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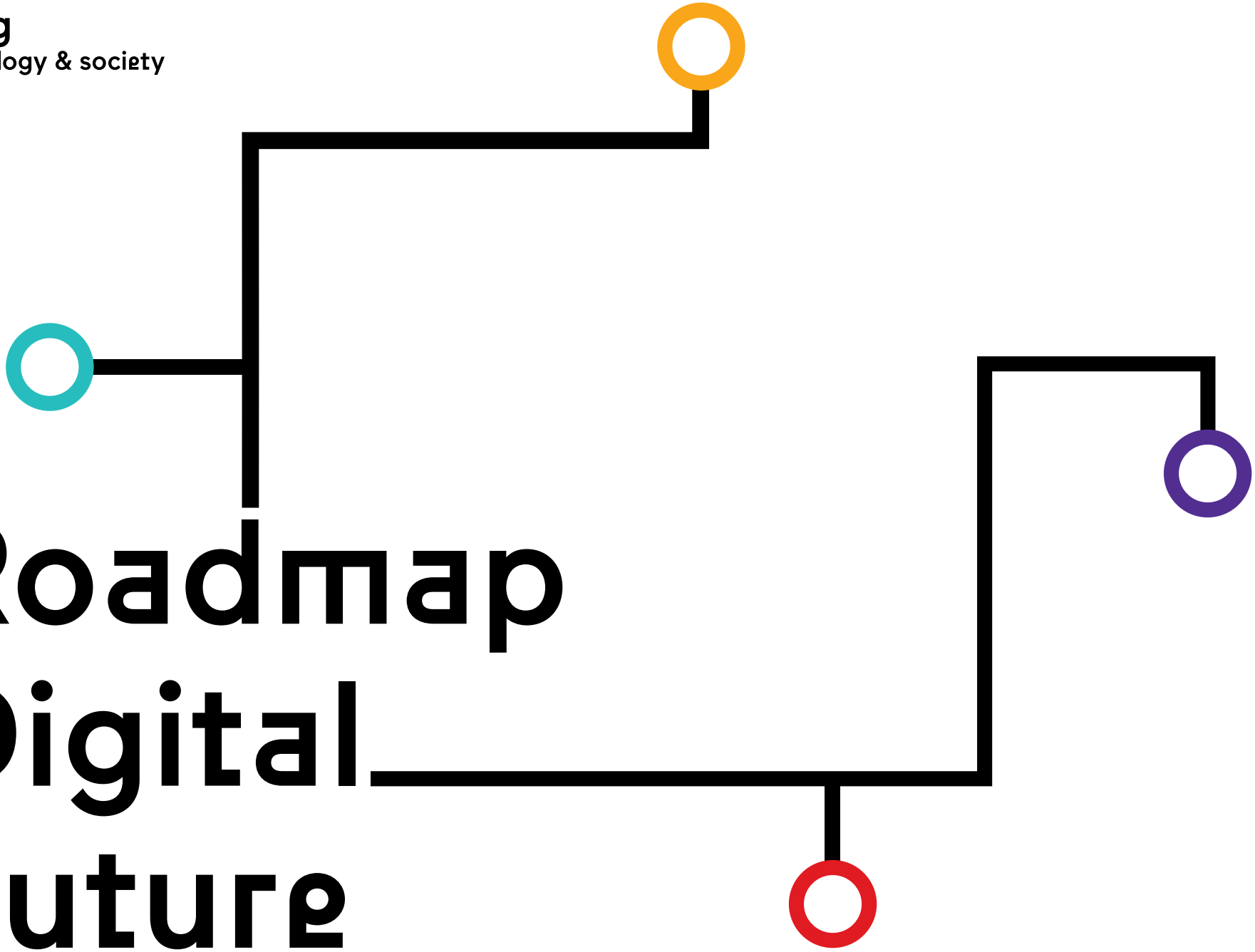

Roadmap Digital Future

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Version 0.36 | June 8, 2020

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Introduction

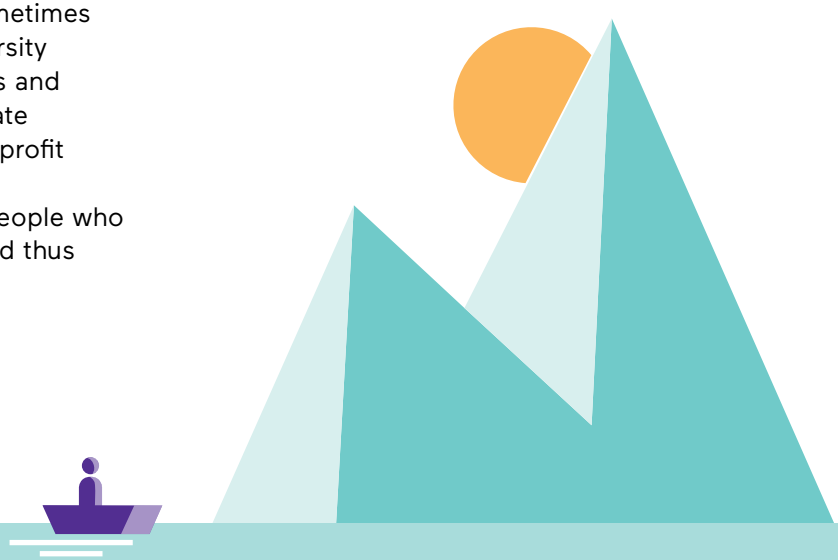
Societies around the world are digitalizing at a rapid pace. Very few people came online in the early days of the Internet, and technology was reserved for specialists and pioneers. Today, nearly everyone has to deal with technology and digitalization, which affect all corners of society. Digitalization is no longer an isolated expertise, such as healthcare or education, but can be compared to finance: a specialist subject that affects every sector and every aspect of society.

In the end, we are nearly all end users of technology, inside and outside of our professional capacity. There's hardly anyone left without a smartphone, social media account, or email address. We use hundreds of different apps from as many developers, and the Internet is in our cars, TVs, and toasters. We use all kinds of services, generate and share our personal data on a daily basis, and come into contact with technology consciously and unconsciously when we are being filmed by a surveillance camera or when we have a smart meter in our kitchen cupboard.

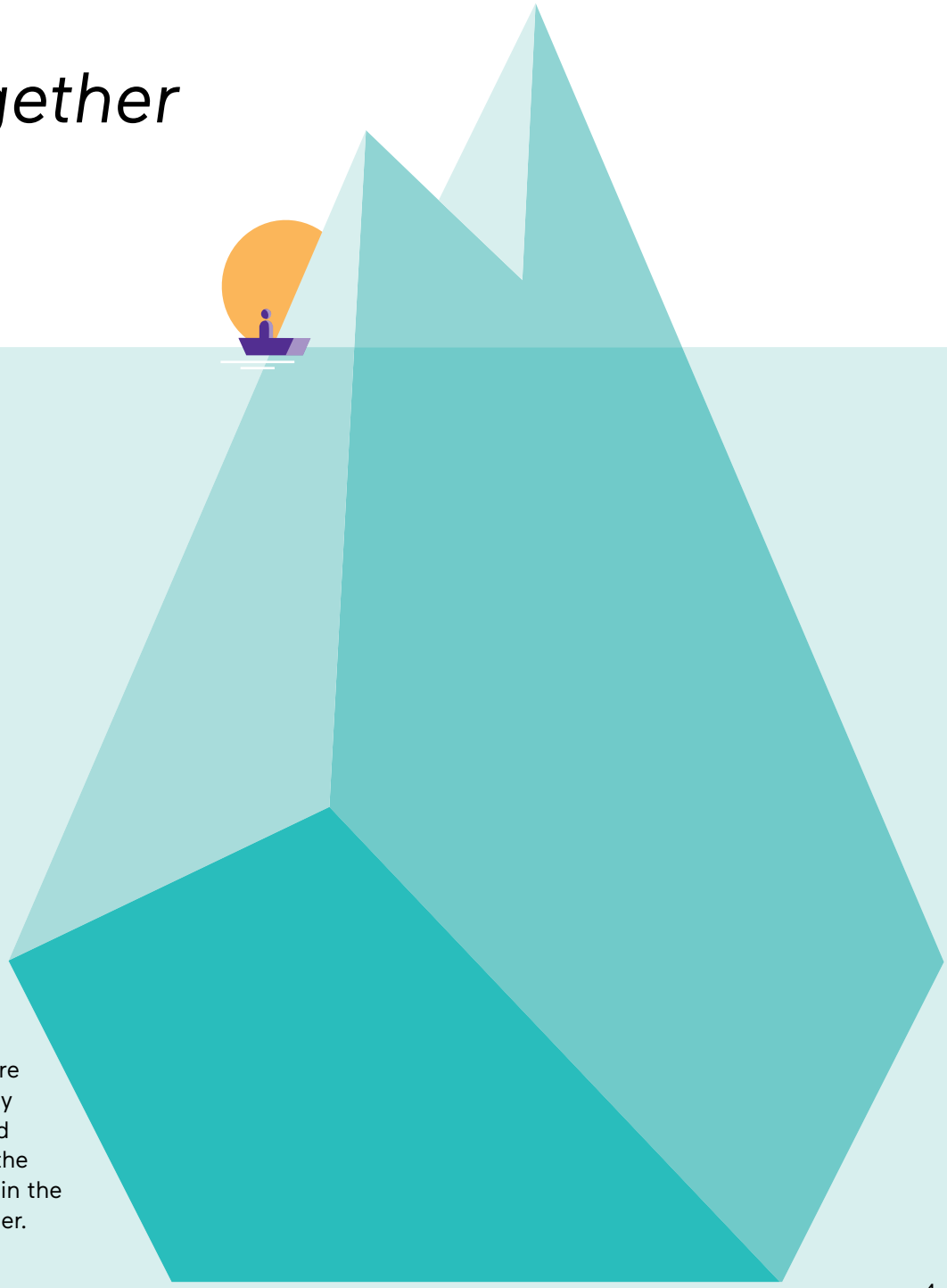
Iceberg

All of that technology has a visible 'face', but what happens behind the scenes? The average user experiences technology as if looking at an iceberg: the tip is visible, but most of the iceberg remains unseen. Underwater, technology is conceived, designed, controlled and optimized. Because such a large part of the operation is invisible, it can sometimes feel as if technology is encroaching on us; as if it develops magically without us understanding or controlling it ourselves. This is what we call the **citizen perspective**.

But we made that iceberg ourselves: In the end, all technology is made by humans. Sometimes the technology is developed at a university or research institute where experiments and inventions are done. Companies innovate by developing new platforms, and non-profit organizations and other NGOs use that technology in a new way. It is always people who design, develop, roll out technology and thus change our society step by step; technology is not neutral, but the product (and arbiter) of countless underlying decisions. We must not only look at the tip of the iceberg, but see and design the whole iceberg together.



We design digitalization together



How do we, as a democratic society, become the designers of our own digitalization? How do we gain understanding and control over the design process? How do we know what lies beneath the waterline? How do we jointly ensure that everything that happens under water leads to the use of safe, inclusive and fair technology above water?

This roadmap initiates this shaping process. We take a deep dive and explore the entire iceberg: What is the technology we use, how is it designed, and why do we build and use it in the way that we do? Digitalization in the world is what we shape together.

Under water we encounter different layers:

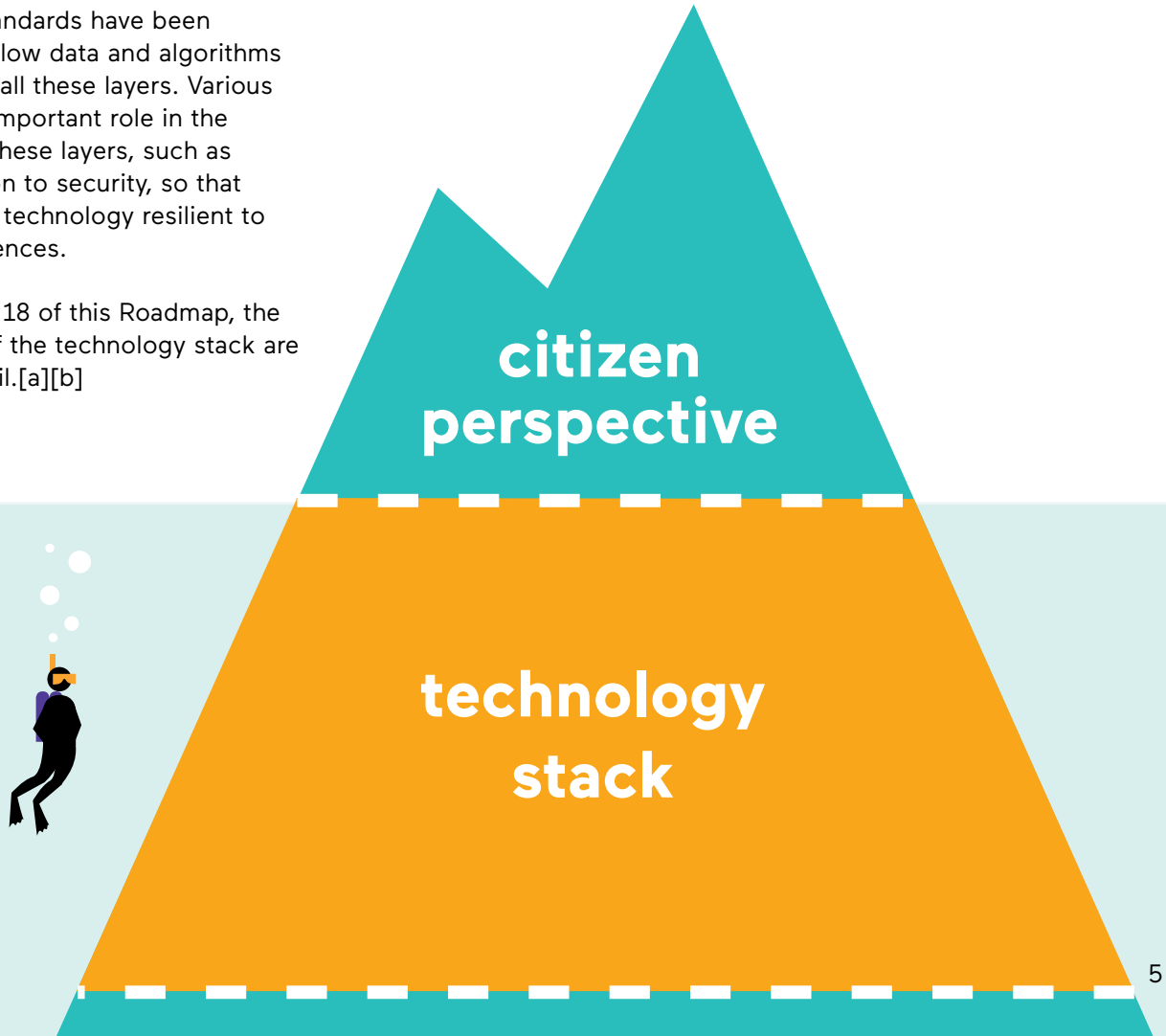
The technology stack

Directly beneath the surface is the **technology stack**: a stack of layers that represent the structure of technology. At the basis of this is the infrastructure. Think, for example, of internet cables at the bottom of the sea and GPS satellites in space. Our devices use this infrastructure for all kinds of functionality. Our devices run firmware and drivers that enable the use of the device for the operating system. At the very top of the stack lies the application layer, which includes, for example, the web browser and the apps on our phones. This application layer is still visible from a citizen's perspective.

As citizens we often see technology because we use a service, for example for e-mail or video calls. Although we experience this mainly through an app or application, such a service only functions through a complex interaction of the whole stack of layers.

This interaction can occur because protocols and standards have been developed that allow data and algorithms to move through all these layers. Various aspects play an important role in the development of these layers, such as sufficient attention to security, so that we can make the technology resilient to undesirable influences.

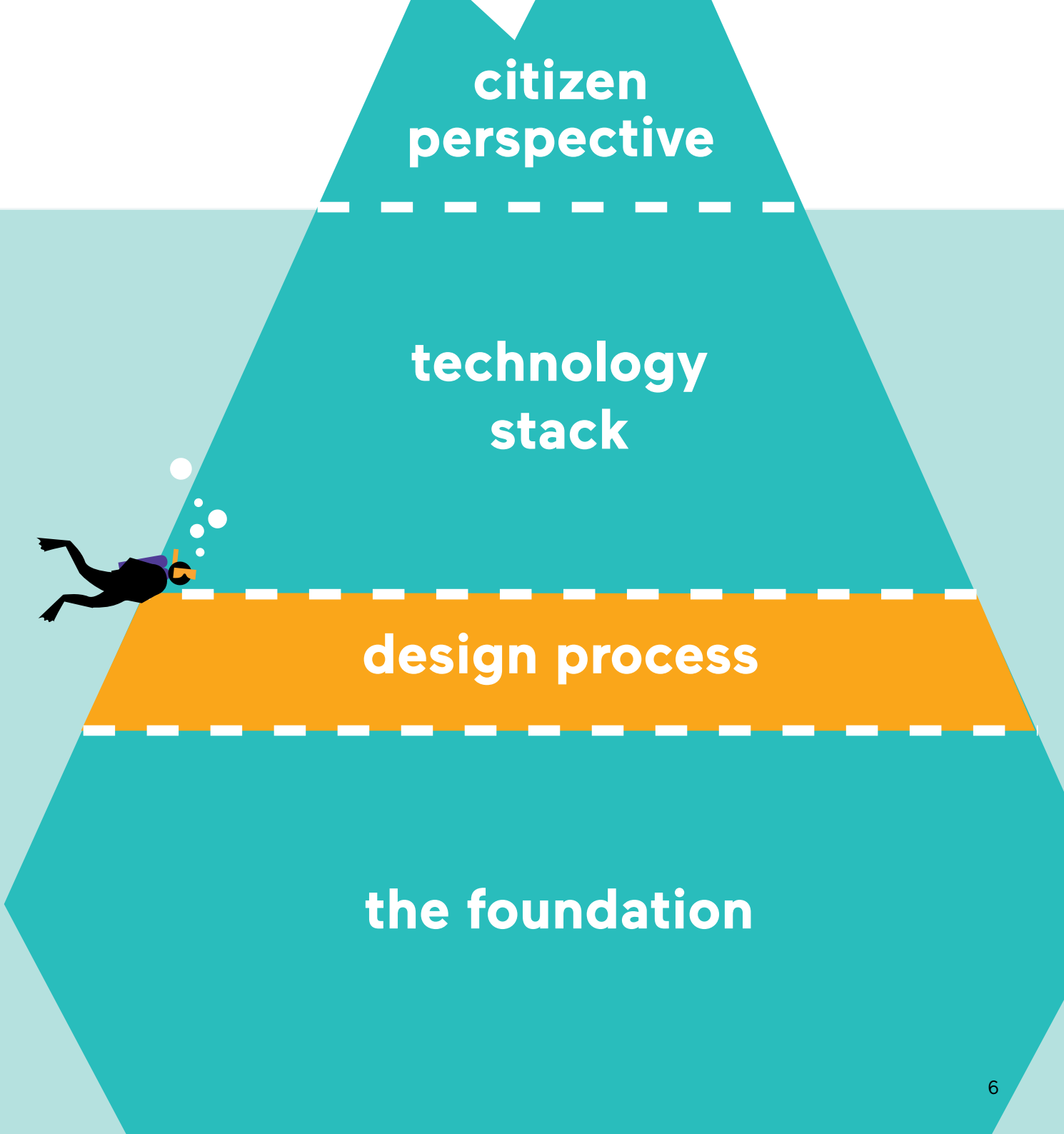
Starting on page 18 of this Roadmap, the different layers of the technology stack are explained in detail.[a][b]



The design process

Each device, application, protocol and the ways in which they work together in the technology stack is the result of a **design process**.

The design process determines whose thoughts and interests are digitalized. In short: the design process has a decisive influence on how the digitalization is given form. A lot of research has been done into design processes and there are many methods that address the characteristics of a good design process. These characteristics should be examined and agreed upon before the design process starts. This happens at the base of the iceberg: the foundation.



the foundation

The foundation

At the bottom of the iceberg is the foundation. Each digitalization issue is preceded by a large number of important decisions. These decisions are made consciously and unconsciously, but resound in all layers of the iceberg. We use the perspectives below to make these decisions explicit.

1. We question **starting points and assumptions**. By understanding the rationale and objectives of technological initiatives, we know who to involve in the design process.

2. We look at **fundamental rights and values**. Digitalization must, of course, comply with fundamental human rights and with additional laws and agreements that guarantee the rights of current and future humans.

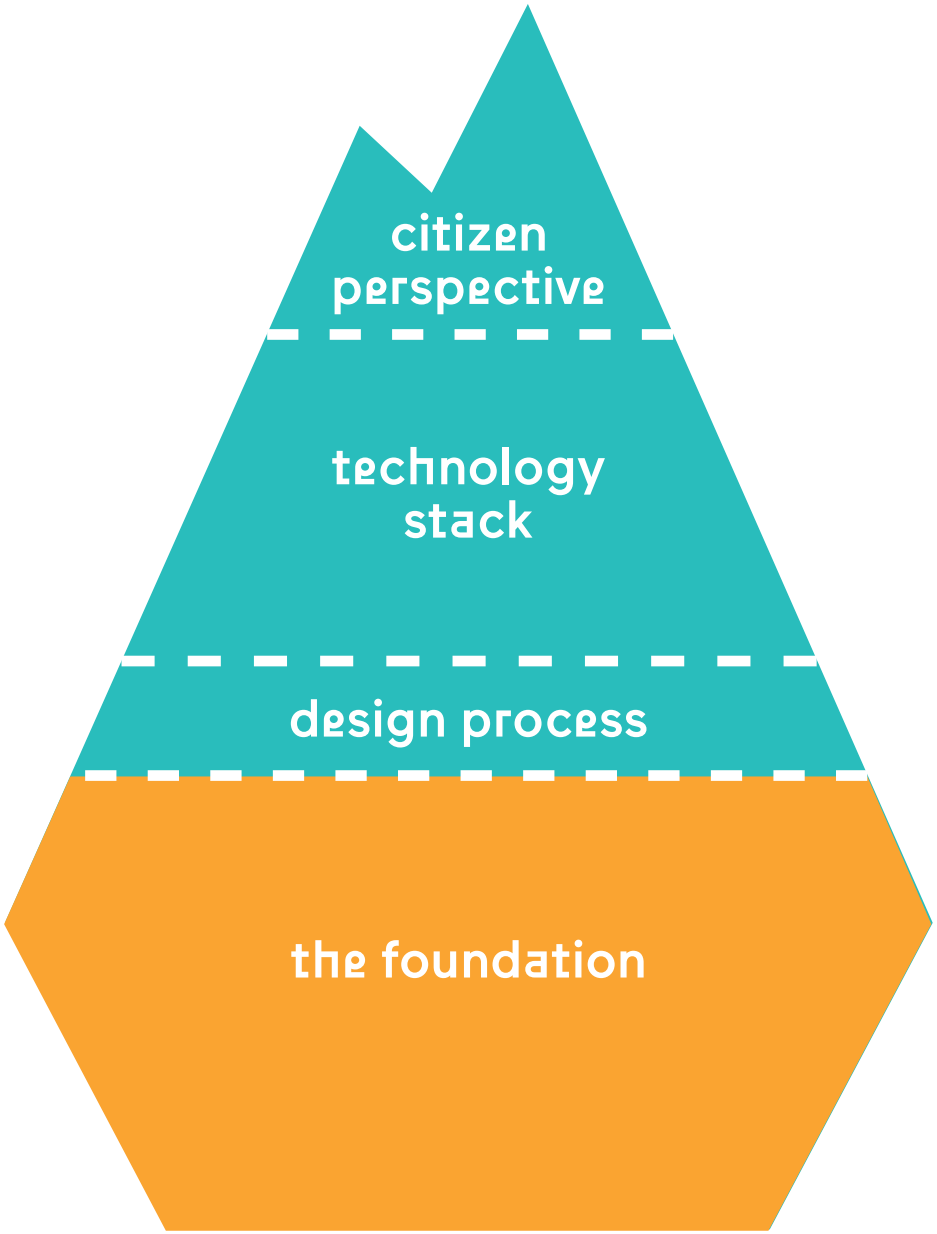
3. We investigate the **governance and supervision** of digitalization. In addition, we study the extent to which supervision by society is possible.

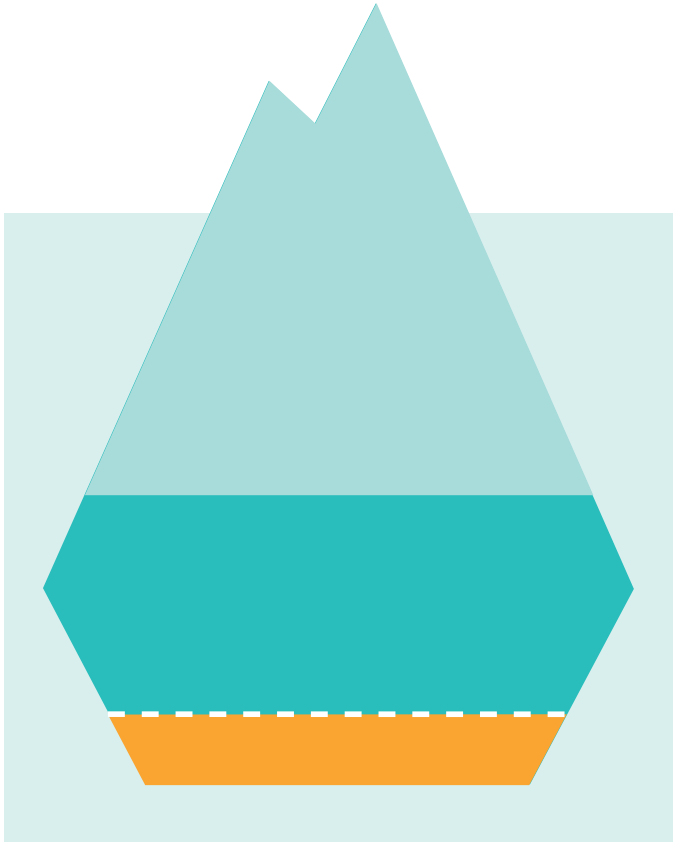
4. We ask questions with regard to **social and socio-economic considerations**. Digitalization must respect the boundaries of people and the planet, and must be financed sustainably. In doing so, we also consider the costs and benefits for society and the earth such as ecological footprint, raw materials, and working conditions.

The foundation

We have now introduced each layer of the public stack. Our goal is to shape the future of digitalization together. That is why we will now question and explore all layers, starting at the bottom of the iceberg; after all, the foundation is crucial for the design process, which must ensure that the technology stack is inclusive, safe and just. This is the only way to give people a perspective on our digital future.

On the following pages we take a more detailed look at the different parts of the iceberg.





Starting points and assumptions

All stakeholders are involved and it is clear to what end we are optimizing.

Whether it concerns an existing or a new digitalization initiative, or larger issues relating to digitalization, interests are always involved. A good starting point in the development of a design process is therefore to identify these interests. In what way do financial and economic considerations apply? Is the efficiency of the government important? Is particular attention paid to the sustainability of government functioning or do social or cultural-social considerations also play a role?

Based on the basic idea that technology is not itself neutral, it is important to properly identify these underlying interests and to make it clear what purpose we are 'optimizing' (digitalizing). Ownership and control also play a central role in this. Because digitalization affects everyone, it is essential not only to identify who has an interest in an initiative, but also to understand who might be affected and involve them in the design process.

See also:

Het Maatschappelijk akkoord van Amsterdam (in Dutch)

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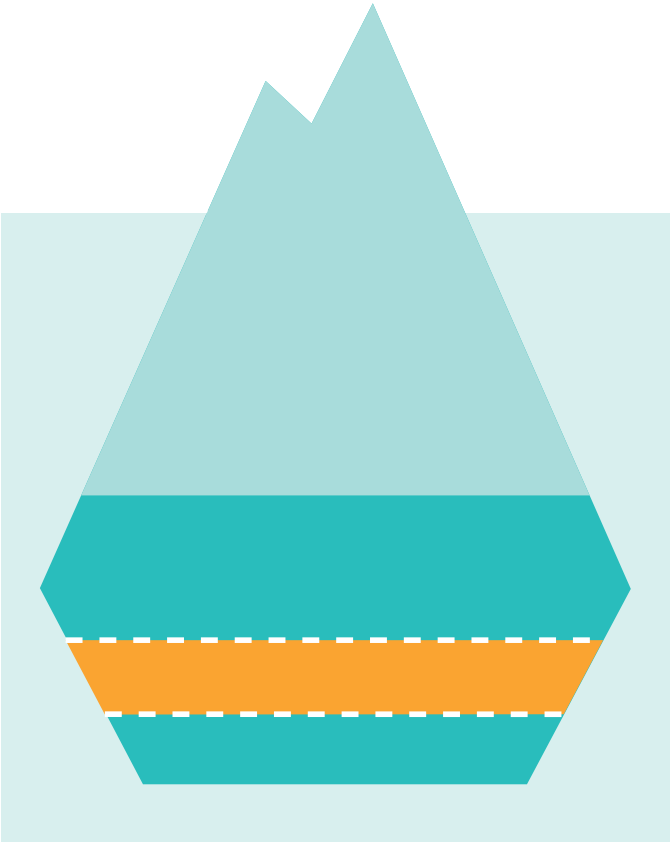
Questions

All stakeholders are involved and it is clear to what end we are optimizing.

Who does this initiative belong to and who are the other stakeholders?	What problem is this initiative intended to solve?	When will the problem be solved? Who defines success?	Which parties does this initiative affect?	In what way are all these parties involved in the initiative?
Who determines the method?	Why is this party taking this initiative?	What importance seems to be decisive in this initiative?	Have all effects been identified and discussed?	



Fundamental rights and values

Human rights are guaranteed and public values are respected.

Digitalization must, of course, comply with fundamental and human rights, but also with additional laws and agreements that guarantee the rights of citizens now and in the future. This allows us to assess the impact of digitalization issues on human rights with the UN Human Rights Impact Assessment.

Fundamental rights and values ensure the existence and preservation of our public domain. The government has a special responsibility in this respect. It must in any case take care of the following three aspects to safeguard the public domain: the right to freedom of information and communication; the right to protection of privacy; and the right to orderly rules (to be drawn up by the government) for social and commercial traffic.

In the public domain, public values apply that should influence technology and digitalization – not the other way around. These public values speak out about (the protection of) individual life, community building, and social cohesion, and they shape the democratic design and control of digitalization. These public values are currently expressed in various ways, such as through the principles of the Cities Coalition for Digital Rights.

See also:

- *Het Nationaal Actieprogramma Elektronische Snelwegen: "van metafoor naar actie" (1994, in Dutch).*
- *Human Rights Impact Assessment Toolbox*
- *Cities for digital rights*

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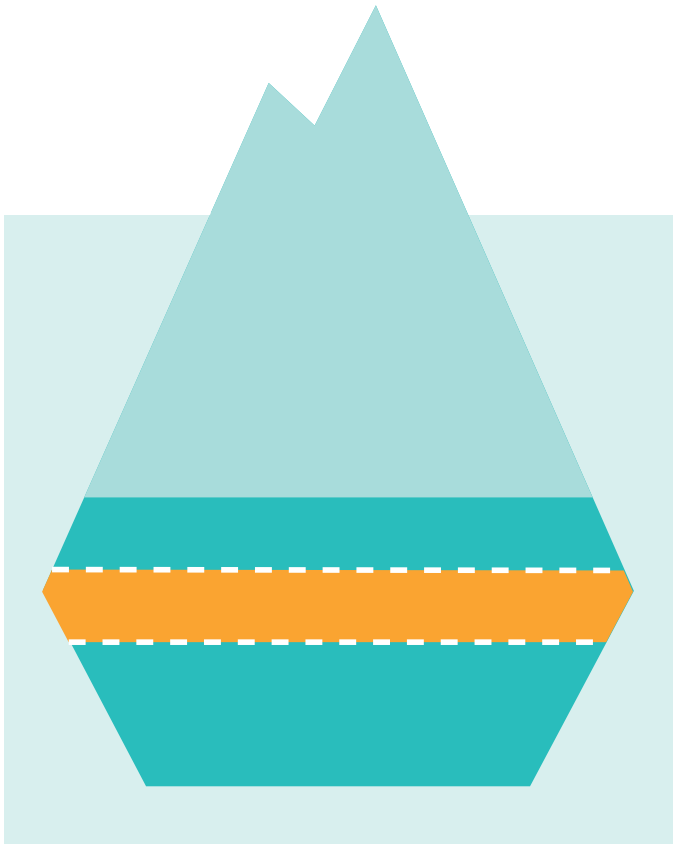
Questions

Human rights are guaranteed and public values are respected.

- How does the initiative safeguard fundamental rights?
- How are human rights guaranteed in the initiative?
- Do we take additional (inter)national agreements into account?
- In what way is society represented?
- Is the initiative in line with the sustainable development goals?
- How do we ensure the preservation and continued existence of our public domain?
- How do shared public values resonate in this initiative?



Governance and oversight

Society as a whole keeps a grip on digitalization.

When it comes to the governance of digitalization, it is important to look at the role that governments at different levels play in this issue. Consider the context of a European municipality: The role of Europe in relation to national governments is crucial. Technological developments are rapid and have a cross-border character. Current legislation and regulations fall short, and issues often have to be addressed in an international context. It is questionable whether national, regional or local authorities are involved in the issue. Digitalization, as well as the impact of technology on the living environment in a broader sense, must be addressed at the municipal level, particularly with regard to the use of technology in public space.

In addition to the importance and role of governments, it is crucial to have a good eye for the role of other parties. This is not only about the role and positioning of government in relation to market parties and knowledge institutions. Social parties also play an indispensable role. Design principles for commons, as drawn up by Elinor Ostrom, can serve as inspiration in this respect as they can help us to design, understand, and evaluate social initiatives.

This new form of governance requires oversight, both of the issue itself and of the issue's governance. Supervisors play a crucial role. It is essential that they have the mandate and the means to properly fulfil this oversight at all stages of the digitalization initiatives. The profound role of digitalization in society may require new forms of supervision (such as enhanced cooperation between regulators or perhaps even the appointment of a new supervisor), for example in the use of algorithms. The internal happenings of algorithms may not remain a guarded secret when they have a profound impact on our legal system, access to rights, and daily lives.

Finally, companies themselves must be enabled to exercise supervision. Only with the correct application of the principles of openness and transparency can society effectively monitor the digitalization that concerns them.

See also: Elinor Ostrom's 8 rules for managing the commons (Opens in browser)

Questions

Society as a whole keeps a grip on digitalization.

In what role(s) are the different layers of government involved?

Who is accountable for this initiative, and to whom?

What effects does this initiative have on the physical environment?

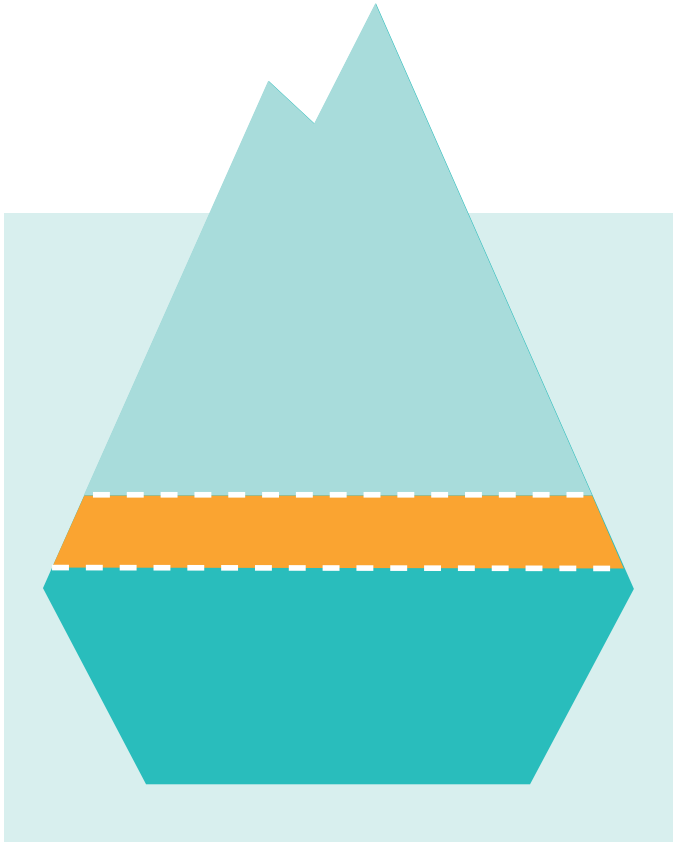
How is monitoring involved at the start of the initiative?

How is supervision involved after completion of the initiative?

Is there clarity about the instruments and responsibilities of the relevant supervisor?

How can the parliament call the initiative to account?

How can citizens hold the initiative to account?



Socio-economic considerations

The financial-economic model takes people and planet into account.

Digitalization must respect the boundaries of people and planet and be financed sustainably. This means that we consider the costs and benefits for society. When making investment decisions, financing instruments with a digitalization initiative must respect the boundaries of man and planet, especially when public money is involved. This is closely intertwined with the aspects of governance: all stakeholders must be represented in decisions that concern them. We address sustainability by having an eye for future generations: how are they represented?

We can approach the boundaries of the planet according to the model of Kate Raworth's donut economy, for example in line with the recently launched initiative of the city of Amsterdam. This model provides a framework for mapping out the ecological footprint, origin of raw materials, working conditions and circularity. Furthermore, people occupy an essential position in Raworth's model, so that the right knowledge and skills are available to all stakeholders to deal with technology.

See also:

- *Amsterdam Circulair 2020-2025 (in Dutch)*
- *Nieuwsbericht (in Dutch)*

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Questions

The financial-economic model takes people and planet into account.

Is it critical infrastructure?	What is the financing model?	How are public interests represented?	How are public values safeguarded in the short and long term?	How are risk and profit shared in society?
Is participation in the conversation reasonably possible for all parties, and will it remain so?	Is there clarity about the instruments and responsibilities of the relevant supervisor?	Are all parties involved (people and planet) improving?	What is the environmental impact of the intended technology?	What is the production chain and is it fair?
Are there any externalities, and if so, which ones?	How can society monitor the initiative?			

The design process

When designing technology, it is essential that we start from the foundation. The most important agreements of this foundation are listed below.

1. All stakeholders are involved and it is clear why we optimize;

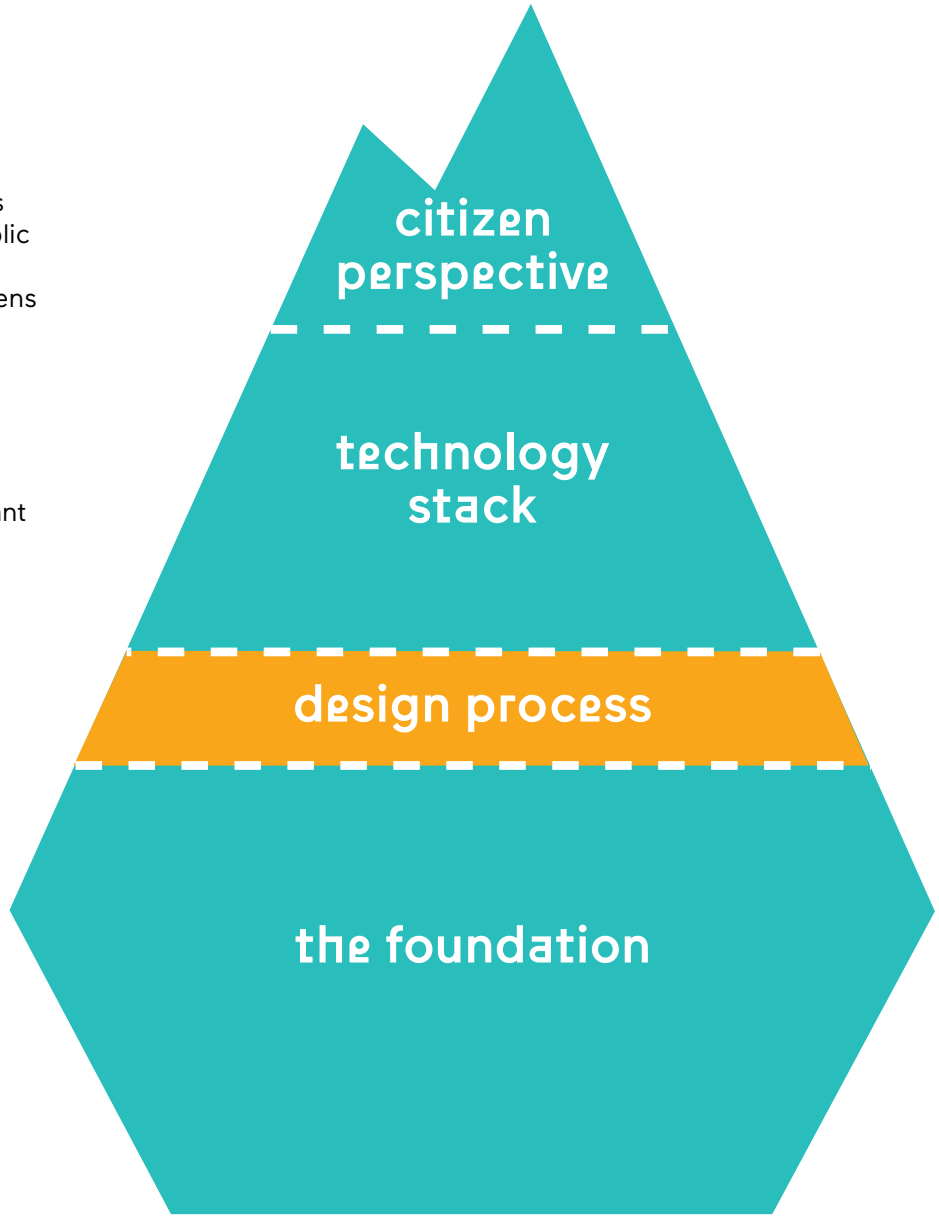
2. Human rights are guaranteed and public values respected;

3. Society as a whole keeps a grip on digitalization;

4. The financial-economic model takes man and planet into account.

We ought to shape the design process on the basis of these agreements. In this way, the design process is a form of public research in which society is the starting point and the living environment of citizens is central.

There are various methodologies to set up this design process. For example, co-creation is a design method that involves all stakeholders with their relevant knowledge and experience in all phases by means of creative working methods. The Knowledge and Innovation Agenda for the Creative Industry 2020-2023 quotes valuable design methodologies (Key Enabling Methodologies) that can help to systematically involve stakeholders, set a design goal or test an idea.



Key Enabling Methodologies
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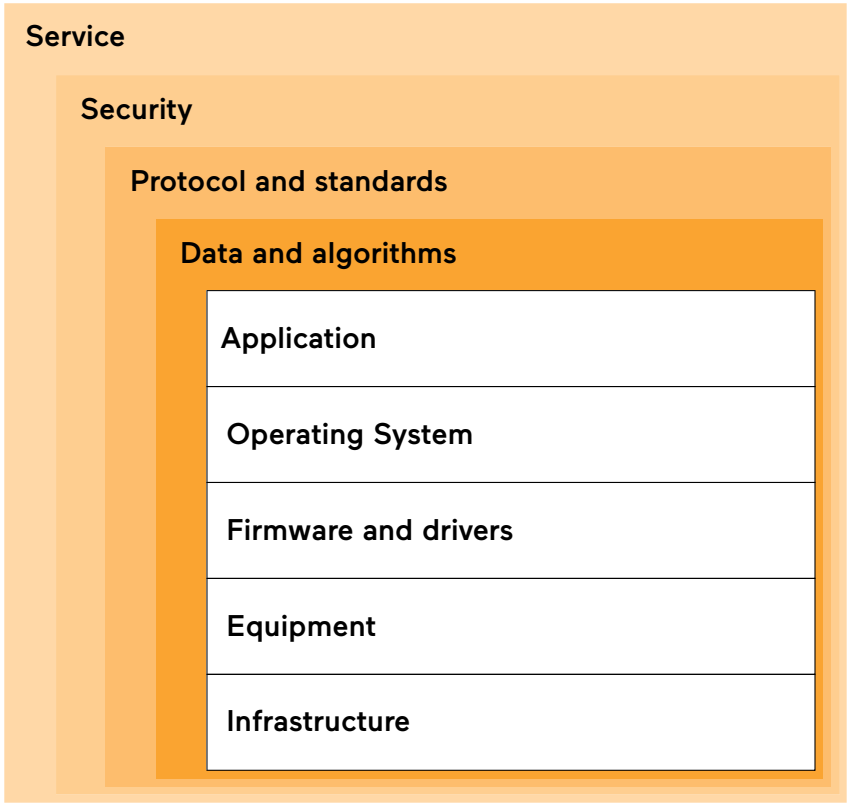
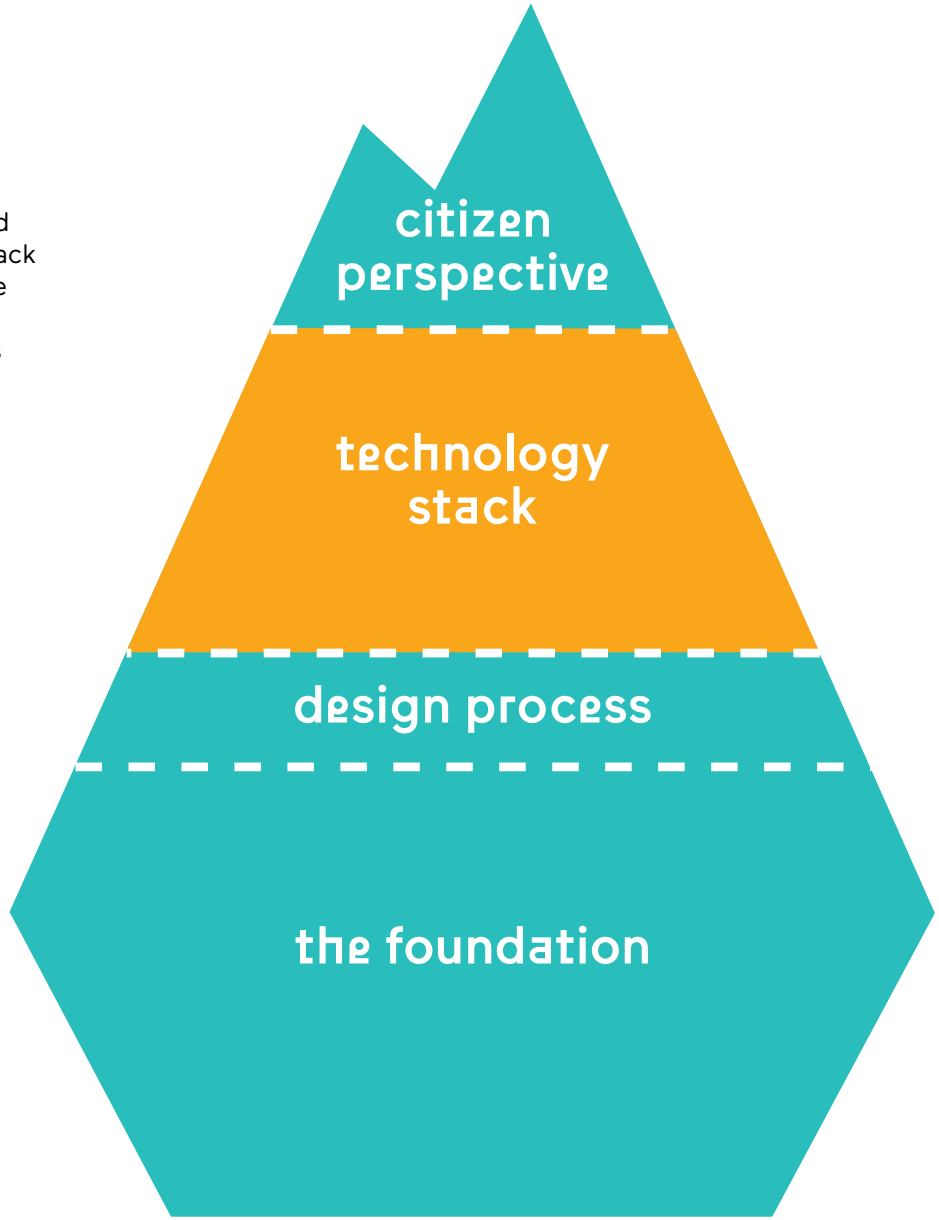
The technology stack

We distinguish between different layers within the technology stack that are constantly cooperating and communicating with each other. Together they provide the services and digitalization. But each layer has its own designers, builders and organisational forms. This means that there is a slightly different dynamic between stakeholders at each layer, and therefore different possibilities for intervention and supervision. We bring the technology stack closer and see that in the core, the white square, different layers can be distinguished. We explain each of these layers below.

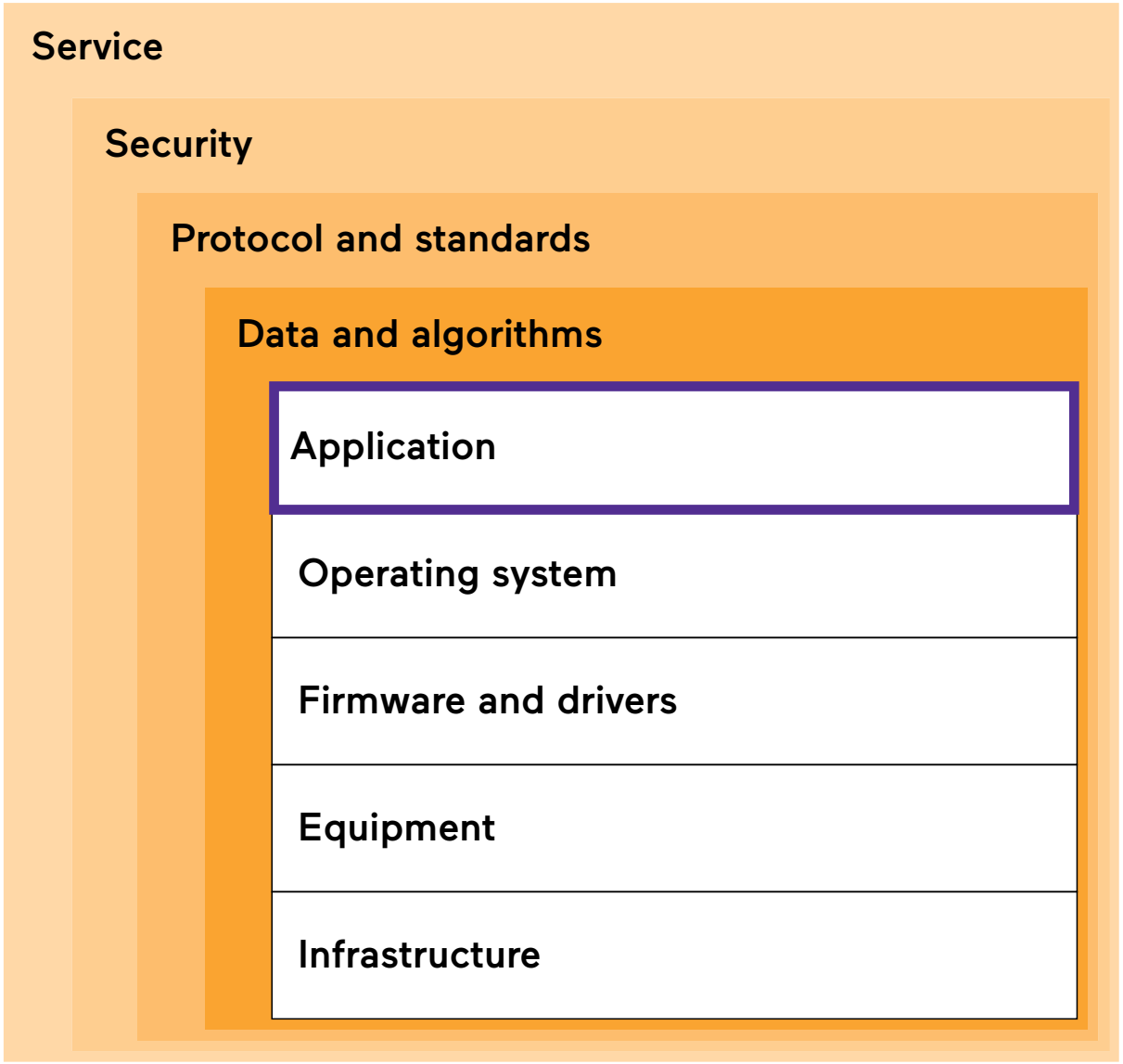




Application

The application layer is the most visible part because it contains the software we interact with: an app on a smartphone, a video calling service, or text editor on a laptop. The web browser is also an application but it occupies a special place. Most applications focus on a specific task such as sending messages or editing photos, but the web browser makes it possible to use a wide range of different services.

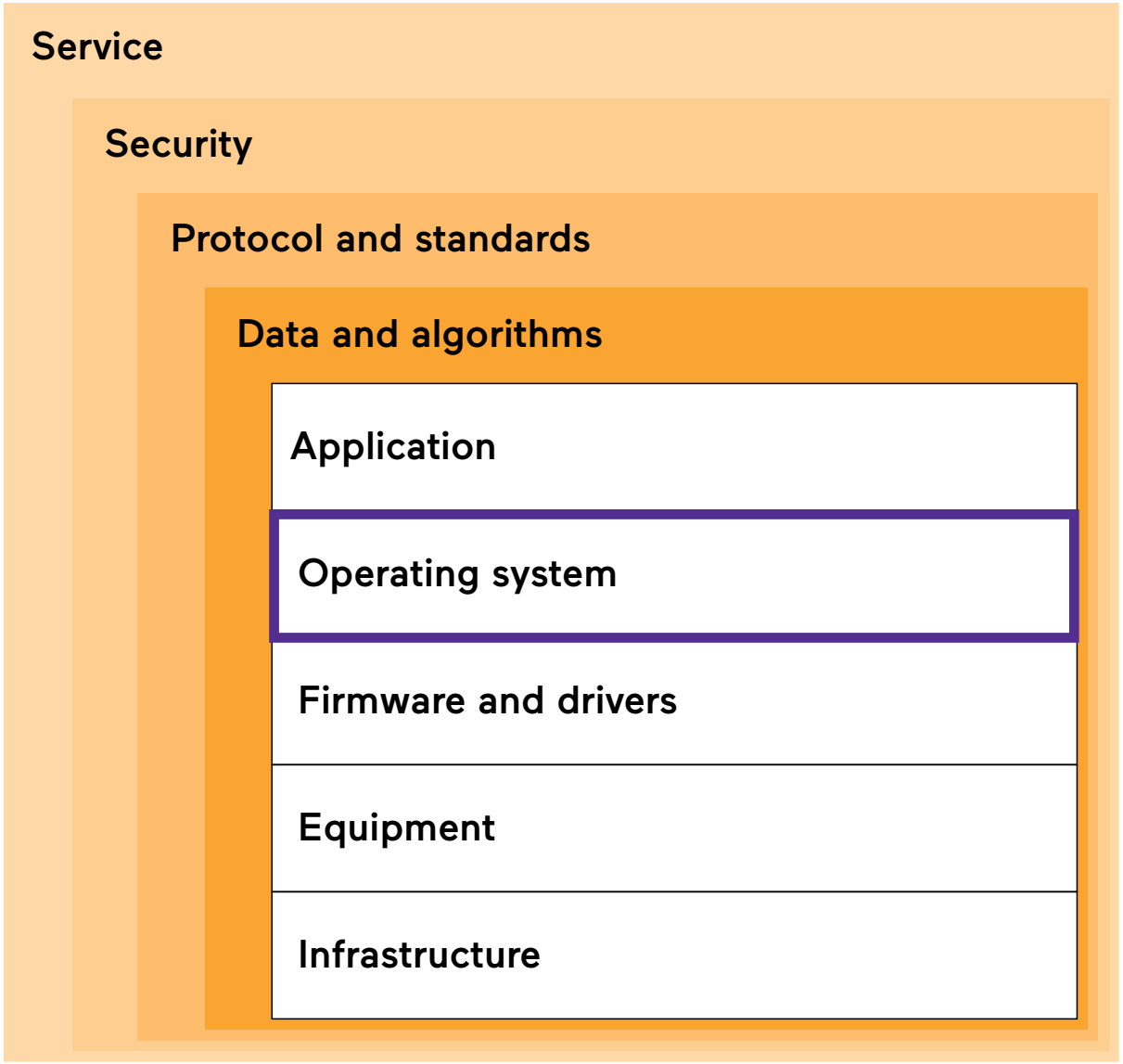
We currently control most applications via touchscreen, keyboard, and mouse. But some applications disappear step by step into the background. As a result, the interaction between man and application does not take place directly or completely consciously. Think of 'smart assistants' such as Google Assistant or Apple's Siri, to whom we give commands based on voice commands, sometimes without us immediately realizing that we are interacting with an application. Another example is the smart doorbell. This makes it possible to see who's at your door via an app on your phone, but the doorbell itself also has an application running that interacts with the person at your door.



Operating system

Applications always run on an operating system. This is software that ensures that the different parts of a device work together properly and are accessible to the application. The operating system ensures that the keyboard transmits the correct letters to the processor and the screen and that files can be stored on the hard disk. Examples of operating systems are Apple iOS, Microsoft Windows 10 and Linux. Many people are familiar with these systems because they sometimes install applications on them.

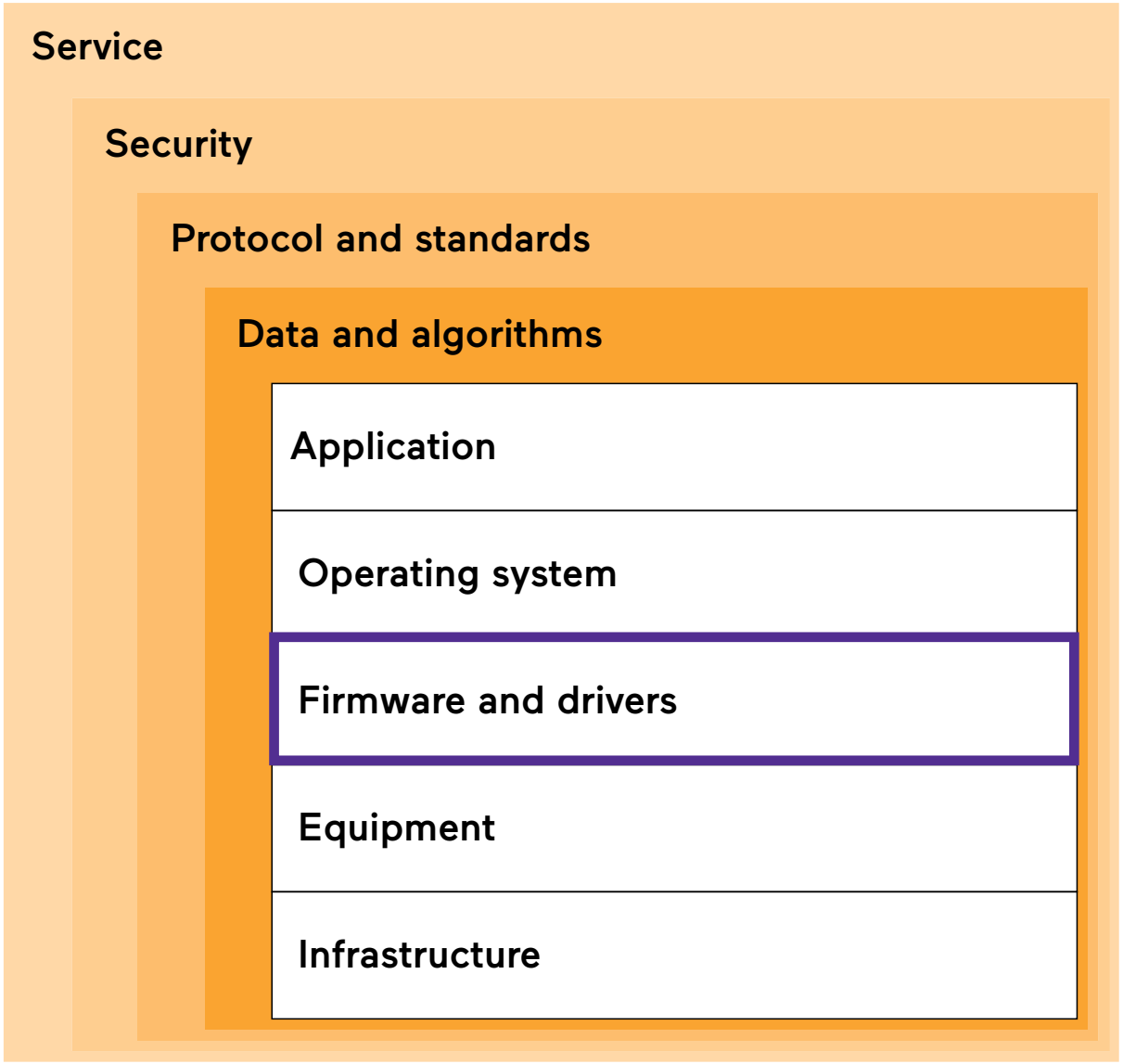
But there are also many devices with an operating system that you might not immediately expect. The operating system is then invisible or hidden. Wifi routers, smart energy meters, a sports watch, the in-car entertainment system – they all have an operating system. If you buy a device, in most cases it's not possible to choose an operating system yourself. For example, the vast majority of smartphones work with Google Android or Apple iOS. On some devices, however, you can switch operating systems (such as on a laptop).



Firmware and drivers

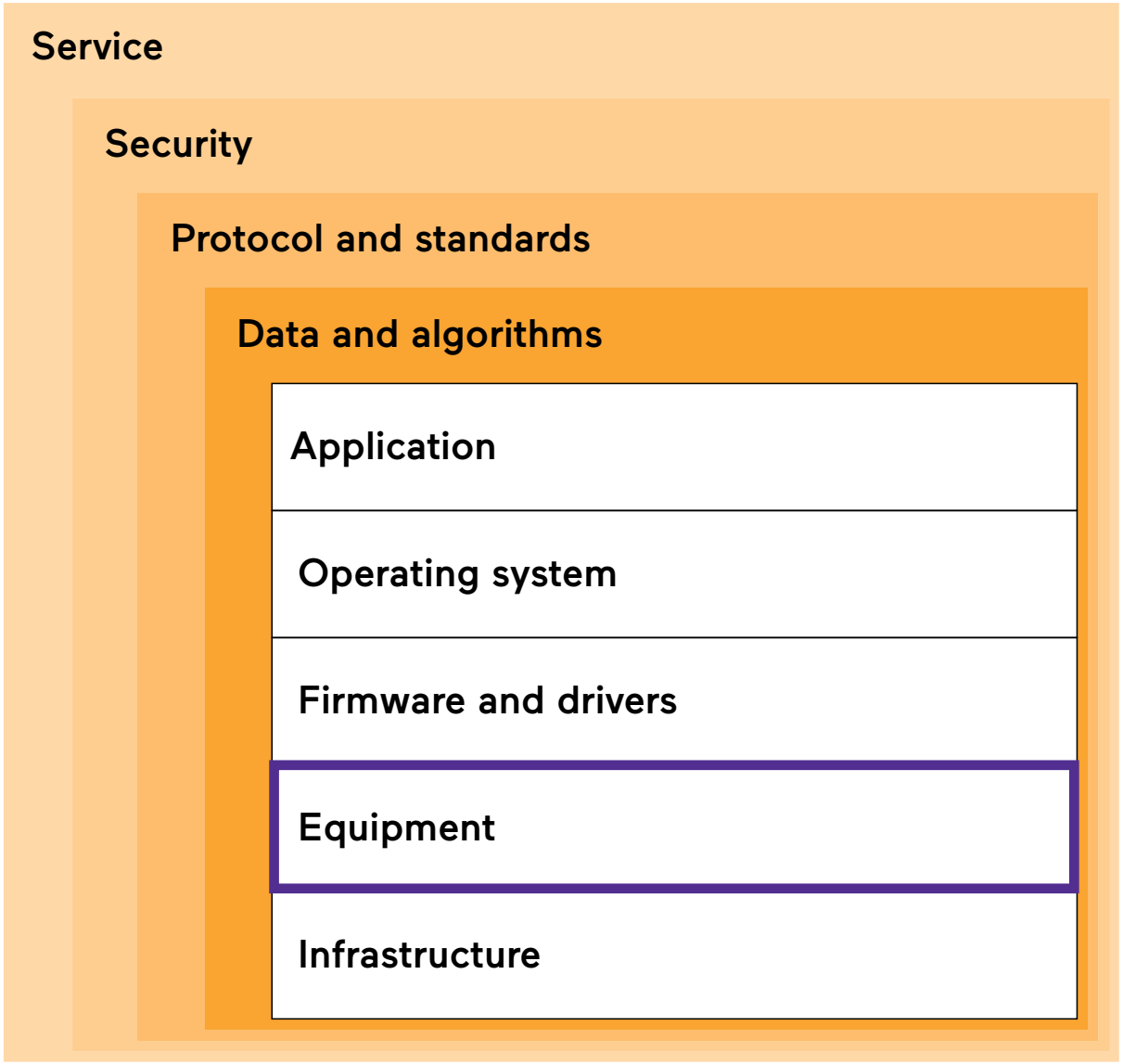
The firmware is the link between the physical components of a device and its operating system. If you press the letter 'a' on a keyboard, the firmware converts this into a digital message that can be processed by the operating system. It is therefore one of the most invisible layers. Firmware runs directly on the hardware and after production is often impossible or limited to modify. Examples are firmware on a remote control of a television or a controller for a video game. Manufacturers sometimes take preventive measures to prevent the firmware from being updated by the owner of the device.

Slightly more complex parts of devices have drivers. These drivers can be updated and ensure that the operating system on the device needs to know as few technical details as possible of the various components. For example, in devices, the components that provide image, sound or data storage are the same as in hard drives that are equipped with drivers.



Equipment

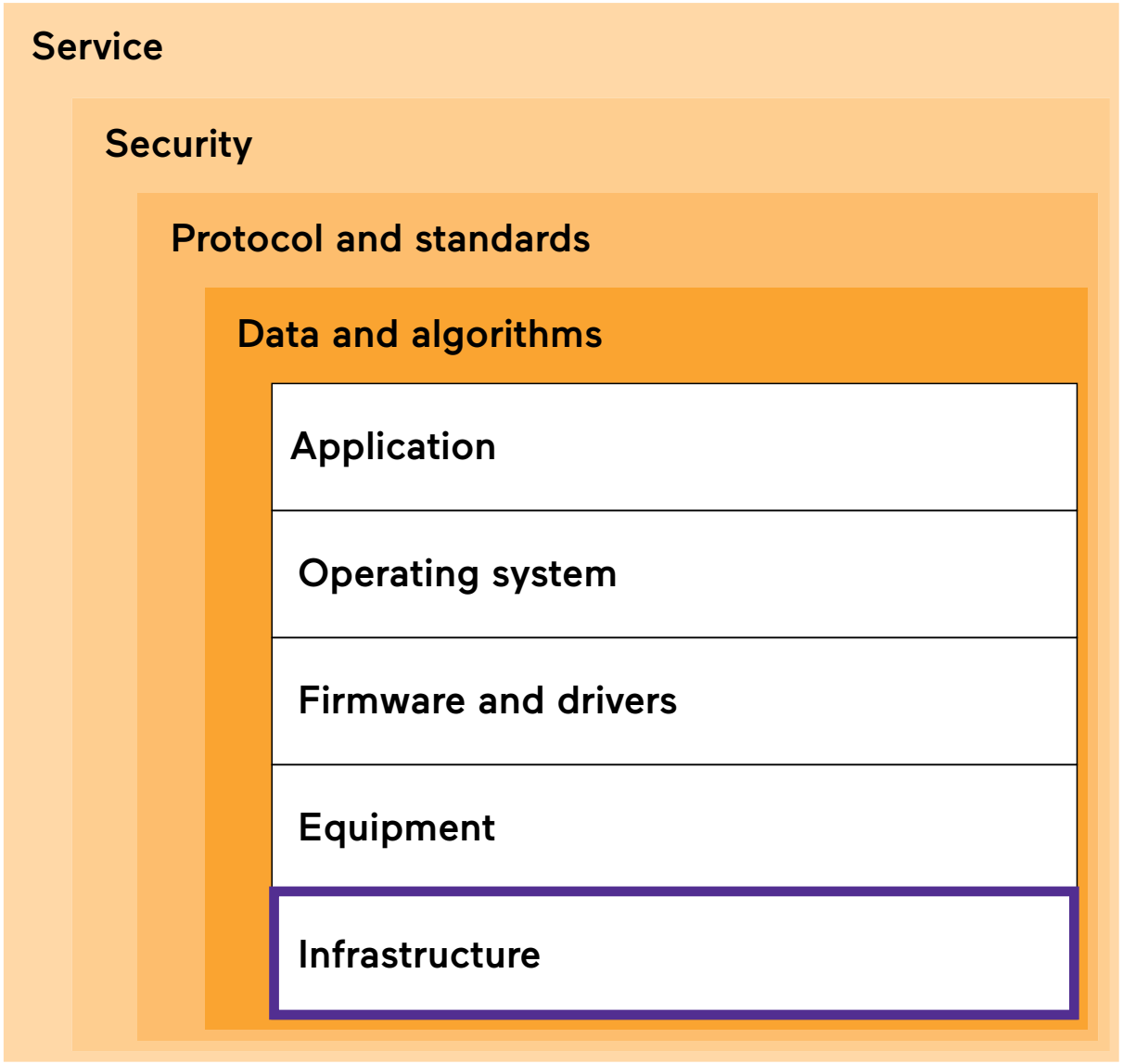
Equipment includes all of the devices we use ourselves, such as laptops, tablets, and smartphones as well as the accompanying hardware we need such as monitors, pencils and chargers. More and more devices are being digitalized. Household appliances such as alarm clocks, refrigerators and washing machines contain incrementally more digital technology and are being connected to the Internet according to a trend referred to as Internet of Things or IoT. This creates more possibilities for new functionalities, but it also introduces new dependencies and raises new questions regarding security, access to the control of the device, and control over the data that is generated.



Infrastructure

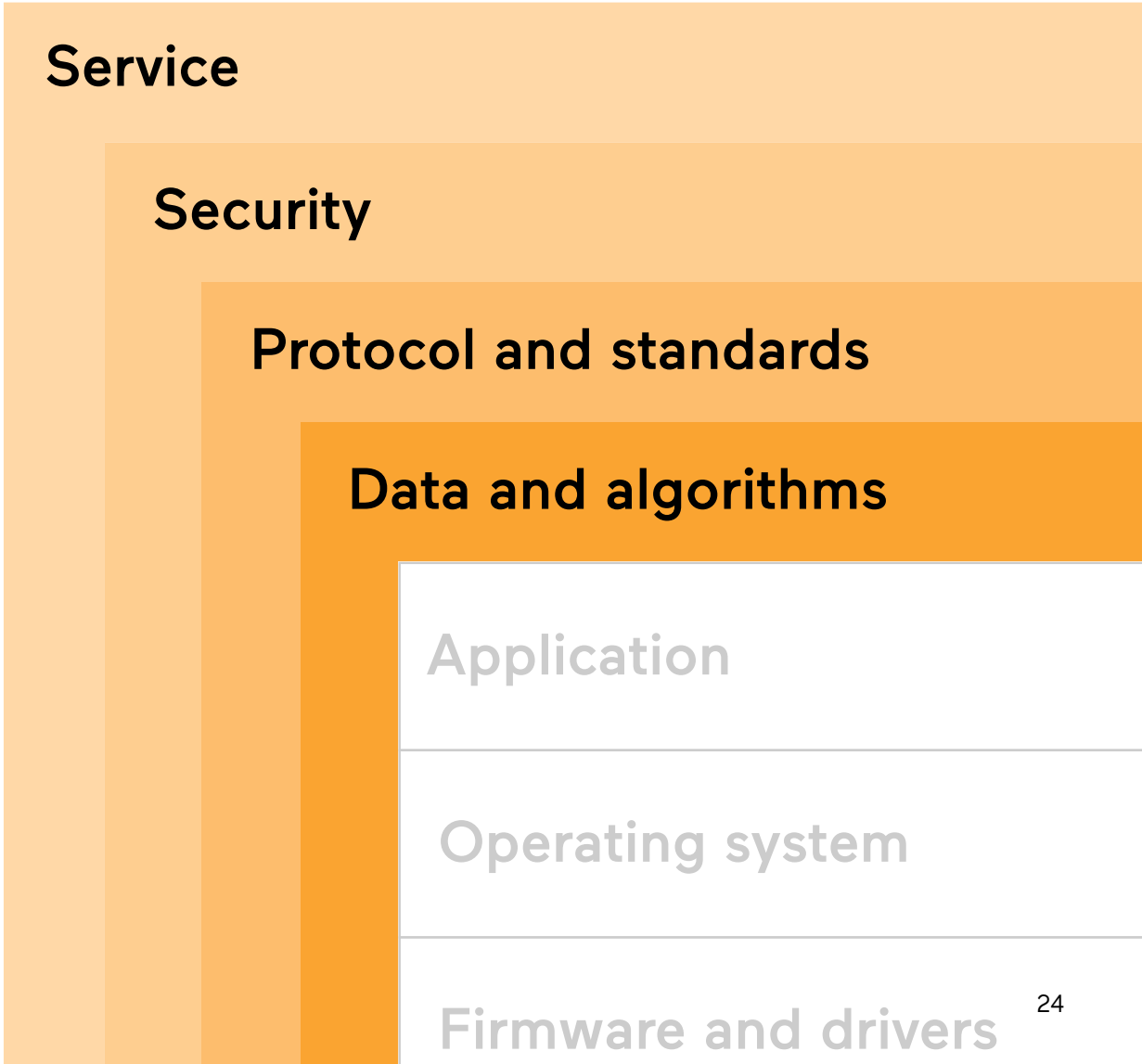
The infrastructure layer connects and supports all upper layers in the technology stack. It concerns network infrastructure, such as internet cables and telephone masts for 4G. Infrastructure ensures that domain names work and are secured. GPS satellites enable positioning on smartphones and navigation equipment. Data centres store our data and ensure that services are available. These many hundreds of buildings containing many thousands of computers make up 'the cloud'.

Managers of nodes in the network infrastructure have great influence and responsibility over the security of networks and data. They can also determine whether certain traffic or use is given priority. Just as the Internet has an international character, the physical infrastructure that supports our digital activity is also global in nature.



The context layers

The layers of the technology stack are connected by protocols and standards. These make it possible for the layers to communicate and exchange data with each other. The technology stack as a whole provides a service for the users. The whole and the individual layers must be well protected against misuse. These important aspects of digitalization affect the entire technology stack and we have now called the context layers. When designing the digitalization, it is important to explicitly include them in the design process.

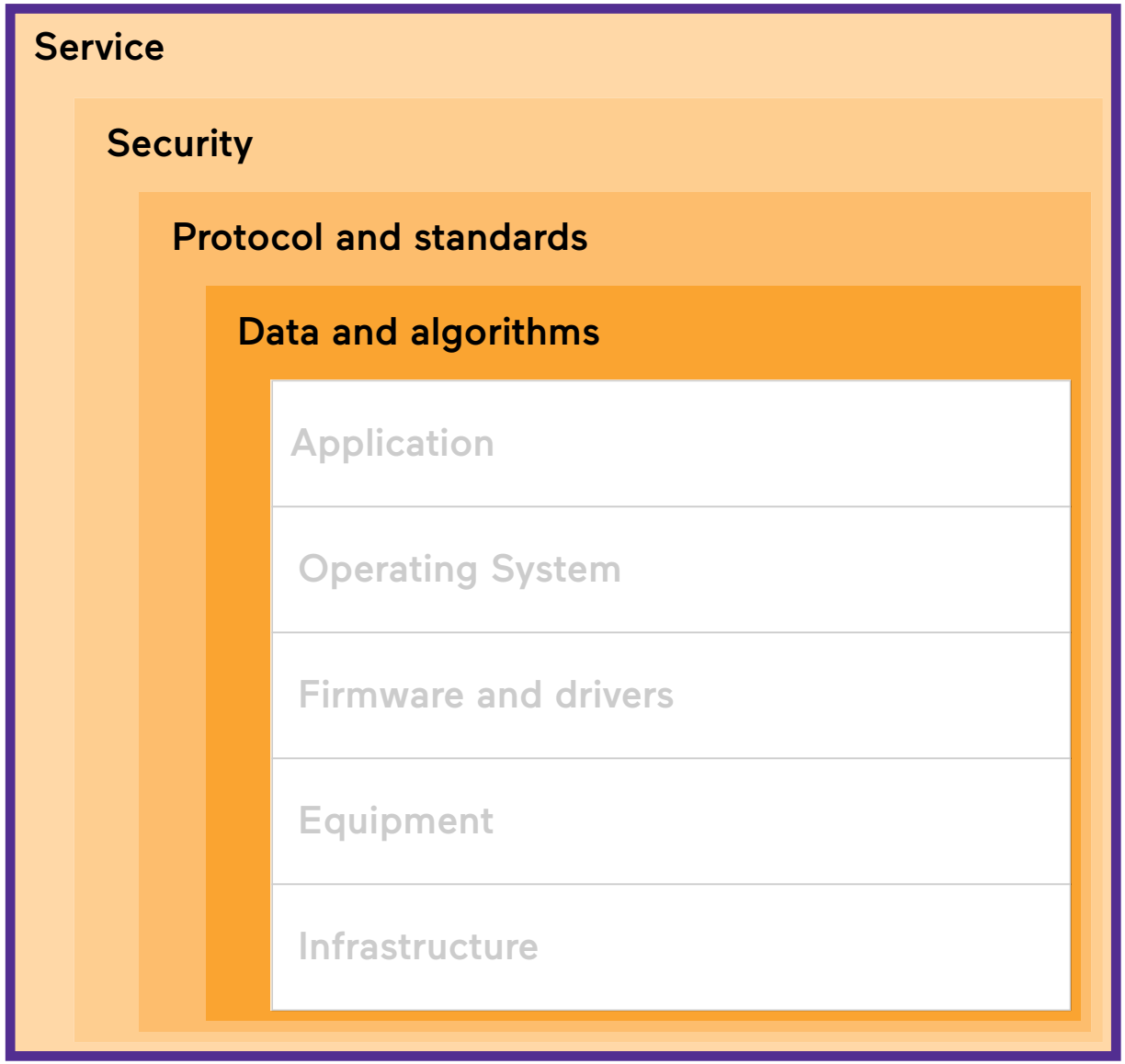


Service

In practice, technology is often used as a service. Characteristic of a service is that it manifests itself across all layers of the technological stack, in multiple contexts and on different devices. An everyday example of this is listening to a song via Spotify. The Spotify app on your phone has access to your headphones via the operating system and firmware so you can hear the song. The song itself is often streamed from a data center over the Internet infrastructure. This means that there is a constant connection between a server and the phone that plays the song: a computer [the server] that sends the song to the device [your phone] via the infrastructure somewhere in the world.

Another example is Sonos: a service that allows you to listen to music in several places in your home. The service consists of speakers and a number of apps to control the speakers. The operation of the speakers in your home depends on the operation of the Sonos technology stack.

These kinds of services play an increasing role in society and therefore raise new questions about how the technology stack can best be designed to serve society and its citizens and avoid unwanted dependencies.

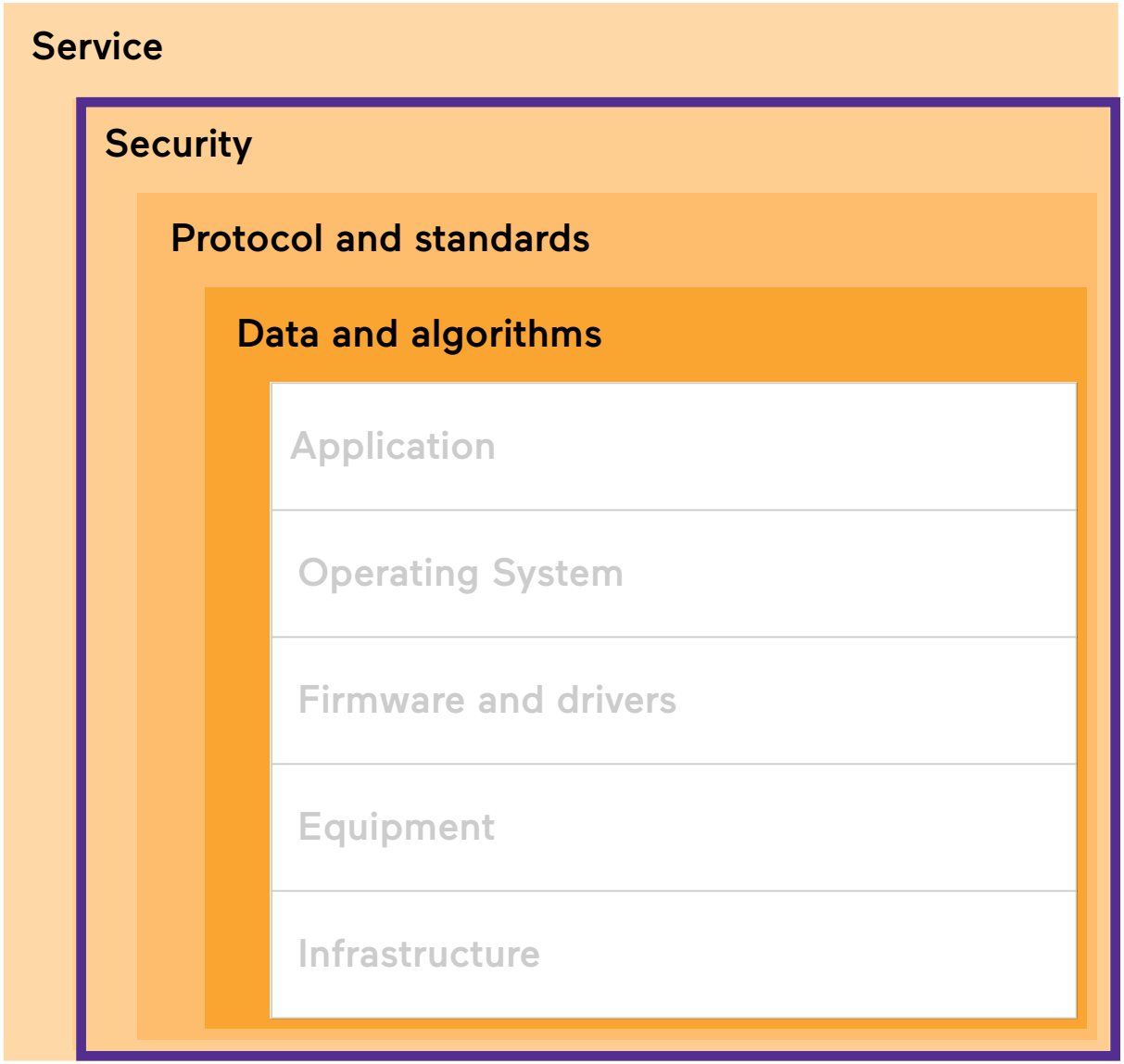


Security

The protection of technology has become increasingly important and complicated. Technology itself has become embedded in an increasing number of networks and has been given a core task in essential societal functions.

Security is about regulating access: after all, if your information sinks into a safe in the Pacific Ocean, it is safe, but not accessible. And that's tricky: the right people have to be able to access certain data and while everyone else cannot.

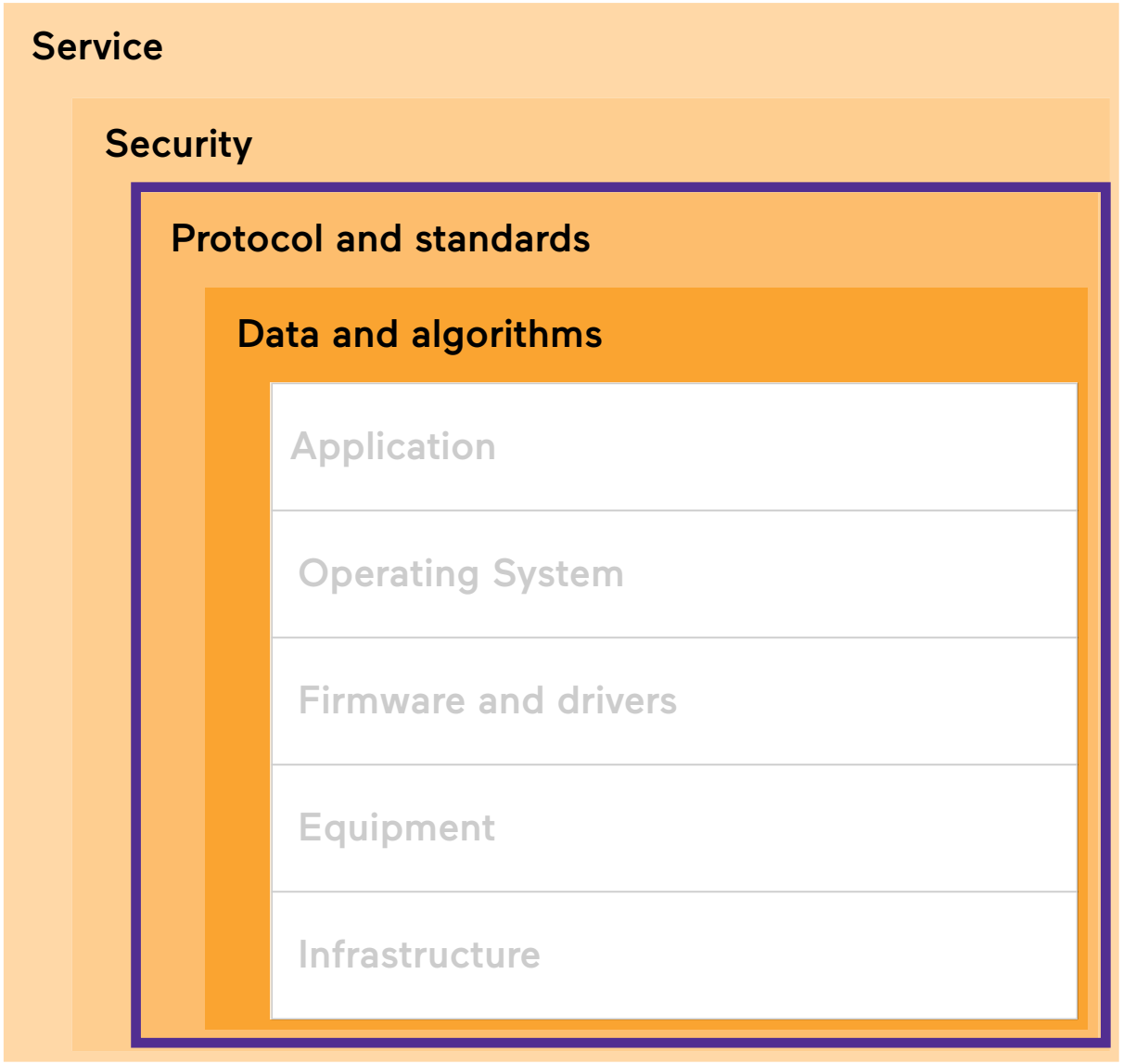
These safety aspects play on all layers of the technology stack. Cyber-security is the discipline that deals with the security of infrastructure and computers. It investigates how computer networks are being attacked with ever smarter methods and techniques and, in response, tries to make the networks and computers increasingly resilient. This is an ongoing game of cat and mouse. Higher up in the stack, on the layers of operating systems and applications, there are often errors in the code that can be exploited, for example, to gain unauthorized access or control over a computer or network.



Protocol and standards

Protocols and standards form the cement between the different layers in the technology stack. A protocol describes the agreements on the exchange of data. When we standardize such a protocol into an 'open standard', it is possible for others to use this standard. This prevents a so-called lock-in, in which citizens are made dependent on a certain product or service. Technology standards are usually drawn up in an international context by organisations such as the IETF and the ITU. These organisations have a multi-stakeholder approach in which companies, knowledge institutes, civil society organisations and governments jointly determine what a standard should look like.

An example of an open standard is e-mail: if you know the email address, anyone in the world can send an email with any computer. Many messaging services (such as WhatsApp and Telegram) use their own closed protocol. As a result, you can only send messages if you use a device that is supported by these companies and you connect to their services.



Data and algorithms

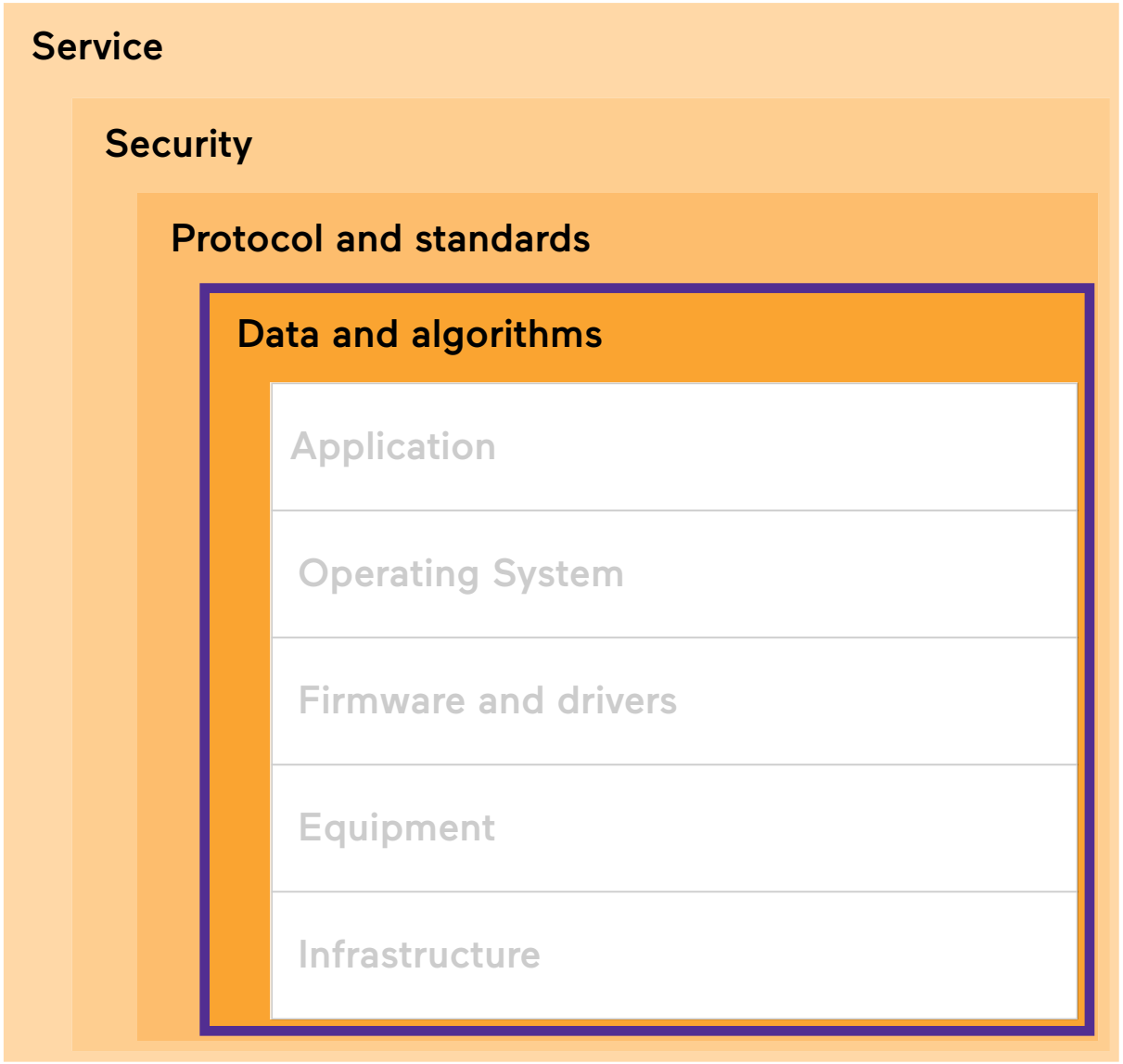
Data is used by all layers of the technology stack. There are different types of data:

1. Metadata is data that describes other data: for example the time at which a message was sent, the sender of the message, or the location from which the message is sent.

2. Personal data is data that can be linked to a person.

3. Open data is data that is shared openly under certain conditions so that everyone can use it.

A lot of data contains (directly or indirectly) data about behaviour: where we are going, what we find exciting, what we don't understand. But data can also contain information about who we interact with, whether we are sporty or sick, what we are sensitive to and what we want to buy. Algorithms are being developed to recognize patterns in all of this data. Data and algorithms are needed to make services work and can form the basis of scientific research, but it can also be misused for manipulation and influence. The collection of data and the use of algorithms therefore involves risk. Consider the example of algorithms that make predictions or need to automate decision-making. It is crucial to design and embed data and algorithms in such a way that fundamental and human rights, as well as transparency and privacy, are safeguarded. Think of data trusts, data cooperatives or data commons. A great deal of research is also being done into the open and comprehensible publication of, and monitoring of, algorithms.



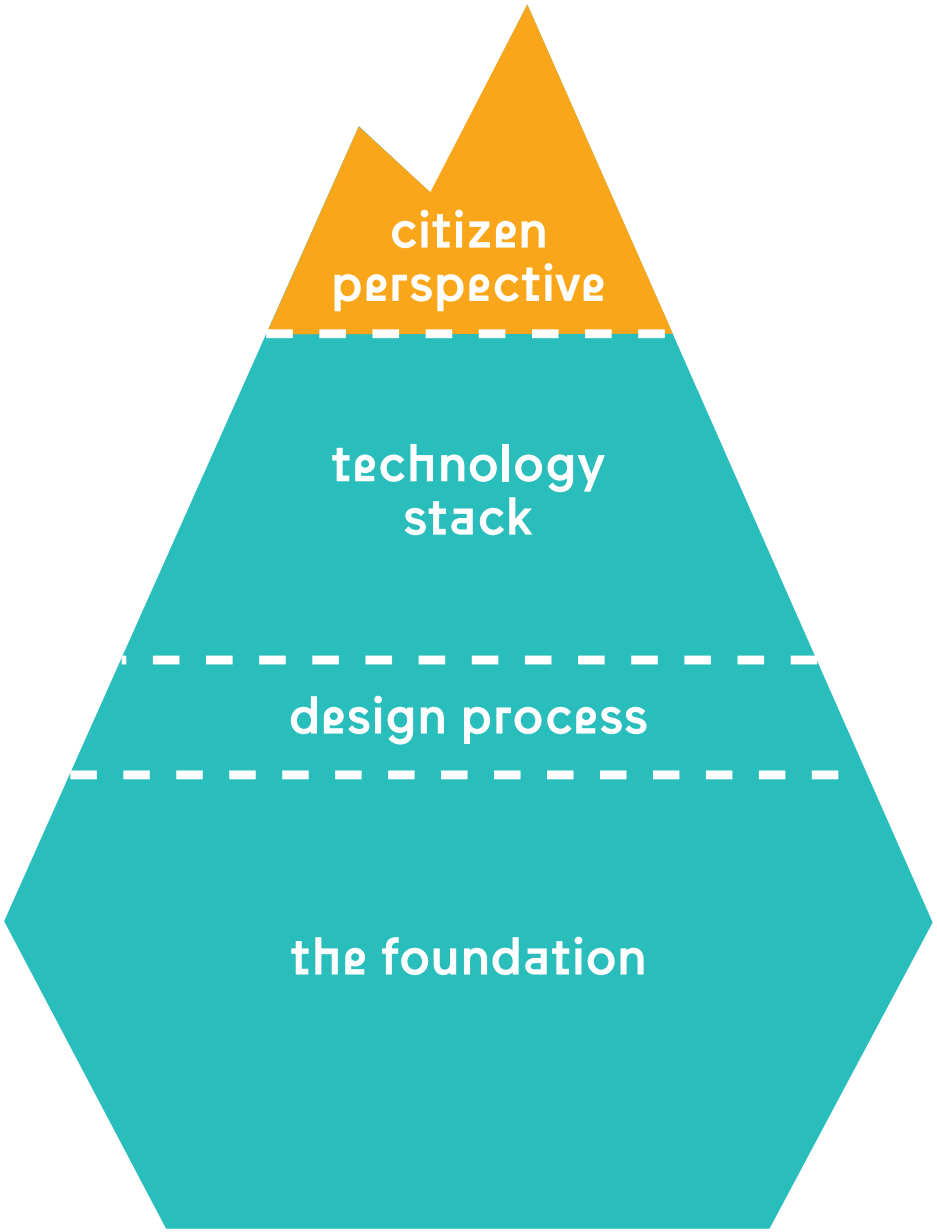
The citizen perspective

After our dive, we now return to the citizen perspective: everyday life in which we all have to deal with digitalization and technology.

We can only get a grip on digitalization if we see the design as a collective responsibility. In principle, every citizen should be able to be involved in the design processes that have relevance in their lives.

This roadmap initiates a design with all stakeholders, based on a foundation of public values in which people and planet are taken into account and governance and supervision are set up in line with these values. We understand technology and how the services we use on a daily basis fit together.

The roadmap is for all of us, but especially for the people's representation which, equipped with this helping hand, can interpret the citizen's perspective and – with it – play an essential role in safeguarding public values in our digital future.



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