European Commission

UNLEASH FUTURE

EIC Horizon Prize on
BLOCKCHAINS FOR SOCIAL GOOD

[DHS]
[Decentralized Health Service]

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1. Abstract (for publication)

Unleash Future is the world's first high IQ organization that serves global for cross-industry and politics. We experienced first-hand how health care differs across Europe, and how poorly data is transferred between stakeholders. Working cross-border, a fundamental idea of the European Union, becomes difficult when you need treatment abroad. To make things worse, some countries already became victim of cyberattacks in their digital healthcare attempts.

We identified three core problems that need to be addressed:

1. Non-transparent and non-standardized interfaces
2. Insecure central data pools
3. Missing data security and safety

It takes an architectural mind shift to solve these problems, which we present in this document. We created an architectural platform called #HealthService to introduce the necessary mechanisms. Technological we will achieve these with Blockchain, smart contracts and PKI signature. In doing so, we consciously re-allocate time and simplify transactions to emphasize communication between all stakeholders.

#HealthSerice allows you to regain full control and sole sovereignty over your personal private health records. We believe that any information collected about you is yours only.
Applying the right mix of innovative technologies, we designed an architecture platform that:

- Improves communication between physicians of different disciplines and countries
- Creates communication between all stakeholders in the health care system
- Reduces drastically the bureaucratic scope of your treatments
- Provides you full control of who can access and who did access your records
- Allows transparency in service while maintaining full privacy of patient's data records
- Provides safety and security, preventing existing threats to human lives by cyber attacks
- Reduce time, costs and efforts for stakeholder
- Introduce transparency in services, transactions and accounting while preserving privacy of personal data
- Ensures compliance to legal regulations

2. Main focus

The team of Unleash Future identified three main challenges in digital health to be addressed as problems. Our mission was to formulate a generic response to the current challenge and include future threats to create a long-lasting striving solution.
The main focus of our idea is the decentralized data management of health and health care data. We introduce a fully transparent approach to digitally connect all involved parties in an individual patient's treatment, while keeping full compliance to protect personal data for any third party. Our solution centers the patient and allows full control of who can access data and transparency of who viewed personal data. This is a major improvement compared to current models.

The health system has many participants, like doctors, hospitals, insurances, pharmacies, pharmaceutical companies and independent research and development institutes. While medical is a people business, there are many stakeholders involved and unfortunately suffering poor communication in a group.

2.1 Problem 1 – Non-transparent and non-standardized interfaces

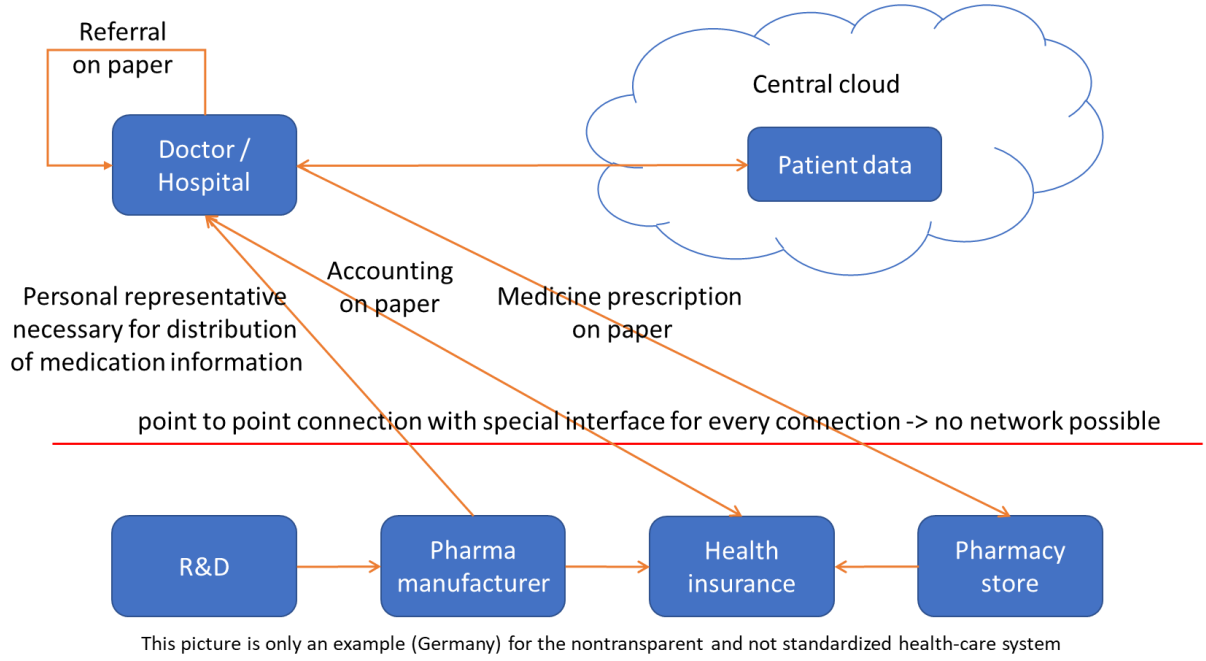

Figure 1 - nontransparent and non-standardized interfaces

All participants have their own and non-standardized interfaces. The communication between the parties is nontransparent, error-prone and often uncertain. The interfaces between the different parties are country specific. There is no digital standard in document format and medical technology often ships proprietary solutions.

Nowadays, many of the interfaces are not standardized and often not even digitized. Critical information is shared on paper! This leads to many mistakes and confusion for the participants.
Some examples in Germany:

"A doctor, general practitioner, is writing a referral to a medical specialist. Dependent on his handwriting, it is difficult to understand what's the reason for this referral. Alternatively, he uses a pinstripe printer, which comes from the last century."
"The accounting between doctor and health insurance is done on paper. It is done with different numbers for the different diseases. As a result, the accounting is very complicated and error-prone."
"Independent R&D is totally out of the game. They can be lucky to find the right patient for necessary studies."

"Official accounting reviews and audits of any practitioner conducted by a third-party bears compliance issues when non-medical personal is viewing paperwork containing names of patient, personal diagnoses and accounting information. Besides of compliance issues, it remains a manual process by humans, which is proven error prone again."

In Germany, we see a very worrying development what happens with the private medical data of the patient. Doctors shall be advised to save the data in a central cloud. Every doctor has to pay money to purchase the technology for doing that.

2.2 Problem 2 – Insecure central data pool

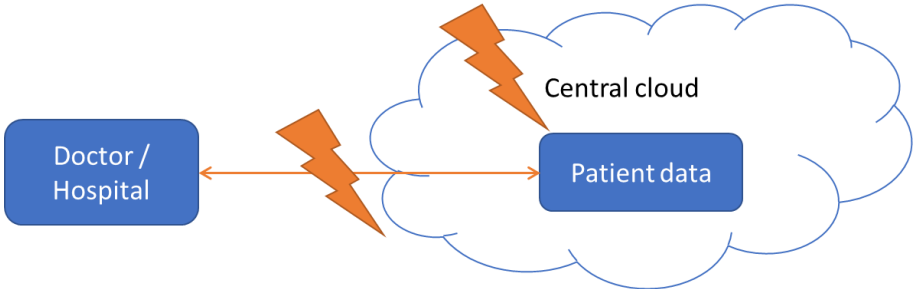

Figure 2 - insecure central data pool

All private data of the patient in a central cloud lures hackers anywhere in the world. All data in one storage increase the desire for getting access to the data. If the hacker is successful, they are able to decode all patient data of every patient.
The communication to one central point opens doors for hackers. Because they know the destination, it is easier to get access.

Health data belongs to the patient, not to a central cloud!

2.3 Problem 3 – Missing data security and safety

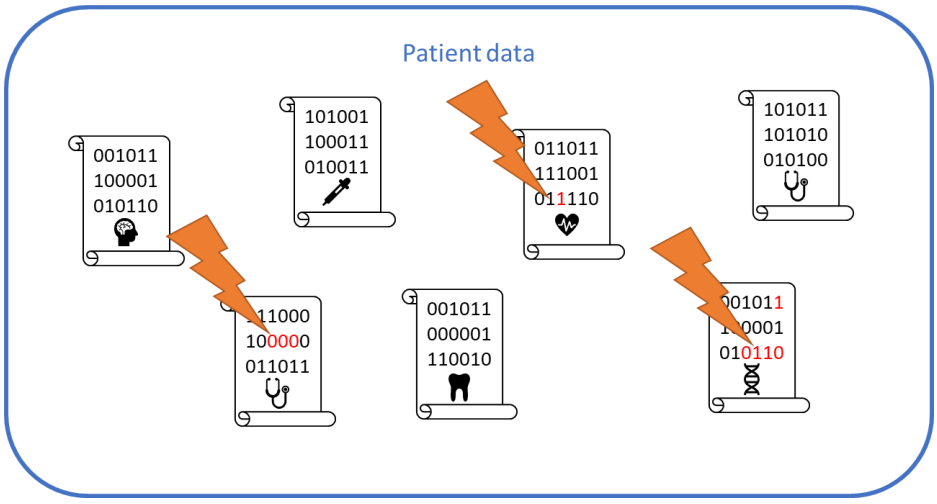

Figure 3 - Missing data security and safety

Safety and Security to human life is endangered by digitalization and cyberattacks. Digital Data in healthcare becomes critical to human safety and security. Therefore, data integrity is extremely important, especially for healthcare data.
Centralized data creates vulnerability, because all data are stored at one place. It's like a big stock of gold, every criminal person wants to steal it. We witnessed feasibility in 2017.

In 2017, hospitals in the UK have been hacked and locked down by encrypting data. The intention for hackers was money.

> *A devastating global cyber-attack that crippled computers in hospitals across the UK has cost the NHS £92m, a report from the Department of Health has found. […] The hack caused more than 19,000 appointments to be cancelled, costing the NHS £20m between 12 May and 19 May and £72m in the subsequent cleanup and upgrades to its IT systems.*[1]

Ransomware caused tremendous problems, costs and threats to hospitals. The motivation was to blackmail money.

We propose sudden actions because future attacks can be triggered by anti-democratic organizations and terrorism like the IS (Islamic State). In such scenario, it behaves like poisoned foods in random supermarket. It is causing anxiety, distrust and you can additionally blackmail organizations. Manipulation of data records can result in wrong treatment. If digital records are altered, treatment can cause significant damage, harm and death. Caused by medical professionals, this is an attack on citizens and creating distrust throughout an entire region, country and/or organization.

Our solution provides generic mechanisms of signature that verifies and validates data records and prevents manipulations by third parties.

2.4 Concept and Solution

Our architecture platform is giving back data sovereignty to the patient.
Your personal data shall be in your control - only.
We will make the communication between the health care parties
transparent, international, save and secure.

The patient should be able to decide what happens to his personal data and who can read and work with this data, who gained access to it, processed and contributed to individual treatment.
The data sovereignty remains with the patients. Our solution is unique because we center the patient, avoiding any point-to-point communication with special interfaces but provide transparency and privacy between all stakeholder. It is a generic approach that creates a new architecture and platform in which all stakeholders can participate and interact seamlessly.
We significantly reduce efforts, time and costs involved in data transaction, creating added value to every stakeholder in the healthcare industry. In doing so, we will not create another stakeholder participating, but a strong foundation that is continuously improving, maintaining and developing the cross-country architecture platform.
Our mission statement is clear: we center the patient, who regains full data sovereignty.
We reduce time, costs and efforts for stakeholder to collaborate. Our solution is fully compliant with data regulations such as GDPR. Accounting is easy, transparent while data privacy is guaranteed.

Due to this we *initiate a grassroot revolution!* People who use the #HealthService system, will become strong supporters and ambassadors of our solution.

Three core problems need to be addressed:

1. Non-transparent and non-standardized interfaces
2. Insecure central data pools
3. Missing data security and safety

[1] Source: https://www.telegraph.co.uk/technology/2018/10/11/wannacry-cyber-attack-cost-nhs-92m-19000-appointments-cancelled/

2.4.1 Addressing problem number 1, "Non-transparent and non-standardized interfaces"

We designed a generic approach that generates and manages identification (IDs), stored in a Blockchain.

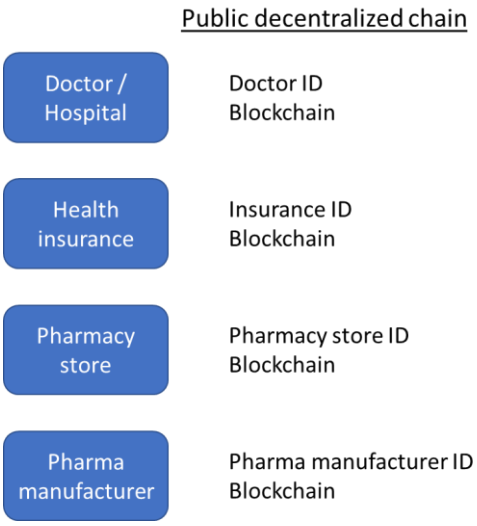

Figure 4 - ID Blockchains

These IDs are unique and can authenticate stakeholders participating in the network of #HealthService. This is a standardized mechanism, yet generic, so everybody participating can be verified. Blockchain provides a decentralized solution that ensures maximum transparency. Because it is decentralized, this becomes a transparent and standardized interface.

Our solution is addressing the interfaces between communication partners. We are fully aware of non-standardized and proprietary document types, e.g. of MRI hardware and other special hardware used by medical professionals. First, we must provide secure and save communication between stakeholders. Then, each player will become advocate for open document formats, pushing industry to proceed in such actions. This will be a downstream and completely logical step once the participants work together on a common architecture and platform.

2.4.2 Addressing problem number 2, "*Insecure central data pools*"

Our architecture is designed to center the patient.

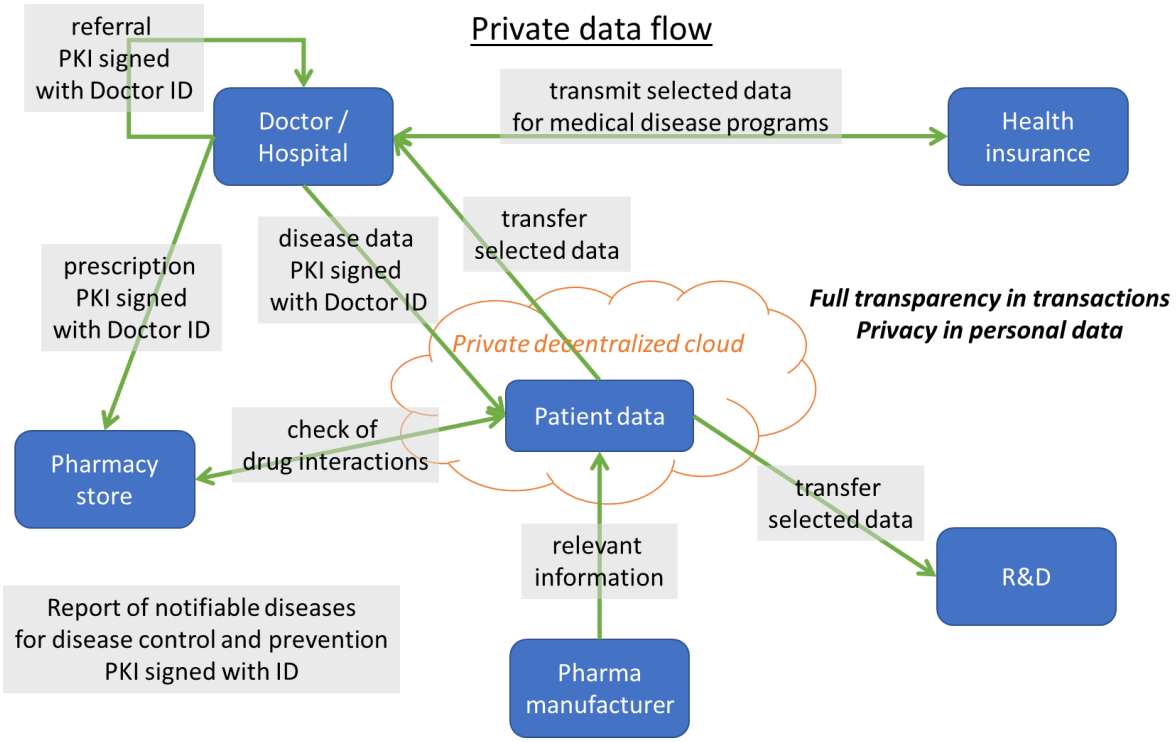

Figure 5 - transparent transactions, privacy in personal data

The patient is a source of personally identifiable information that is measured, monitored or generated only for his or her person. Therefore, they shall keep control and sovereignty of data collected from or about them. Data must not be stored in central data pools of organizations. Storage becomes agnostic in this procedure, but it shall only be accessible by the patient. The patient can manage access privileges and track individuals who gained access and participated in their personal treatment. To fully grasp the idea of access control for reading, simply think of a printed document on which you see every fingerprint of the person who got to read it.

2.4.3 Addressing problem number 3, "Missing data security and safety"

We warn about the rising risk of data manipulation that can cause significant harm to human lives, even threat of death because of data manipulation causing fatal treatment.

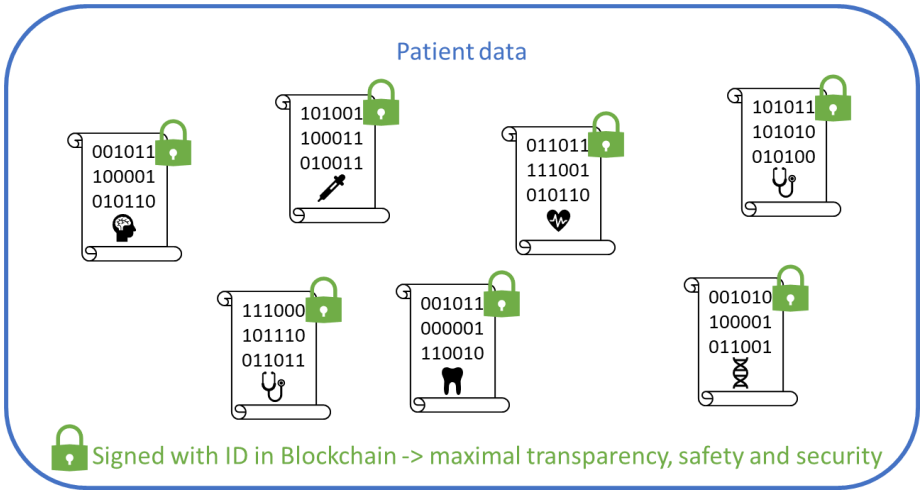

Figure 6 - secure and save data due to Blockchain

It takes an architectural shift to alter future attacks on healthcare data.
The architecture platform that we propose is providing generic mechanisms to sign and verify all data records. Manipulation and altering of these records become impossible. False entries by professionals can be marked and updated, but history stays complete and safe at any given time.
We use IDs managed in Blockchains to track the origin of each document and data record. We also sign and verify every document to ensure data integrity. To keep the Blockchain lean, efficient, economically and ecologically responsible, data itself is not stored in the Blockchain, but all attributes necessary to verify and secure data records. Altering data records will not be possible. Any error or false statement needs to be updated in new records.

2.4.4 New opportunities

I**n digital communication**, verification and separation of classified data on single records, **we open a new field for additional services and significant improvements.**
These improvements are in the field of accounting, contracting, research and development of new drugs and medication, automatic transactions and various customer centered operations. This customer centered operations are for example control of complementing medications, reservations, re-occurring medication for chronical diseases, continuous monitoring as well as providing anonymous datasets to drive research and teaching.

The following exemplary picture shows seamless, digital secured data communication between stakeholders in the health care industry and service. Our architecture platform is including medical professionals such as doctors, organizations like hospitals, pharma stores, pharma manufacturer and health insurance.

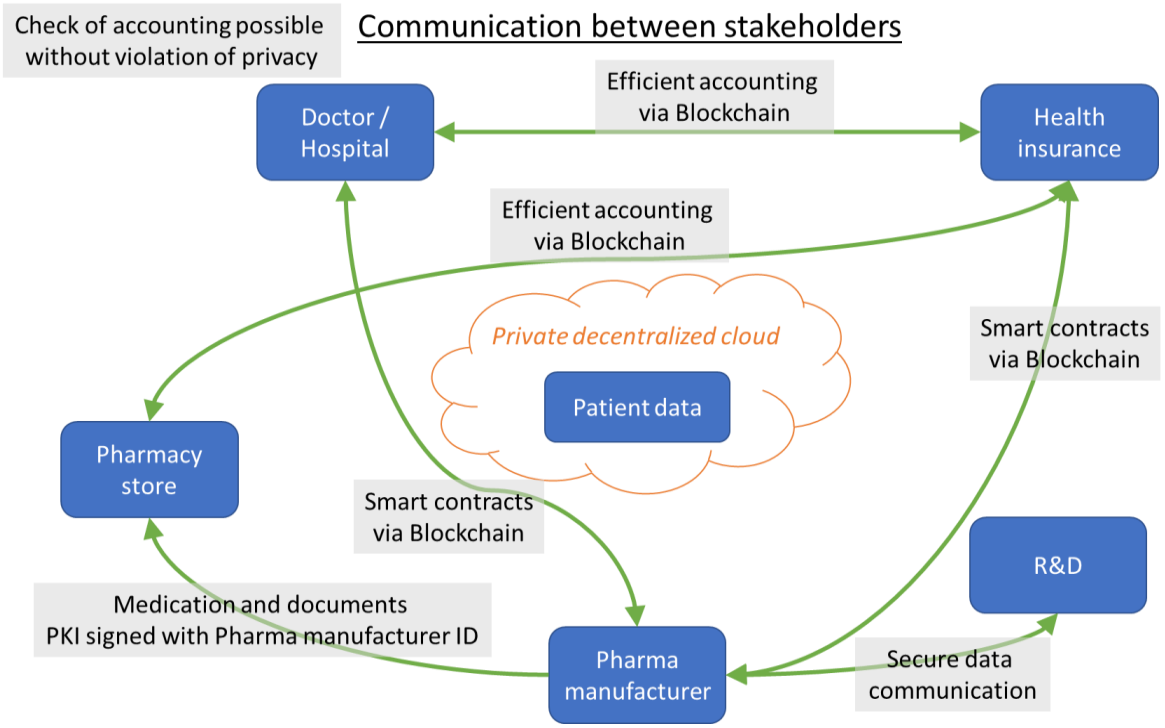

Figure 7 - transparent and standardized communication

Unleash Future already interviewed corporations, including the one of the world's largest pharmaceutical companies located in Europe. Currently, R&D is developing medication in a waterfall approach. There is not enough feedback about medical treatment and currently no mechanism for continuous improvement and development of medical devices, drugs and medication. We are the first architecture that is open for all players, providing mechanisms to add teaching, research and development of corporations and universities alike.

Because of the patient data being the single source and sovereignty of individuals, our mechanisms are designed to contribute data, not identity, to those who continuously improve medical technology and, drugs and medication. Simple in design, contributing will become easy with a single click on a button.

Our architecture platform is launching a cross-country collaborative network unleashing the great potential of European R&D to strengthen our position in the global community.

Smart contracts allow both, contribution of information to teaching, R&D, accounting and financial audits of institutes, companies and organizations. Any medication and documents are PKI signed. Pharma manufacturer can use their individual ID to verify their data. Cross-medication can be checked – we are first to create a digital, secured and validated mechanism for new technology providing services to customers and professionals, such as medication cross-checking and big-data analysis for drugstores.

Digital contracts and billing provide excellent mechanisms to separate data records to ensure privacy of patients and transparency of accounting. Currently, it is difficult to ensure full GDPR compliance when third-party account audits take place. Digitally, this will be less error prone and fully GDPR compliant.

The concept of Europe is to keep people moving and foster cross-border collaboration. In today's healthcare, we experience great difference and insufficient communication when travelling. It is our software architecture that enables seamless service to individuals and provides communication that is secure, transparent but still keeps privacy of personal data to the highest priority.

This is done by our Blockchain solution that keeps accounting information and data signatures available to all parties. Trust is the key to provide digital collaboration and validity of data. This is best achieved with Blockchain technology. Blockchain will provide exactly this trust model. To keep the Blockchain efficient, economically and ecologically responsible, we designed an architecture that can adapt to future findings and improvements but keeps relatively small in transactions. As a service, it will include in processes and current technology. As an app, it will provide data to patients and medical professionals. Professionals may interact by apps and/or existing services that adapt for future architecture.

We are looking forward to seeing many new services evolving and innovating our current healthcare. For now, we focus on an open platform and new architecture to create the strong foundation and framework for future innovations.

2.5 Application area of our social innovation

#HealthService serves multiple categories indicated in the rules of Contest.

The biggest match is category "*d) enabling the development of decentralized social networks or clouds, or of decentralized platforms for the collaborative economy*":

#HealthService is an architecture platform introducing seamless, secure and validated communication between healthcare stakeholders. Collaborative economy in favor of improved treatment of patients and continuous development of drugs, therapy and medical procedures is therefore core of our solution.
In our decentralized concept, stakeholders can validate and collaborate in a medical network including the full value chain without prior knowledge of each other. We provide a digital solution balancing transparency in transactions and communication while preserving full privacy of personal data.
#HealthService is creating trust between previously unknown parties. The open and standardized interfaces will create a platform and initiate development of social networks. Because trust is generated by decentralized mechanisms, growth and innovation will happen. We introduced 2.4.4 New opportunities as a chapter to present our framework enabling future development, growth and decentralized social networks.

There is also a great match with the following category "*b) allowing for a greater visibility of public spending and a greater transparency of administrative and production processes*":

Transparency of actions and communication is currently not given. For example, the costs of treatment are not known to the patient. Without this knowledge, patient appreciation is limited to the healing process alone.
Our #HealthService will allow greater transparency of spending and provide transparency of all stakeholders involved. Accounting can be simplified and automated. Data records can be provided for financial audits, generating transparency to third parties while preserving privacy of personal data.
We forecast that full transparency of accounting by Blockchain and smart contracts will generate appreciation and respect for the entire healthcare system in our society.

We identified an additional application area of our social innovation that we like to highlight "*g) cross-country digital infrastructure for future collaboration and cross-border treatment*":

Our solution is generic and centers the patient, creating a grassroots revolution. We boiled down to the core of our medical system, the treatment of a patient by his doctor. Generic mechanisms keep information in the sovereignty of the patient, but include all stakeholders of the treatment, including medical professionals of all kind, insurance companies, drug stores, R&D of pharma companies and many more.
Identification and verification of stakeholder can take place even cross-country. The European concept is encouraging cross-border activities. In our travels, we experienced insufficient solutions in various countries of Europe, but even worse, cross-border activities between medical professionals were completely out of scope.
Our solution can provide the necessary mechanisms to collaborate internationally in Europe, independent of where treatment takes place and even if the patient is moving across borders. Even the United Kingdom.

We see small overlaps with category "*e) managing property, land registry or other public records*":

We create a totally new public record. The new public record is the #HealthService ID's Blockchain.

Also the category "*f) contributing to financial inclusion*" is applicable:

Official reviews conducted by a third-party bears compliance issues when non-medical personal is viewing paperwork containing names of patient, personal diagnoses and accounting information. This happens for example when doctors or therapists have a tax audit.
Our solution promotes digital contracts and billing. This provides excellent mechanisms to separate data records to ensure privacy of patients and transparency of accounting.
Currently, it is difficult to ensure full GDPR compliance when third-party audits take place. Digitally, this will be less error prone and fully GDPR compliant.

3. Nature of the application

New decentralized architecture

Our solution #HealthService addresses a European need for cross-country data management. This data management keeps compliant with regional rules and fully adapts to regional habits and processes in healthcare management. It is best named as 'new decentralized architecture', because patient and single individuals will rely on advanced app technologies, while professionals may integrate solutions in their existing infrastructure as a service.
Blockchain is the underlying technology that connects the various dots creating a network of interoperability, trust and security among all parties.

4. Participant(s)

Unleash Future - Engineering Office Lars Holger Engelhard

MBA B.Eng. Lars Holger Engelhard - Technical lead
Extraordinary global cross-industry expert
CyberSecurity, IT & technology architect
Visionary mind and leadership
Strategist & Inventor
Superpower: thinking outside the box

Dipl. Ing. (FH) Stefanie Engelhard - Lead-Autor
Lobbyist & program manager (V2X)
Hardware & communication expert
Exceptional mindset and project lead
Inventor & Entrepreneur
Superpower: cross-industry solutions

Supporter:
Dr. Lorenz Eberle
Experienced doctor and innovative mind
Michael Wüstefeld
Finance professional and husband of a physiotherapist
Unleash Future Think Tank Members
The world's first high IQ organization serving cross-industry & politics contributing to this document.

We can also rely on an exceptional international teams, organizations and supporters.

For the development of this architecture we will create a new foundation/company "Unleash Future Health Service" and hire additional employees.

5. Source code

Decentralized information that is transparent will certainly become open source.

The character of this application is a solution that provides an **architecture platform** for all stakeholders to communicate, share and progress treatment of individuals. Interoperability requires a great openness of interfaces and clear structures.

However, to make existing solutions participate in the new architecture platform, certain closed source modules, external and internal, might become necessary. Existing, mostly proprietary solutions may require adaptation to the open standards. Therefore, it is unclear which type of license will finally be applied that can guarantee a striving architecture platform in which new solutions can choose their license while proprietary stakeholders can choose to adapt the mechanisms necessary for European collaboration in medical healthcare.

The team currently investigates on the solution to address processes and best practices of European countries such as Germany, Sweden, Norway, Austria, Switzerland rather than legal license models.

The complete team of #HealthService agrees that a strong foundation is necessary to push this long-term mission. Our solutions will provide an architecture platform for current stakeholders in Europe, providing a fully digitalized mechanism. This will significantly reduce costs in our healthcare system.
After deployment of this system, maintaining and continuously improving this architecture is crucial for the long-term success. We plan to continuously re-capitalize the foundation to ensure a strong organization capable to promote the architecture and communicate with stakeholders in industry, politics and public. This is achieved by minority provision on transactions, consulting and advisory to adapt commercial implementation to participate in the architecture platform. Therefore, we will need to find a proper licensing model balancing social aspects and providing re-capitalization of the foundation. Approaching foundations like Mozilla Foundation and Apache Software Foundation will certainly push efforts to find a proper solution for #HealthService.

To avoid any conflicts, it is feasible to create a foundation dedicated solely to the #HealthService architectural platform, serving the social wellbeing and continuously developing and safeguarding the architecture.

6. Adherence to the award criteria

6.1 Positive social impact

We are already connecting to stakeholders in Europe, including medical professionals, drug stores, stakeholders in treatment, such as physiotherapists, and large pharma corporations. This creates an architecture and platform that can connect all stakeholders. To the date of submission, we created a profound architecture that improves in direct communication with stakeholders. In the next phase, we will start implementing a PoC (Proof of Concept) in which stakeholders can verify feasibility. Technology involved is already available, but we create a platform that is unlocking unchartered territory. Therefore, prototyping will allow us to achieve full coverage of requirements across the stakeholder.
In 2018, 73 million insured persons were registered in the German health insurance fund, 8,74 million in private health insurance.[2] 392.400 medical professionals were registered.[3] This is an enormous community size that is addressed in our solution. And we go cross-country for Europe!
Since 2015, #HealthSerivce is designed in iterations, starting from generic approach and technical feasibility, we gradually expanded our network to medical professionals, treatment participants, medical accounting. Since 2017, we take this approach abroad and include insights of other countries. In 2019, we started to add further stakeholders: organizations like hospitals, the pharma industry, R&D and teaching institutions.
The EU Horizon Price is the perfect opportunity to introduce the concept to a broad audience and take the idea into actions.

Our solution is generic and centers the patient, creating a *grassroots revolution!* People who use the #HealthService system, will become strong supporters and ambassadors our solution.

6.2 Decentralisation and governance

The main focus of our idea is the decentralized data management of health and health care data. With our solution, the health data sovereignty will remain with the patients. We center the patient, introducing seamless, secure and validated communication and providing transparency and privacy between all stakeholder. It is a generic approach that creates a new architecture and platform in which all stakeholders can participate and interact seamlessly.
We significantly reduce efforts, time and costs involved in data transaction, creating added value to every stakeholder in the healthcare industry. In doing so, we will not create another stakeholder participating, but a strong foundation that is continuously improving, maintaining and developing the cross-country architecture platform.
In our decentralized concept, stakeholders can validate and collaborate in a medical network including the full value chain without prior knowledge of each other. The collaborative economy will improve treatment of

[2] https://de.statista.com/statistik/daten/studie/155823/umfrage/gkv-pkv-mitglieder-und-versichertenzahl-im-vergleich/

[3] https://de.statista.com/statistik/daten/studie/158869/umfrage/anzahl-der-aerzte-in-deutschland-seit-1990/

patients and continuous development of drugs, therapy and medical procedures. We provide a digital solution balancing transparency in transactions and communication while preserving full privacy of personal data.

6.3 Usability and inclusiveness

Our proposed solution is centered on patients. This means that we include all citizens, independent of their state or gender. We currently learn about the challenges in Germany, but we already receive notice from other countries that our solution is meeting international requirements and adopts to different procedures and therapy mechanisms. We connect individuals conducting treatment for a citizen. That keeps us agnostic of country specific aspects. Since we keep highest focus on transparency in transaction but keep privacy of user data at the same time, we eliminate any conflicts with country specific rules. For both usability and inclusiveness, we are well prepared to present a technology to support seamless health services across Europe.

At the same time, we keep required background and computer skills low, because mechanisms shall be simple to be used by any citizen. As an entry requirement, we need awareness of technology and connectivity at least, as people with a smartphone do. Procedures of handling will be easy enough to adopt in real-live by imitating other patients and follow simple advice of medical personal.

6.4 Viability at large scale

Since we focus on health service, citizens across Europe are addressed equally. We promote a new architecture and platform to ensure scalability and security. Ecological sustainability is important and Blockchain shall only contain relevant information and attributes for data verification and authorship of data records. We ensure efficiency of storage, energy consumption and environmental impact.
It is extremely important to keep energy consumption low and balance technology, comfort, social and environmental impact!
Security is the biggest advantage of our solution. Since paperwork can be viewed without leaving evidence, we can provide a track record of reading access for each data record. The possibility of making changes in order to inflict harm on a patient becomes impossible.
Our solution fits the needs to drive a cross-country European foundation that can connect all parties and stakeholders in the health care service and industry. It is possible to scale extremely quickly.

6.5 European added value

Our solution secures any critical medical data. It becomes impossible to manipulate, alter or misuse by any third parties. It is an architectural platform that provides generic mechanism, centers the individual and enables stakeholders across the full value chain to collaborate, share information and proceed treatment across different countries in the European union.
We achieve data sovereignty and introduce both transparency of the health industry while keeping private data secured with individuals. In our European and global mindset, we will introduce an open standard that enables visionary thinkers like us to jointly push for a striving future in the European Union.
It is important to us that this is fully compliant with individual regulations and the patient's privacy. Therefore, we created a concept and architecture that mitigates existing threats and presents a platform for future collaboration and striving economy at the same time. Blockchain is the backbone of our idea to preserve these principles in a decentralized, trusted network that is applicable in different nations at the same time.
Treatment will be continuous and seamless regardless of travels abroad.

7. Publicity measures

In our concept, we see a great potential in distributing the idea throughout a large network. We will do this in our international Think Tank 'Unleash Future', as well.
Spreading the idea and the deployment of the #HealthService will initiate the grassroot revolution. Due to this we support, encourage and promote the communication of our solution. We authorize and encourage the Commission services to disclose additional information about our solution.
Social media like Facebook, Twitter and LinkedIn will be one of the most important media to distribute information. Reference of authorship Unleash Future and linking to #HealthService is much appreciated to grow our network and engage with future supporters.

8. Ethics

We introduce our solution to the EU Horizon Prize 2020 to improve health service in Europe. We counter current hacking attacks and prevent potential threats by digital terrorism for safety and security of our most valuable personal data of each citizen. In our solution, we introduce new options to allow transparent transactions and verification mechanisms while protecting individual data. Since we are compliant to strongest privacy regulations, we consider Ethics as a base of any our actions.

Ethics is the fundament of our solution, since data is treated as private property of the individual patient. Transparency in transaction is guaranteed to prevent fraud, misuse and criminal attempts. We do not intend to alter current business but create a software architecture platform #HealthService that connects all stakeholders throughout the healthcare participating in medical treatment of individuals.

Planned as a foundation that is dedicated to public service, we aim to create a strong and meaningful organization that is independent and self-organized. The foundation will be funded long-term by reduction of process costs in current healthcare mechanisms by digitalization. We consider this ethically important because we will not introduce another corporation participating and creating costs. Instead, we will provide a platform that is meaningful and benefitting participants equally, improving the process and creating new opportunities for Europe to become a striving force in this public service.

9. Table of Figures