separate universes for AI and the cloud.

Quantum computing and AI challenge the security of telecommunications.

Quantum computers, quantum computing, and AI bring many good things with them, but on the other hand they can also be used to break telecommunications encryption almost in real time. This may lead to new types of telecommunications solutions, such as increased use of optical fibres and the development of quantum-safe encryption technologies.

Satellite networks replace mobile networks.

From the perspective of mobile operators, it would be a bad thing if satellite technology replaced mobile technology in its current form.

AI is used in advertising.

The risk with AI is that it becomes another annoying advertising channel and a way to sell more advertising that affects us more effectively, because AI knows us better than we know ourselves.

Recurrent attacks against networks and data.

The situation becomes so bad that people no longer trust the technology, except in separate islands of trust.

Security concerns have not been solved.

The energy consumption of digitalization is not brought under control.

The key tools of digitalization — AI, especially the use of generative AI, quantum computing, high-performance computing, and fast telecommunications connections — consume a great deal of energy. Sufficient attention must be paid to reducing their power consumption.

What important decisions should be made?

We have to approach the decisions from different angles.

The first angle would be what is best for Finland. The second would be what is best for Finland within the European Community. The third would be what is best for the European Community, or for like-minded nations that respect rights. And the fourth would be what is best for the global population. There is some overlap, but the tactics and the policies will be different. There are also interdependencies between the levels. We need to think both Finland as its own and Finland as a member of larger communities.

Finland

Focus, focus, focus

Finland must choose the battles it enters.

Finland cannot be the best in the world in every technology area, so we must choose where we want to succeed and then invest in education, research, innovation, and patents. Good candidates include next-generation telecommunications networks, quantum technology, and space technology.

Finland must decide its own priorities and invest in them.

Finland must make use of its strengths, make strategic choices, and adapt to the dynamics of global competition. We must have priorities and objectives, and sufficient resources to achieve them either alone or with partners. If resources cannot be found for something, then it is not a priority after all.

In which sectors does Finland have the best chances of success?

We cannot do everything, so we must choose what to focus on. Which sectors are based on high value added or long-term RDI investments and could bring more wellbeing to Finland? Denmark, for example, has systematically invested in the pharmaceutical industry and is now benefiting from the success of companies in that sector. In data transmission, Finland already has a fairly good position.

An overall strategy for key technologies

Finland needs an overall strategy for new technologies.

In Finland, separate groups are studying mobile technology, artificial intelligence, quantum computing, and semiconductors, but the conclusions of these groups are not brought together into a single high-level view of what the impact of these technologies could be on Finland and its economy. On the basis of the strategy, development and funding would then be steered in the right direction. However, the strategy must not be

top-down command policy. It must be flexible enough to be changed on the basis of examples, experiments, experience, comments, and feedback.

Finland needs a playbook for key technologies.

In Finland, things are being done at the same time with both too broad and too narrow a brush. We have an industrial policy strategy that covers all possible businesses and sectors, and we have a quantum strategy that focuses on only one key technology. Finland should prepare a strategy for key technologies and harness the resources of Business Finland, Finnish Industry Investment, and private equity investors to support it. Capital should be used as efficiently as possible to develop deep tech and key technologies and the business emerging around them.

Finland must have a clear strategy for maintaining competitiveness.

Investing in competitiveness and innovation is the way countries such as Korea operate.

Technology policy must be moved to the centre.

Finland needs new investments in critical sectors that bring industry and jobs to Finland. Critical areas include technologies, minerals, mining, and Arctic expertise. These new technology areas will also become export markets.

How Finland invests in critical technology sectors.

Finland should invest even more strongly in the development, innovation, and availability of talent in critical technology sectors. These areas generate economic benefits and spillover effects for security-related areas. Finland must also make bolder choices than at present in R&D investments, education investments, and attracting skilled foreign labour.

How Finland makes use of its central role in critical technology areas in Europe.

Finland clearly has a role larger than its size in critical technology areas in Europe. In connectivity, Finland is a European and even global pioneer. Through this, Finland can influence European technology policy, innovation policy, and security-related measures.

Less jumping after trends.

In Finland, people often think that startups will first solve all the world's problems and then also Finland's economic problems. Good ideas and perspectives come from the startup side, but not all companies can operate like startups.

How can Finland ensure that strategies are also implemented in practice?

Many kinds of strategies are drawn up in Finland, but their implementation often remains halfway.

Societal consensus

Finland needs societal consensus.

At present, there is no political consensus in Finland on the direction in which we should go. Finland needs deregulation, a functioning immigration policy, and favourable legislation and taxation. A significant share of large companies see these measures as helping international competitiveness more than any support packages or tax relief.

How can Finland create a “Winter War spirit” in the discussion between companies and employee organizations?

Finland needs a new forum where companies and employee organizations — not politicians — can discuss, for example, how people and robots can work together, and then start taking that forward in the right way. In bilateral discussions, both sides largely agree on the issue, but this is not reflected in the public debate; instead, the debate mainly emphasizes oppositions. Can we bring about such a change without external pressure?

Companies must commit to Finland and to creating Finnish wellbeing.

Companies must see themselves as part of the Finnish ecosystem and not only look at the figures below the line. They must understand that the geopolitical playing field has changed and that this affects their own value chains. What are the most critical parts of the value chains? How should their procurement be diversified?

Reviving the spirit of collective effort.

Finland must pull itself together, because we cannot keep putting ourselves further into debt. Now people talk about “if there were money”. There is always only a certain amount of money, but it would be more important to think about what it is used for and then allocate that scarcity. Have we forgotten how things used to be done through collective effort? When times get tougher, that spirit is needed more.

Partnerships and networks

Finland must choose its strategic partners.

The world is increasingly built on cooperation. How do we find and choose like-minded international partners who operate on the basis of the same values and with whom we develop solutions together? They may be technology companies or states.

How Finland builds bilateral relations with key allies.

Finland must make its own choices in relation to third countries outside the EU, meaning that it must build bilateral relations with key allies. Good initiatives have already been taken with the United States along the connectivity axis, the quantum axis, and in icebreakers. Finland needs these relations for economic and security reasons, because they anchor us more firmly in the security structure that we have been building in recent years.

Finland must build a network of trusted partners.

Finland must do everything it can to keep its trusted partners and work together with them. Companies, too, must seek to build partnerships and internationalize more strongly, even though this is not always easy.

Forming partnerships.

Finland should now be clever and agile in forming partnerships and look at how Finnish expertise benefits allies.

Where can new cooperation partners be found?

Finnish industry needs new cooperation partners for research, development, and production chains. Our traditional partners, above all China and Russia, have closed or

are closing. Companies have already found America, but there one must know the right states and actors. Other opportunities exist in India and the Middle East.

Finnish companies must become more active in applying for EU projects.

The more technology-oriented the EU is, the more useful it is for Finland and for European technology, which risks falling badly behind the United States in software and China in hardware. The project funding Finland receives from the EU must rise to an entirely different level from where it is now.

Better use of EDF funding.

Finland should apply for and receive more EDF funding. EDF funding cycles are long, but if one is involved in several projects, decisions on some of them will come out earlier. This also provides expertise and visibility at EU level.

What kinds of bilateral cooperation initiatives will Finland make toward Trump's United States?

The change of power in the United States also creates opportunities for Finland, because Trump is, as an actor, specifically a dealmaker. With the Biden administration, things have been civilized and possible, but they have always involved restrictions. The EU is currently not a particularly good reference group in the United States, so everyone is considering what kinds of bilateral initiatives they should make toward Trump. Finland's advantage is that we are a small and harmless NATO ally with strong expertise in disruptive and dual-use technologies — 6G, quantum, AI, cybersecurity, and so on. Nor are we a direct or serious economic competitor to the United States. The scale of the initiatives must be sufficient, at least EUR or USD 100 million, so that they gain enough visibility in the United States. Finland must play the bilateral game in such a way that Trump feels he is getting something through it that he could not otherwise achieve. First Trump's interest, then the interest of Trump's supporters, and then the interest of the United States. In precisely that order. And other countries will play exactly the same bilateral game. If we stay and wait, the Swedes will certainly show us how this game is played. They are extremely good at it, and I would be very surprised if they were not already very far along.

Companies need to network more.

The modern world operates through networks, so companies must invest in building contacts and be active members present where discussions are taking place. Not everything can be handled through Teams, webinars, and virtual meetings. Trust is built by getting to know people and talking with them. Through this, people learn things and understand what the best are doing and how they operate. Investment must be made in cooperation and learning. The best and busiest people must be involved, not only those who have time.

Finnish companies need to network more.

Companies must join the innovation and business ecosystems of leading national or international companies. From there, they gain a great deal of useful information and contacts and learn from other members of the ecosystem. This lowers the threshold for success in the future. The best advance information does not come from consultants. It comes from universities, higher education institutions, deep tech companies, and major end customers. This is like group work at school: if you are in the same group as the best

in the class, you cannot fail badly. The best information is free, if only you know whom to ask. Networks are key to this.

How Finnish defence industry approaches EU markets.

European protectionism is difficult; France and Italy in particular are difficult markets for Finnish companies. Germany is something of a mental ally for us, so things work a little more easily with them. Finnish companies must ally themselves with the major prime contractors in the defence sector — Lockheed Martin, Airbus, Thales, Leonardo, and so on — and prove to them the value of Finnish technology and expertise. Finland is not a threat but an opportunity. In practice, this might start with producing specialized solutions, with the prime contractors handling integration into military solutions.

How Finnish defence industry allies itself toward the United States.

Finland has had a traditional defence industry, but now many new actors are beginning to enter this playing field. In the 5G/6G area, we only have Bittium, and Nokia may enter through dual-use technologies. Finnish companies should gain access to international markets quickly in all important subareas. The U.S. defence administration makes many procurements, so we need good cooperation arrangements in that direction and with American companies. To be on the safe side, Finnish companies should have subsidiaries in the United States.

Developing competence and understanding

Ensuring sufficient competence.

It is important for Finland to ensure that all companies, from the smallest workshops to large corporations, have a sufficient understanding at different levels not only of the opportunities offered by 5G/6G but also of security-related issues and of how data and connectivity can be utilized. This applies to companies beyond the telecommunications sector as well. Large companies are important because they pull smaller companies along with them by setting requirements for them and teaching them the right kinds of operating models.

Finland must ensure the availability of highly educated labour.

So far, Finnish industry has been able to acquire educated labour, but the government's recent measures have not increased Finland's attractiveness in the eyes of foreign workers.

Directing long-term funding to research.

If there is no money, then we also do not have people who invest their effort in research.

How should R&D support be allocated in Finland so that it produces the greatest benefit?

R&D support is useful, because it has been proven to increase companies' own investments and thereby innovation. On the other hand, it is also clear that over the past 10 years, it has not been allocated optimally from the perspective of growth. Finland is increasing public funding for R&D activities. Now understanding should also be increased regarding how support should be allocated so that it produces the greatest possible economic benefit.

How are RDI investments decided in Finland and the EU?

The state cannot decide sectoral choices alone; some wise method must be found for this. Different committees are not market-driven, because they are not responsible for selling the results. Choices and decisions must be based on information and assessments. We also need a parliamentary RDI consensus that investments and development work will continue even when governments change.

How can we ensure that Finnish 6G research is genuinely top-level research?

The topic alone does not make 5G/6G research top-level research. Universities should conduct research that industry does not do — for example, looking 2–3 years ahead. Finished results and technologies should be transferred to a company that commercializes them.

How can we ensure that Finland is a good place to conduct 6G RDI work?

Is the Finnish state prepared to invest sufficiently in 6G research and product development? For example, in the microelectronics IPCEI project²³, the German state budget was significantly larger per capita than Finland's.

Strengthening cooperation between companies and researchers.

Nokia originally emerged from an ecosystem of companies and academic actors in which everyone pulled together. Over the years, we have become each other's competitors, as everyone has had to survive.

Increasing customer understanding.

Machine manufacturers should talk and experiment with their customers and gather understanding of how customers use their machines.

Raising the level of ambition

We must not be too satisfied with ourselves.

Satisfaction kills innovation and prevents a realistic assessment of the situation.

The level of ambition must be set higher.

There may be many reasons for a low level of ambition, such as poor availability of capital or the national character: because we have not succeeded before, we will not succeed now either. Finland may have the world's most satisfied people because we settle for what we have. But that is not the way to move forward.

Finland must have the courage to look beyond its own borders.

Finland has top-class expertise and solutions, so we should not be too modest. Finnish innovation and expertise must be taken boldly to the world.

Finland must renew its economy.

Finland needs competences related to expertise, technology, and 21st-century industry.

²³ IPCEI = Important Project of Common European Interest, for example "IPCEI for microelectronics", <https://www.ipcei-me.eu/>

Finland must move from preserving subsidies to renewing and bold RDI investments, attracting international expertise, and creating areas of competence.

Finnish industry must be bolder.

Companies must dare to invest, they must be attractive options for foreign labour, and they must be able to make bolder decisions in order to move forward. Pioneers generate results below the line. The EU has a very important role in this.

Companies must think about disruptive business models.

A company cannot rely on customers continuing to buy its current products with its current business model in the future. Technological development and business model development must be monitored and studied 3–10 years in advance. Disrupting current business with new alternatives can be difficult. Often, new ideas are not allowed to grow enough for them to be validated and for their business potential to be properly assessed. The world is changing, and companies should be part of that change — and prepare for it in advance.

Joining joint experiments.

Companies should start experimenting with different models of working together, such as data sharing and the adoption of AI, for example with a supply network or value network. Even if no very dramatic improvement occurs, companies that quickly make use of new tools gain a major advantage over slower companies. Move quickly and place sufficient emphasis on continuous training!

Improving public-sector productivity through digitalization.

In Finland, areas such as health and social services must be boldly renewed through digitalization and AI. AI should be introduced to make doctors' work easier. Ultimately, this is a productivity game and depends on how much we dare, are able, and know how to make use of technology.

Finns must want to internationalize.

It is not enough for us to develop new things domestically. Finland is such a small market that companies seeking growth must go abroad. Almost all Finnish companies operating in the United States say that they should have gone to the United States earlier. Students must be encouraged to go on exchange to foreign universities. Finnish universities have excellent networks with top international universities.

Can Finland create an operating environment in which good business ideas and startups can grow and succeed?

Finland has strong innovation actors, such as universities and VTT, and the distributors of public innovation funding — Business Finland and the Academy of Finland — have good priority areas. However, in Finland it often happens that when business activity gets started around a good idea, a foreign investor comes and buys the early-stage company. From Finland's perspective, it would be better for new innovation companies to be taken forward with Finnish money. Investors and owners should have the patience to grow a company large and sustainable enough for it to build a broader ecosystem around itself.

Leveraging strengths

Where will Finland find the innovations that put it on a growth path?

The right solution is not necessarily to pour enormous amounts of money into something. Companies can choose between improving the efficiency of existing operations and building something new. Improving efficiency does not usually create the kind of environment or corporate culture that contains significant creativity. Innovation is difficult to manage systematically. What is needed is an environment where people think big and take risks. Innovation is not created by changing labour legislation or tax legislation, or through other decisions by the Finnish government. People must be allowed to tinker with all kinds of crazy things, and something may emerge from that. Throw darts at the board, and one of them will hit.

Finland should actively start creating digital service platforms.

In Finland, the use of data has been strongly restricted by legislation and especially by attitudes: no one wants to share any data with anyone. Instead of trying to restrict those applying new data-based business models, such as Wolt and gaming companies, we should learn from them and apply the experiences gained from them to other areas. Service platforms start from data and connect different actors to it as needs are identified. One example could be transport operators that operate all of Finland's transport data. Another example would be a group of health and social services operators that would operate the health data of people in each wellbeing services county. This would provide a platform through which data moves with the person between wellbeing services counties and service providers. It would also allow health and social services data to be read and processed outside Finland, and a Finnish patient/customer could receive the health and social services to which they are entitled in, for example, Germany, Spain, Portugal, or Romania. Multihoming and competition between platforms would steer operations in a more efficient and productive direction and would help eliminate, among other things, failure demand.

Forests should be seen as more than just a source of raw material.

This is linked to the foundation on which Finnish industry operates, and that foundation is still largely based on raw material sources and expertise. A small population, darkness, and cold are poor starting points on their own. The themes of autonomy and digitalization are strongly linked to this. We must use every possible method to inventory forests so that we can make rational decisions about which parts of them can genuinely be utilized by existing industry and around which parts we should be able to create new kinds of revenue streams.

How can Finland make use of the world's most stable bedrock?

What could be done with it? Could we, for example, create "Posiva x 100" and announce that we will accept all high-level nuclear waste and store it in our bedrock? Until fusion energy becomes available, nuclear power is the only way we can survive the future energy challenges. The waste problem associated with nuclear power has not yet been solved, but Finland could solve it.

Targeted investments

Finland needs more courage to invest.

Finnish companies must be bolder in their decision-making. Once choices have been made, they should be followed at least to the point where it becomes clear whether they work or not, instead of stopping halfway.

Favouring domestic manufacturers in investments.

Finnish companies should boldly test and buy solutions from small Finnish companies.

Large-scale deployment of new technologies in society.

This will create national expertise and signal to other countries how advanced expertise is put into practice.

In the short term, no 5G/6G decisions are needed.

Manufacturing industry does not need to make any critical 5G/6G decisions. For example, replacing Wi-Fi with a private 5G network is an operational decision that a company's IT administration can prepare and make with partners. 6G is so far in the future — five to six years away — that it is not yet on companies' radar. Few companies think about investments over such a long time horizon. From the perspective of manufacturing industry, more important themes include artificial intelligence and the use of data related to it. For example, understanding what data one has and how it can be utilized is needed. Finland also has semiconductor expertise elsewhere than at Nokia and in networks, so something interesting may emerge from there.

Finland should allow and also actively support the development of the data economy.

Large platform actors, such as Meta, Wolt, and Airbnb, conduct business on the terms of the individual and their data. Users have the freedom to make choices about which networks they belong to and which services they use. This is a modern way of doing business, and new technologies such as artificial intelligence, quantum computing, and 5G/6G can be linked to it in the best possible way.

Information security must be kept under control, and critical data must be protected.

Active participation in the development of regulation.

Companies and universities must jointly ensure that Finland participates actively in the development of all regulation related to the future of wireless technologies.

Finland must invest in wireless data transmission and security.

Finland has a great deal of expertise in wireless data transmission that has global significance. Finland should boldly build its own security and Europe's security by investing in the development of expertise and technological capabilities. Finland must also take care of its security investments.

Companies must examine what new elements mobile technologies bring to their future.

Finland needs a national awakening — a will to do something impactful together and to define what the desired future is and what it looks like. 6G will bring new elements to companies' operations that they cannot even imagine now. These should be studied

together and at an early stage. A sufficient number of major thought leaders and guiding stars are needed — actors that can afford to explore and want to learn this technology. The critical mass would be 5–20% of companies, but even fewer would be enough: a few dozen from Finland and from around the world. And then, once they do something, others can follow.

A significant increase in the level of industrial automation.

Increasing the level of automation requires significant investments, and in addition to these, investment must be made in developing manufacturing processes. What does the increased mobility of machines enable? How does it affect manufacturing processes?

Promoting the shared use of defence-sector and civilian networks.

Companies must adopt artificial intelligence more widely in their own operations.

It is said that the large actors have already won the game in AI platforms and language models, and that Europe cannot compete. But value and business also emerge from applications built on top of platforms. Similarly, a 5G/6G network is technology and infrastructure, and the actual business is created through applications. Companies must understand what kinds of applications they can build on top of general language models.

Investments in Western production capacity, Western supply chains, and partnerships.

NATO has identified 5G/6G as a technology that may potentially disrupt military operations. If 6G is also to be deployed on the military side, suppliers must come from trusted countries. Finland must be active in these discussions and emphasize its broad national expertise in the development of secure mobile networks.

Increasing resilience

Finland must increase resilience in critical technologies.

This applies especially to data networks and energy infrastructure. It requires investments in research and development and cooperation with companies and universities. One of Finland's top priorities should be the security of digital infrastructure, and this could also be refined into an export product.

How can the resilience of Finnish society be improved?

Resilience depends directly on how the relevant industry and sector are organized. “Interchangeability” and “interoperability” are the two words that also recur in NATO contexts. Everything must be replaceable; one can never build on only one producer or supplier. There must always be alternative routes for carrying out the same task. If we do not ensure diversity of solutions and interoperability, buyers of services cannot put out to tender the solutions on which society will build its next leap.

Creating a Finnish security playbook.

The playbook is created as a team involving large cornerstone companies as well as new, young, and hungry actors that want to develop a wide range of innovations to support the building of civil society and defence and security thinking. Once the playbook has been put together in Finland, it becomes an export product that can be marketed at EU level and globally to partners that want to play according to the same principles.

How can the availability of critical materials and components be secured?

The current technology stack produces functioning devices and solutions. However, each layer has global networks that produce critical materials, components, and services. Where are these obtained from? If, for example, China is removed from today's global value chains, what remains are not value chains that would be immediately functional. During the coronavirus pandemic, we saw that value-chain dependencies are more complicated than is usually understood. In addition, they are properly revealed only when some connection has been broken for long enough that intermediate storage in the chain can no longer save the situation.

Industrial preparedness plans.

We talk about preparedness in military and national security terms, but we should also take it into account on the industrial side. SMEs are generally unable to maintain large contingency stocks, and when those run out, business also comes to an end.

The greatest threat perceived by export companies is global political uncertainty.

A few years ago, the coronavirus caused enormous disruption, but at that time we saw how quickly and effectively the best Finnish companies reacted once they understood that the situation would not pass quickly. We also saw how quickly they realized that the coronavirus was, in fact, a major opportunity for them. The majority of Finnish companies are therefore capable of making even major decisions quickly. The current global political uncertainty may mean that companies have to change their distribution chains, raw material suppliers, and business models.

Europe

A bold and independent Europe

Europe needs to be ready to go on their own.

The U.S. is no longer a reliable partner, it is like India: big, powerful, and erratic. Europe needs to think what happens, when they have to go alone, and they're not prepared to do that. There is quite a lot of populism in France, Germany, the Netherlands, Italy, and UK. Populism is the result of a discontent that is justified in many ways. How does that affect it? How do you weave that in?

Europe needs to build its own defense.

Europe thought they could rely on the U.S., and it made sense to be a free rider. Now Europe needs a good air force, a good space reconnaissance force, precision guided munitions, and electronic warfare and cyber capabilities for intelligence. It also needs industrial capacity to rapidly build drones and other weapons. None of these exist today. It would be more fun to spend the money on something else, but that's not an option. Trump has four years at most, but Europe cannot wait.

The EU must dare to be an actor larger than its size and its Member States.

The EU must create effective but bold regulation and bring together resources and financing solutions so that it can succeed in global industrial and technology-policy competition.

Do the EU and Finland want to be like China or like America?

The European operating model is fundamentally wrong. We are in a situation similar to the late 1970s and early 1980s, when eurosclerosis²⁴ prevented the utilization of all innovation. Even then, good research was done in Europe, but hardly any concrete benefit was gained from it. Europe and Finland have two options. We can become China, meaning that we implement centrally planned industrial policy and five-year development programmes, as the EU has tried to do. Or we can become America, meaning that we reduce taxation, dismantle regulation, and liberate industry. Only the latter option will bring companies to Europe and Finland that actually succeed.

The EU must implement the instructions and recommendations of the Draghi report without delay.

This requires a pan-European approach and a shared value base, and less unnecessary regulation and pursuit of national interests.

A brutally realistic and inspiring analysis of why Finland and Europe have fallen behind.

What are the root causes of this development? How can these root causes be corrected? How will the change be implemented? Are research and production too far apart? This applies to countries other than Finland as well. Germany, for example, is in serious trouble. It is Europe's largest economy, but it has not yet made the digital leap, digital services have not broken through, and cash is still widely used for payments.

Regulation

What EU should regulate and what not?

One purpose of regulation is to make competition fair, for example, with spectrum auctions. Should EU move from market targeting regulation to safety oriented and value based regulation? We would get a system that is really good for the people in Europe. If we have lots of connectivity and flexibility, the market would be open for new kinds of applications, like devices talking to each other or AI organizing information to solve problems for us.

Regulation of key technologies and platforms in EU.

Key technologies are on top of the agenda in the EU, US and China much more than 5-6 years ago. The recent Draghi Report was a wake up call for EU about key decisions that need to be made in order to regulate these developments.

How does European regulation affect the 5G/6G world?

Competitors from outside Europe will make use of the restrictions created by European regulation in their own operations. We should review, according to the devil's advocate principle, the regulation attached to ICT over the past four to five years and determine what it actually means. Similarly, we should examine how new European regulation currently emerging would affect the 5G/6G world if it were applied in full. At present,

²⁴ For example <https://en.wikipedia.org/wiki/Eurosclerosis>

regulation is mainly restrictive and preventive. It should also do much more to promote, encourage, and even compel new activity.

The EU must enter the AI race.

In regulating AI, the EU should at least initially have remained at the level of general guidelines — that is, set guardrails within which companies have the freedom to develop their solutions. Now the EU must find a balance in which regulation does not restrict development work too much, but still remains an EU asset that provides clear rules within which companies can operate.

How can the EU ensure that companies have good operating conditions?

The EU has invested enormously in creating uniform European digital regulation, and the regulations have only just entered into force. Although the regulations are massive, they also involve room for interpretation. Would it now make sense to examine all the regulation that exists in the EU, for example in the areas of 5G, 6G, and the data economy? Do the regulations contain features that prevent or hinder companies' operations in the EU? Could they lead companies to move, for example, to the United States?

Surveillance.

Anything that is connected, can be monitored, hacked, and manipulated at any time. Our societies should be much smarter on what is connected and how they are protected. Without protection they are vulnerable to attacks.

Public funding

The EU must act with EU-level muscle.

The EU must not fragment into conflicts of interest and competition between Member States. The EU must create new mechanisms and financing instruments through which funding is collected, allocated, and prioritized at EU level for competence development and support for RDI activities.

European funding for key strategic areas.

The Draghi report talks about enormous figures, which China and the U.S. are already putting into the game. In Europe, the strategic investments need to be aligned effort between the private side and public side, with funding both from the EU and from Member States.

The EU must strengthen innovation and technological competitiveness.

Finland now has the Commissioner responsible for the EU's technological competitiveness and innovation. Finland must work strongly to ensure that the EU moves away from distributing agricultural subsidies and regional subsidies and toward pursuing genuine technological and industrial sovereignty, as well as a more competitive and more innovative Europe. The Horizon Europe programme is only crumbs compared with the subsidies distributed by the EU.

The EU must build a functioning financing model for network investments.

If Nokia or Ericsson sets out to build a network in, for example, Tunisia, decisions on financing and export credit are needed. Chinese manufacturers do not need them, because the Chinese state fully subsidizes the financing and decisions are obtained

quickly. Interestingly, the EIB and the World Bank have financed Huawei's operations, for example in Africa.

The EU needs common capital markets.

In the current financing competition, Europe cannot succeed in free or grey markets if it does not have common capital markets. The United States and China absorb capital and eventually European companies as well. Because of the lack of a European financing alternative, for example, two of Europe's best AI companies, Mistral and Silo AI, were sold to the United States within a few months of each other. There, they can obtain capital for the further development of their operations.

The EU must decide how it supports innovation in Europe.

Speeches emphasize that the EU must increase technological self-sufficiency and sovereignty, but how is this promoted in practice at EU level and in the Member States? The EU must support innovation and growth based on it so that inventors do not have to move to Silicon Valley to move things forward. Member States must provide conditions for both early-stage and growth-stage innovations, and they must then also have the patience to grow innovations into large companies. If this is not done, Europe will regress into a consumer economy or an open-air museum.

The EU must decide how it supports semiconductor expertise in Europe.

Compared with many other sectors, the telecommunications industry uses relatively small quantities of semiconductors, but the system-on-chips it uses are extremely demanding. Nvidia graphics processors cannot be used as system-on-chips. System-on-chips cannot be bought ready-made; they must be designed in-house. The semiconductor expertise of telecommunications manufacturers is a strength for the EU. This should also be remembered at EU level, and it should be ensured that the expertise remains in Europe.

The new world of telecommunications

Europe must understand that telecommunications is a strategic technology area for it.

Telecommunications must have priority in the EU's global technology diplomacy, in the work of European financing actors, and in the EU's cooperation with third countries. Important export markets in Africa, Asia, and Latin America must be made to understand that digital infrastructure should be built with trusted European suppliers.

How can the technology stack and geopolitics be reconciled?

The current global technology stack represents a way of thinking according to which everyone is friends with one another and pursues commercial profit, and this leads to an efficient outcome. With bloc formation, this no longer holds true. The EU, too, wants to be an independent actor in several areas and to control critical services, such as cloud services. It also wants to control its own data, even though, on the other hand, it promotes the global openness of data. At least in some situations, the EU would like an entirely European technology stack.

Integrity of data for individuals and companies.

We need to decide what data can be shared and what it can be used for. For example,

who owns the information? Can my data or my company's data be used without my consent and outside my realm? Those discussions are ongoing right now.

Consolidation in the European telecom operator market.

The telecom players have requested that, in order to create European champions, EU needs to allow players to consolidate.

Connectivity, digital infrastructure, and 5G must have significant roles in Europe's investment strategy, Global Gateway.

Rules for the use of standard-essential patents.

The standardization discussion and related decisions in Europe.

How are the roles of data actors and telecom actors defined?

Traditionally, data actors and telecom actors have been separate. With 5G and 6G, the situation will change, and this will happen most certainly in private networks and military networks. The increasing use of edge computing will also change the situation: will computing take place on the telecom network side or on the data network side? Should the merger of data actors be allowed? Who would own such an actor?

What kind of industrial ecosystem is needed for success?

We are facing a redistribution of critical infrastructure. In whose hands should the telecommunications networks now being built be? Does society have any role in this? What is the whole that needs to be addressed together? In addition to telecommunications, it should include artificial intelligence, data centres, and the entire data industry, so that we can keep monopolistic structures out. All parts of the ecosystem must also be sufficiently competitive, because only a competitive market provides a genuine opportunity to change service providers.

Creating a European alternative for future communications.

A consortium of national companies must be built in Europe to create a European model and alternative in the field of communications. In addition to 5G and 6G mobile networks, the model would broadly cover the data and ICT world, terrestrial and submarine cable systems, and satellite systems. Finland could act as a facilitator and initiator here, because we have strong expertise, know-how, and a corporate base. We also have researchers who are willing to cooperate. Europe needs new kinds of policies, and through this the world, too, could receive a new spark for development activity. New cooperation partners could also be found somewhere other than among authoritarian states or states seeking to become authoritarian.

How does Europe support 5G/6G innovation?

International competition is tough. If we want 5G/6G development to continue in Europe, for example by Nokia and Ericsson, the EU must decide how public funding will be used to support this R&D activity. Without public funding at EU or Member State level, there will not be many European "innovation champion" companies. This may require entirely new types of tools and financing models.

Restricting the use of Chinese equipment suppliers.

The EU's 5G Toolbox leaves room for national discretion, and that creates a risk for us. The United States, the United Kingdom, Australia, and many EU countries, including Sweden, have taken a strict position on the use of Chinese equipment suppliers in 5G networks. In Finland, their use has been restricted in the critical parts of the network, and efforts have been made to protect against vulnerabilities.

What would be a good strategic question?

Where does innovation come from?

From combining scientific research and company-led research better than today also at the practical level, from risk-taking, and from good timing. At the meta level, from better planning and implementation of the boundary conditions and focus related to innovativeness. From Europe gaining clearly better access than today to markets for goods related to digitalization and especially artificial intelligence, and from improving the conditions for startups operating in Europe — see, for example, the Draghi report.

Can we choose several scenarios in which we operate?

The starting point is that scenarios can be used to make or justify important decisions. Can we, for example, choose two scenarios in which we operate simultaneously, but separately?

How can the right understanding of the necessity of productivity growth and the development of autonomy be brought into all industrial activity?

In Finland, and also in the EU, most politicians and even some business leaders do not understand the concept of productivity. They do not grasp how essential it is in the age of AI to understand the concept of autonomy, how technical solutions lead to increased autonomy, and how they are implemented. This problem is especially visible in countries whose industrial structure is one-sided, such as Finland and Germany, which is completely dependent on the automotive industry.

Who would be the key players in 3–4 years from now?

Why would they be the key players? What would have happened since then and until that time?

Change of mindset — Finland

Should Finland and Europe together stop looking for problems and instead seek sustainable self-sufficiency in matters that are critical to them?

The things that are critical to us are probably critical to others as well. If we are able to develop solutions for them, we can sell them to others who need them.

Should we stop comparing ourselves with Sweden?

In Sweden, everyone smiles, it is always summer, and no one ever has a hangover. Should we stop making this kind of comparison and think about our own strengths? We too are good in some areas, perhaps even in certain sectors of the international consumer market.

Should Finland stop looking in the rear-view mirror?

Should Finland dare to bring forward new actors to challenge the old and traditional ones? The old and traditional actors should not be thrown away, but they should be made hungry to act and to learn something new.

How can existing initiatives and projects be brought together better?

Instead of separate projects, we need to bring activities, ideas, perspectives, and resources together better.

Should the resources of all policy actors be better utilized in this joint work?**Should Finnish actors make simpler products?**

If all product features are included in the only model, it may become so sophisticated and expensive that no customers can be found for it. Should we have cheap and simple models, as well as products for demanding customers? Simple models are bought, and add-ons can be sold for them. Is it worth selling to developing markets a product in which the network's energy consumption has been minimized, or a more affordable product that uses older technology? What kind of product portfolio will keep the game in Finnish hands? And should Finland's solution portfolio be such that Finnish actors are able to produce the solutions for it in all cases? Also for markets where climate and other issues are not yet at the top of the agenda.

Should Finland make better use of mobile infrastructure?

Finland has very high-quality mobile networks as a starting point. How could they be used better? How could services be built on top of them?

Should Finland build its own cloud solution for the public sector?

A few years ago, the United Kingdom implemented its own cloud platform for the public sector, G-Cloud²⁵. Should Finland do the same?

Should Finland abandon paper-based processes altogether in the public sector?

Should Finland carry out a revolution and direct everyone to use the internet? That would inevitably create efficiency. The group that refuses or is unable to use a computer would be left outside the services.

How should Finnish companies act in order to differentiate themselves from their competitors?

Companies need to think bigger, expand their networks, and consider what they want to be when they are large. In the words of Michael E. Porter, "operational efficiency is not a strategy". In the most recent income tax statistics, a significant share of the highest earners work in companies that are less than 15 years old. What could be learned from those companies? The world is changing faster than before, and innovation development cycles are becoming ever shorter. Old operating models no longer work.

Should Finnish industry move from development cycles of several years to development cycles of months and weeks?

Greed and envy are the forces that carry the world, but could positive envy in the business sector awaken the kind of hunger that the solutions of this era require? Should we decide that things can be done, instead of starting from the assumption that they cannot be done?

²⁵ For example https://en.wikipedia.org/wiki/UK_Government_G-Cloud

Should Finland also focus on the global consumer market?

The gaming industry is by far the most international of Finland's content industries, yet even there it is very rarely asked whether we should approach the global consumer market in an entirely new way. We have a strong idea of the B2B market and of the notion that nothing smaller than a horse is worth exporting from Finland.

Priority areas — Finland

How should strategic priorities be chosen?

Priority areas must be chosen carefully; they cannot simply be picked from some list. Usually, an entire ecosystem is needed. For example, the hydrogen economy requires not only hydrogen production but also users of hydrogen.

What is the right “Finnish Mix”?

Is it right to look for one specific technology that will save Finland by improving productivity, promoting exportability, or something similar? No national economy works around just one thing. We need to think about what the right combination of key technologies is — the “Finnish Mix” — and build success on top of it. We must also make choices and decisions that support the selected combination of technologies.

Should Finland create a national key technology strategy and a related capitalization programme?

Should Finland define priority areas for technology development?

What are the technology areas in which we are good and where we aim for self-sufficiency? In which areas do we rely on international partners and the support received from them? In my view, navigating this technology field at the boundary between national and international expertise is an important strategic question.

Should Finland choose 3–5 technology priorities?

And then invest in developing and promoting them.

Should Finland use public money to accelerate RDI investments?

China, for example, has succeeded in combining a planned economy with capitalist structures and has achieved impressive results. It has made technology choices with a good hit rate. Does Finland have enough patience for large and long-term RDI investments? How are they monitored? How can and should their results be assessed?

What are the strategic functions and industries that will maintain Finland's wellbeing over the next 10–15 years?

How does Finland invest in supporting R&D activities? How does Finland support the scaling of internationalizing companies? If 2,000 startups are founded in Finland and five of them succeed in growing into unicorns, they will produce more wellbeing for Finland than if the Finnish forest industry grows by 30%. So far, all Finnish unicorns have been born around a technological idea. Regulation will not make Finland a leading country in any sector.

Should Finland invest in building one or two clusters of centres of excellence?

Alternatives could include 6G, quantum technology, or artificial intelligence. Finland

already has special resources and particular expertise in these areas, for example through Nokia in 6G or through LUMI and LUMI AI in artificial intelligence. Significant investment should be made in building such clusters.

Should Finland more boldly prioritize technological expertise as the future foundation of its economy?

Should Finnish industry invest even more strongly in emerging technologies?

In addition to telecommunications, investments are needed in quantum technology and satellite communications. How could such investments be financed?

Should Finland invest even more in developing its own strengths?

There is a great deal of potential synergy between connectivity expertise and other key technologies — especially artificial intelligence, chips, and cybersecurity. At present, however, these are mainly treated in Finland as verticals. Should Finland examine more closely the cross-connections between these technology areas? Interesting applications and innovations with economic value may be found at the interfaces, for example for the security sector through dual-use opportunities.

Should Business Finland consolidate its programmes into even fewer and more impactful programmes than at present?

International cooperation — Finland

What kinds of cooperation arrangements does Finland build?

Finland is too small to succeed in this world on its own. What is Finland's position, and how do we improve it, for example as part of Europe? Or will we be supported by some kind of North Calotte economic area? Finland will disappear from the world map if this continues. The population is ageing, and soon we will not have enough money to keep up with technological development.

Should Finnish industry invest in the development of wireless technology alone or with a strategic ally?

The search for allies could begin with the Nordic countries and then expand to Europe. And if we look at the big global picture, we can now also ally ourselves with the United States. By allying with the United States, we could gain many advantages, for example in financing innovations and startups.

Should Finland promote closer Nordic cooperation?

Finland, Sweden, Norway, and Denmark are now all in the same NATO boat. Would it be worthwhile for them to deepen their innovation cooperation, for example in the 5G/6G field?

Should Finland choose between the United States and China?

Should Finland ally itself with China?

Allies must be such that they improve our own level of security.

What would a world shaped by China look like?

China's leaders have set as a goal to write the rules for the world. The Chinese figured this out at least a decade ago: the real power is not having the biggest fleet or the biggest

army, the real power is the ability to set rules for global institutions. It suggests that the global institutions aren't going away, but their direction and governance will change. What does the world led by China look like for Finland? When China sets the rules, they would prefer rules that accommodate the Chinese Communist Party. Does Finland become a Tributary State for the new Emperors?

What will the relationship between Finland and China become?

Finland and Finnish industry must rethink their relationship with China. We cannot decouple from China in the same way as from some other places. What does Finland want from China? What does Finland do with China? What does it mean for politics? What does cooperation with China mean for relations between Finland and the United States? Companies must consider these questions from their own perspective. There is a very strong link here to technology, because China has caught up enormously in the adoption of new technologies in important sectors.

Should Finland bet everything on America?

Only domestic-content rules prevent Finnish pension investors from investing all their assets in the American market. As China closes, Finnish universities are turning toward America. Finland's political leadership, including the Minister for Foreign Affairs and the Minister of Defence, are constantly in America. The media, and especially social media, have long revolved solely around American reality. Since Finland is investing so much in America, should we invest even more — or diversify?

What should Finland do over the next four years while the United States has a Trump administration?

The context would be critical technologies, with the focus on 6G and the final stages of 5G. The scenarios would look not only at technology policy or frequency policy, but equally at security and geopolitics.

Should Finland deepen bilateral cooperation with the United States?

The current situation looks surprisingly positive, as over the past year Finland has gained access to many discussions that were previously impossible. The NATO decision has therefore had real significance and impact.

Should Finland be the United States' trusted partner in this area?

Achieving such a position requires a national joint effort and major openings. A great deal of groundwork has already been done with American funders — the Department of Defense, the National Science Foundation, and others. If Finland wants to become a trusted partner of the United States, it needs a clearly expressed national will, focus, and a sufficiently high level of ambition.

Should Finland seek like-minded, technologically advanced countries to strengthen EU investments in key technologies?

What should the relationship between Finland and the Global South be like?

Is the Global South, especially Africa, an opportunity or a threat for Finland? Finland should not approach Africa through Europe because of the colonial past of EU Member States. Finland must look beyond Europe and think about Africa as part of the Global South. What does cooperation with the Global South require from Finland? What could Finland, and especially Finnish companies, do there? Finland has long provided

ideological and humanitarian development aid, for example to several African countries. However, many countries need systemic change and structural reform, in the implementation of which governments and cities play a major role. This requires a comprehensive approach that no individual company can provide. SMEs in particular need larger support structures and national-level measures.

Change in operations — EU

Where does Europe fit into?

This is not the Europe of 125 years ago, when it was inventive, dynamic, even aggressive. Europe sacrificed itself on the altar of its world wars and has yet to recover.

Should the EU genuinely take on the role of a global geopolitical actor?

What would this require?

Should Europe grow a backbone?

Does it even have the capacity to do so if the German economy falters because of the difficulties of the automotive industry?

Should the EU establish common capital markets?

Should the EU fully open up data markets?

In manufacturing industry, everything depends on volume: the price of products comes down as production volumes increase. The use of data is even more volume-dependent. Should Europe grow its data markets by removing all national borders and restrictions from data?

Should a three-operator model be made possible in Europe?

In principle, the model would be similar to what is already used in China, India, and the United States. In addition to these, there could be some smaller local actors in the market. Should the same also be done in energy markets — that is, should they too be treated as a Europe-wide issue?

Should companies move more of their production to Europe?

Bringing production back to Europe requires increasing the level of automation, but it would also be a better solution from the environmental perspective. The EU could impose higher tariffs on products from China, but production might then move to Vietnam or the Philippines.

Should the EU change its technology policy?

Technology policy is also linked to innovation policy, education policy, immigration policy, and competition policy. How can these be changed so that markets function better? How can European companies be given better opportunities to develop key technologies?

How and where should the EU and its Member States direct public funding?

Should the EU invest even more boldly in critical technology areas?

This would mean reducing investments in areas that are familiar and traditional for the EU, such as agriculture and certain cohesion-related matters.

Telecommunications — Finland and the EU

How does Finland ensure that the outcome of 6G standardization is in Finland's interests?

Finland must take 6G standardization work seriously and ensure that it is started early and properly resourced. This is how Finland has succeeded before.

Should Finnish technology companies invest more in standardization work?

For example, in the 5G/6G field, standardization and spectrum policy are key issues through which new markets are created. Should companies be supported so that they allocate sufficient resources to these discussions?

Should Finland promote the emergence of one global 6G standard?

How much should Finnish manufacturing industry invest in 6G technology?

Many American competitors have begun developing their own system-on-chips for their devices, because they do not want to be dependent on large semiconductor companies. Developing one's own system-on-chips, however, requires large production volumes. Should actors in some industrial sector jointly develop a platform or system-on-chip that they all use? One example could be manufacturers of autonomous vehicles and platforms. How can they ensure that they get enough chips in every situation? Where will they get them from? Could additional funding be obtained through the implementation of the dual-use principle?

How ethical should the products built by Finnish actors be?

In Finland, we talk about ethical values and respect for human rights, and we imagine that everyone thinks the same way we do. The 5G network standard enables crowdsourced traffic monitoring only if a state actor requires it. However, there are equipment suppliers in the world that enable traffic monitoring also in other situations. What is the role and responsibility of technology? How are ethical questions embedded in networks? Is it worthwhile for Finnish actors to build ethical choices into their products, such as human rights and climate considerations? Is it enough for us that international agreements and rules define what may be done? Or do we require Finnish equipment manufacturers to implement things in a way that 80% of customers do not want or intend to use? The risk is that other kinds of actors will take the market.

What would be a way to build a network and the standards to enable value creation at the next level?

There's always the operator perspective and the service provider perspective.

Should Europe prepare for the fragmentation of the 6G standard?

Can 6G fragment into several national standards? If the United States and China begin developing their own technology standards with strongly national agendas, what should Europe do? What would the 6G market look like if, for example, the standards used by Western countries and China begin to differ technically and several 6G standards enter the market? For example, if a Finnish-European-American standard and a Chinese standard are available in 6G, what will African customers buy?

How do we ensure that we can depend on the 5G/6G network?

Key words are integrity, safety and crisis robustness.

Should Europe focus on driving market dynamics or support creation of strong European IT and ICT industries?

In the past, Europe has focused on driving internal competition. If Europe wants to become a strong industrial player, it needs to balance internal competition with strategic investments in companies that work in the chosen industries.

Does the EU want there to be top companies producing network technology in the EU?

And if the answer is yes, this requires commitments and measures from EU countries and the Commission.

Should Europe invest more in its connectivity infrastructure?

Should the EU exclude Chinese manufacturers from European markets?

Will European markets be closed completely or only partly to Chinese and other “bad” actors? How are “bad” actors defined? And where will Europe obtain semiconductors after that?

What role will satellite networks — NTN, Non-Terrestrial Networks — play in 6G?

The Starlink service offered by Elon Musk’s companies has played a key role in the war between Russia and Ukraine. Can NTN networks gain a significant foothold in mobile internet services? Can they offer a broadband solution in crisis situations or for sparsely populated areas, such as Africa? Should Europe have its own satellite system, for example through ESA, so that it is not dependent only on Elon Musk’s companies?

Resilience — Finland and the EU

Should Finland prepare for war?

Unfortunately, this kind of scenario must be included on a 3–5-year time horizon. Its probability is still limited, but it is nevertheless possible. Through such a scenario, we could consider how Finland should act so that the path to emergency conditions would be smoother. Or how the procedures and cooperation models of companies, public administration, and the Defence Forces should be developed so that they could be used as such also under emergency conditions. Overall, Finland must prepare for exceptional circumstances more than it currently does.

Should Finland and Europe invest in developing defence capability?

Should Europe encourage industry to invest in maintaining traditional and digital defence capabilities, for example by investing public money in them? And should Finland do this together with the Nordic countries, Europe, or NATO? And at what level?

Should the EU build itself into a security union?

A couple of years ago, people laughed at Emmanuel Macron’s comments about NATO being brain-dead, but they are no longer laughing, because the Western alliance is on quite shaky ground. This is also linked to the dual use of critical technologies.

Should the EU invest in dual-use technologies?

The EU has Horizon, research programmes, and many other investments that are clearly directed at the civilian sector, but in practice the expertise developed there can also be

used on the military side or in crisis situations. Technologies are, as such, dual use, but this is simply not talked about. This should be considered as a whole at EU level. Something can then be left outside if desired.

Should the EU invest in developing its own resilience?

This question concerns manufacturing industry in particular. During COVID, for example, the EU was unable to produce enough of even such a simple product as face masks. The EU and its Member States should identify what kinds of capabilities they must have for crisis situations: a good analysis, followed quickly by measures to close the worst loopholes. The focus must be directed forward. There is no point in competing with the Chinese in the market for cheap solar panels; instead, Europe should invest in innovation and create the next generation, because the sector is developing so rapidly. Cooperation between civilian, crisis, and military applications adds further depth to resilience.

Should Europe prepare for a total internet blackout?

This threat is unlikely, because the internet has been designed to withstand almost anything, but it would still be useful to consider it, especially on a smaller scale — for example as a result of local storms and floods. How can citizens and companies be brought back online quickly?

What unexpected developments could occur within the traditional West?

How will the politicization of technology appear within Western countries? The United States has now imposed tariffs on Mexico, Canada, and China. This would mainly be a question of the United States versus other countries, or perhaps the Anglo-Saxon countries versus the others.

Semiconductors — EU

Is there a desire to increase Europe's self-sufficiency in semiconductors?

Does Europe want to remain competitive in semiconductor design expertise?

The question is relevant for the telco sector, but also for many other industries. Self-sufficiency includes not only manufacturing but also the design of chips, such as system-on-chips. Design expertise is important because the use cases for chips vary, and for example different 5G use cases require different system-on-chips. It would be good if Europe — and Finland as well — had unique top-level expertise related to design.

In which parts of the semiconductor value chain does Europe want to operate in the future?

The EU has supported the local semiconductor industry, and the idea is also to bring semiconductor manufacturing facilities to Europe. The EU's next Chips Act decision must also include support for the design of demanding system-on-chips. From the perspective of Europe's resilience, it is important that Europe has designers who know how to design the most advanced chips. Finland has a key role here, as around one third of Europe's designers of the most advanced chips are located in Finland.

Should the EU invest in European chip production?

The EU is in a great hurry to bring chip production and other related capabilities back to Europe, because everything depends on chips. The same thing has happened with chip production as with other manufacturing industry: first, cheap production was sought from Asia, then manufacturing equipment was taken there, and now Asia also has top-level expertise in manufacturing technology. Europe is starting from behind, because others are already so far ahead and can produce good products cheaply. Europe could initially focus on more specialized and more innovative chips, because their prices have not yet been pushed down. But Europe also needs to obtain cheap chips from somewhere, because they are needed everywhere.