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Executive Summary	The project "Connected for Health" was active from June 2015 to June 2016. The main part of the project was to establish four pilots, one in Denmark, two in Finland and one in Sweden. The aim of the pilots was to gain experiences on the use of FTTH (Fibre To The Home) and broadband for applications in social care and healthcare ("digital homecare"). This report is about recommendations aimed as a knowledge foundation for decision- and policy-makers as well as other stakeholders who plan to establish and/or expand their FTTH/broadband networks to include digital homecare applications. The recommendations are based on the experiences from the pilots. This project, although limited in time, has created a real and positive experience for the participants of the pilots, the end-users, the staff, and industry about what is achieved and what is possible in the future. This includes e.g. empowerment and better quality of life for the end-user; staff appreciation of new, efficient and quality work processes; industry experience of an expanding market segment and cost savings for municipalities. The recommendations of the consortium are as follows: 1. Support the deployment of FTTH networks to provide connectivity in rural areas 2. Define a specific digital service class for digital homecare services including performance specifications and network requirements for their delivery 3. Standardise the technical platform for delivery of digital homecare services using a dedicated communication channel ("welfare broadband"). 4. Promote operator-neutrality, open access for the new FTTH networks, and encourage local government involvement 5. Define sustainable business models, highlighting financial and non-financial gains for all the key stakeholders; make sure that the authority in charge of providing homecare services (digital homecare) has a financially sustainable business model; and spread successful experiences and best-practices, which are now starting to appear. 6. Prepare for organisational changes and training programmes necessary for the new digital services to be successfully introduced
Keywords	Broadband, FTTH, healthcare, social care, eHealth, digital homecare, telemedicine

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1 Introduction

This report contains a collection of recommendations aimed at policy makers at local, regional, national and European level on the topic of digital homecare and open FTTH (Fibre To The Home) networks. The report has been produced by the team of Connected for Health (CfH) project[1] which was active during June 2015 – June 2016. The background of the report is in the scope of the EC Call that expressed interest in two significant aspects of the use of FTTH with open access in addressing the demands of the ageing population in Europe. The first aspect is to explore the possibilities of sharing the experiences from the Nordic countries -- with the development of optical networks making broadband access available to the rural households -- with other European countries. The second aspect is to analyze and process available information on the use of FTTH for improving access of citizens to healthcare and social care services, with positive qualitative and economic benefits.

Along with the development of the EU Digital Single Market (DSM) strategy, the findings in this report may also serve as a catalyst for market growth of digital homecare services and products in rural areas.

Please note the following definitions in the document

- **Digital homecare:** social and health care delivered with the help of information and communication technology (ICT) usually to patient or client's home.
- **Homecare authority:** the public or private authority in charge of delivering social care and/or healthcare services of which digital homecare is considered to be part.

1.1 About the project

The Connected for Health was a unique project piloting social and health care services in open access FTTH networks. The aim was to pilot digital solutions in the three Nordic countries Finland, Sweden, and Denmark. Pilot number one, run in the municipality of Hudiksvall, Sweden, tested a digital social alarm, video communication, and night surveillance by night-vision camera, integrating the digital homecare services on an open platform. The second pilot tested distance consultation in wound care, day and night time monitoring, as well as electronic recordings in home care in the city of Alavus, South Ostrobothnia, Finland. The third pilot, carried out at the South Ostrobothnia Health Care District, developed and tested a new distance care model for diabetes patients. In pilot four in South Denmark, digital homecare solutions were tested as part of a larger ecosystem, paying attention to the infrastructure supporting telemedicine services.

The pilots were mainly run in the rural countryside where the access to services may be limited. Even though more and more FTTH networks are currently being built in rural areas, it is not yet very common to have high speed broadband access. The Connected for Health project was able to find certain answers to the important question of providing services to these areas often also having an aging population. Although having limitations as to project runtime and number of participants, the pilots demonstrated that a well-functioning infrastructure is a prerequisite for operational digital homecare solutions.

The piloting was studied and assessed systematically by utilizing a lighter applied version of the MAST methodology (Model for Assessment of Telemedicine). For the basis of the project results, material was

[1] More information about Connected for Health project as well as all the approved public deliverable reports can be found on the project website: http://www.epliitto.fi/connectedforhealth_en

collected from several sources, such as literature, interviews, questionnaires, other project reports and discussions. The main research interest was to analyse the perceptions of the end users of the piloted digital homecare services. Also a cost-benefit analysis and a socioeconomic assessment of the pilots were carried out.

1.2 How to read the document

This report introduces the recommendations of the project, the lessons learned from the project as well as an appendix detailing the business cases for three digital homecare services. The recommendations were formed by combining the new information produced by the pilots with the existing knowledge gathered elsewhere. It is essential to keep in mind that the project included small scale pilots within a short period of time hence the recommendations are not exhaustive and may be extended by further research. The primary target group of this report is the policy makers and politicians on the European, national, regional and local levels. The secondary target group of the report consists of the decision makers in charge of social and health care issues and broadband access development.

This project and this report can also be viewed in the broad scope of renewing and innovating the social care and healthcare sectors to meet the challenges of increasing costs, increased expectations of the citizens regarding access and quality and the ongoing demographic ageing. In this context, governments and countries, globally, are looking for solutions to meet the needs of the citizens, including the ageing population and to support sustainability of care systems cost issues. ICT and digital homecare will play a decisive role as enablers for innovation in this area. This project contributed to the foundation of knowledge for innovation within the mentioned sectors and will hopefully give inspiration to be able to turn the challenges into opportunities for new solutions, products and services, contributing to wellbeing, market expansion, new jobs in industry, economic growth and export possibilities.

2 Recommendations

These are the **six main** recommendations based on the project results. The structure of this chapter is the following. Recommendations are numbered from one to six, not indicating any order of importance. The text in bold explains the recommendation and the text with normal font links the recommendation with the Connected for Health pilot activities. **A busy reader may focus on the bold text.**

1. Support the deployment of FTTH networks to provide connectivity in rural areas

Most digital homecare services available today are designed to work on poorer connections although at the cost of limited features and quality. However, things are evolving rapidly. In particular:

- **As FTTH becomes more widespread worldwide, digital homecare service providers will start seeing a big enough market for more advanced services, requiring FTTH speeds**
- **As a result, an increasing number of services are being delivered to digital homecare users.**

Moreover, the availability of infrastructure for broadband connections in rural areas is often so insufficient that even copper or wireless connections have poor performances. Developing FTTH networks in rural areas would provide a future-proof infrastructure that virtually removes bandwidth and latency limitations, hence giving the freedom to provide the optimal mix of digital homecare services with no compromise on features or quality or number of services, or on geographic location of the homecare users. This will improve quality of life and enables important cost savings especially in traveling and time use of professionals. Additionally the fibre network can serve also as a backhaul

infrastructure for 4G and 5G networks, as well as for premium business connections, with positive socio-economic externalities.

During the Connected for Health project we were able to run the piloted services over both FTTH and wireless connections. Although no major difference in service quality between FTTH, 3G and 4G connections was seen for the services piloted, the results clearly indicated that a more stable/robust connection is achieved using FTTH to provide the services especially when the use of digital services increases.

Many of the Connected for Health pilots were based on video calls (for example in Pilot 2 with wound consultation and in Pilot 4 with mental health patients), which requires a robust connection to enable good visibility and audibility. This is important especially since the users often are older individuals who may have problems with hearing and seeing. A great part of care, both social and health, consists of communication, support and advice that is possible to be offered by using video calls. While the number of people with computers and internet connections continuously increases all over Europe[2], the provision and usage of digital homecare gradually becomes a common activity.

Providing stable and reliable broadband FTTH connectivity has an important role for the European healthcare and social care service production especially in the rural areas, where long distances create obstacles and high costs to healthcare and social care service provision and usage. In healthcare and social care, digital services provide alternative ways for interactions between professionals and clients/patients that provide faster, safe and adequate social interaction and safety for the clients/patients. Digital homecare can also improve client/patient empowerment making it easier to control their care situation. For example in Pilot 1 the homecare social visits were replaced by social video calls that allowed the clients to use the same device for calling friends and family members. Regional equality may improve for example by increasing the services available in rural areas. The project has shown that the quality of care can be improved when introducing digital homecare services. In Pilot 2 the home care professionals offered better quality wound treatment at the homes of the clients when they were supported by the specialist wound care nurse via video calls. Finally, all pilots showed great potential for savings in travels for both users and providers of services.

2. Define a specific digital service class for digital homecare services including performance specifications and network requirements for their delivery

No matter whether a dedicated platform is used or whether each service relies on a dedicated infrastructure, digital homecare is a critical service with stringent requirements in terms of security, quality and reliability. Hence a specific digital service class alongside existing commercial triple play services (Internet, television and telephony) should be used for homecare care service delivery. Requirements should be specified, possibly for different classes e.g. from basic to premium allowing the delivery of increasingly complex services, and standardisation should be promoted in relevant fora.

Within the CfH project, there were a number of issues with the technical delivery that could be made easier to deal with having a service class standard as a base for development. A service class would include specifications for the delivery of digital homecare services from one point to another over the Internet. There are already initiatives for new service protocols e.g. SCAIP (Social Care Alarm Internet

[2] See Information society statistics http://ec.europa.eu/eurostat/statistics-explained/index.php/Information_society_statistics_-_households_and_individuals

Protocol) tested in pilot 1. However, standardising the delivery by implementing a service class would put in place a base for developing well-functioning reliable services with high quality.

Typical qualitative requirements of digital homecare services experienced within the CfH project on access network include:

- Network availability on demand with necessary bandwidth for the intended communication
- Symmetrical broadband capacity in both directions
- Stable and controlled operational parameters e.g. bit rate, low latency
- Synchronised video and audio with suppressed echo
- Security against external and internal attacks as well as information leakage

The experiences from the CfH projects point to the fact that developing a standardised service class will facilitate interoperability and lower the costs for developing and implementing new digital homecare services.

3. Standardise the technical platform for delivery of digital homecare services using a dedicated communication channel

Homecare services can technically use any suitable (broadband) access by connecting service devices to the network and the experiences from the project pilots suggest that a specifically designed standardised platform should be considered for digital homecare service delivery.

The results in the CfH project clearly point to the need to deliver an increasing number of digital homecare services resulting in increasing connectivity requirements. A platform model for the delivery of all digital homecare services relies on one dedicated communication channel separated from other services such as Internet and TV, hence guaranteeing the required quality of service (QoS). An open platform puts in place a market for the procurement and delivery of digital homecare services.

The Connected for Health project piloted an open platform for delivering multiple services from more than one service provider over a single FTTH connection, a "**welfare broadband**" solution. Several homecare services were delivered via the open platform reducing the need for providing connectivity for each service separately. The open platform piloted in the project uses a dedicated Internet channel for the home care services providing a stable and controlled connection. An alternative to a dedicated channel could be to use VPN for best effort service delivery over an existing Internet connection.

The project has shown several reasons to consider implementing a common/standardised open service delivery platform or "welfare broadband":

- **Cost minimisation:** A single Internet subscription can be used to deploy all services needed by the end user instead of multiple Internet subscriptions. An example is pilot 1 in Hudiksvall where several commercial digital homecare services were delivered through a common platform
- **Quality of service:** Sharing network capacity with other non-homecare traffic may degrade transmission quality. Having a separate channel gives a better possibility to control of the quality of service.
- **Privacy and safety:** A separate channel for digital service delivery in networks creates a better environment for handling privacy and safety than using an existing connection accessible to all Internet traffic.

- **Public subsidising issues:** In Sweden, for example, it is illegal to subsidise Internet subscriptions for part of the population -- hence providing a welfare broadband solution through which the digital homecare services were delivered was a prerequisite for deploying the tested services.
- **Remote management and support:** The technical support associated with a homecare provider in order to configure, maintain and expand homecare services is easier to manage through an open standardised platform and can be done in a more efficient way.

4. Promote operator-neutrality, open access for the new FTTH networks, and encourage local government involvement

The experience in the project Connected for Health indicates that an operator-neutral network (open access) and local government engagement are key enablers to align service needs and network requirements and to create a truly open market from which to procure the digital services, including digital homecare.

In principle, an open platform can be deployed also over a traditional "vertically integrated" network such as the national incumbent telecom operators'. However, open-access networks have the key advantage that they are inherently built to support separate IP networks, each carrying different type of services. Moreover, it is less likely for network providers on open FTTH networks to be in the business of digital homecare, and hence end up in a conflict of interest or even lock-in situation.

Vertical integration vs. open access, what do we mean? The traditional telecom model is based on "vertical integration": one entity (often the incumbent telecom operator) delivers the service, operates the network, and owns the network infrastructure. Some of these telecom operators are now starting to look into delivering some smart-home and digital homecare services as well. In the open network model, instead, the network is operated by a **network provider (NP)** while the services are delivered by independent **service provider (SP)**. The NP is not selling its own services and hence is not competing with its customers: the SPs.

The network provider may also own and operate the passive infrastructure as well (as in pilot 1), or may lease the fibre from a third party, e.g. a municipal network, a utility company or a cooperative of users owning their fibre infrastructure. The end users typically purchase services directly from the service providers. The NP receives revenue from the SP. As our project partners could experience when running the first procurements (pilot 1), vertically integrated operators may tend to be reluctant to put in place and maintain open platforms that allow third party service providers to compete with their own services. On the other hand, the Hudiksvall pilot showed that an open network is inherently open to making an available new solution for new service classes (such as digital homecare) because new service providers means new revenue. However, because the market is still not mature and standardisation not complete, it is advisable that the homecare authority is involved to ensure, together with the network provider (but also the platform provider and the service providers), that the technical solution is working properly.

In the context of an open FTTH network, the platform provider (e.g. aka trusted service operator in Finland) is in essence one special SP, offering the platform over which the different digital homecare services are aggregated and delivered. As the market matures, the platform provider role may become integrated in the network operator, hence simplifying the business model.

5. Define sustainable business models, highlighting financial and non-financial gains for all the key stakeholders; make sure that the authority in charge of providing homecare services has a

financially sustainable business model; and spread successful experiences and best-practices, which are now starting to appear.

The business model defines how the different stakeholders interact with each other, and how value and money flows between them. For any innovation to establish itself in society, it has to be supported by a business model in which all stakeholders have something to win. In other words all stakeholders should see a positive net benefit (defined as benefits minus costs).

In the appendix, a business model for the delivery of three digital homecare services is presented. The business model showed that - provided that the right value chain is established - a financially sound business model can be made for the homecare authority.

Throughout the Connected for Health project, different business models were analysed in order to make the most of the open FTTH network, and to reduce hardware and connectivity duplication. The project findings are that it is possible to put in place a value chain in which all stakeholders see a positive net benefit. This makes the model sustainable.

The project has also looked at the key issues to make the business model successful. Broadly speaking, there are technical, financial and communication issues to tackle. The technical issue may seem trivial but as the pilots have shown, minor technical issues may spoil the user experience to such an extent that the non-financial net benefits become negative for key stakeholders like homecare professionals and homecare users. This can even carry reputational damage, which may invalidate future development plans.

The second issue is more obvious to visualise: each digital service must contribute a net positive benefit/cost result. This implies calculating exact costs and benefits of the specific service and being able to document the calculations before, during and after the introduction of the service, in order to secure and maintain the needed political support.

The public communication aspect of new broadband services was not explicitly investigated in the project, but it is as crucial. Digital homecare services are a sensitive issue that becomes easily controversial. Involving all stakeholders, early, relying on their feedback in an open communication campaign towards external stakeholders (press, industry and interest groups, political associations) will make it easier to avoid opposition to the project.

Many of the services piloted in the project are already scheduled for further operation in their respective regions. In general, the experience of the partners in the project is that participation in the pilots has been valuable. The project deliverables and reports contain information that will make it easier to develop similar services in other regions in the EU. Digital broadband services and practices based on them would surely enrich the information base about innovations and inspire other health and social care authorities in EU. It is also an opportunity for partners in European Innovation Partnership on Active and Healthy Ageing (EIP on AHA) to learn more about services that may have significant positive impact on quality of care and its economy

6. Prepare for organisational changes and training programmes necessary for the new digital services to be successfully introduced.

Implementation of digital homecare services often requires significant change in work processes and service provision. This relates to care workflow as well as coordination and scope of services. Engage the professionals in the planning of digital homecare services and train them well in advance to use

the technologies. Especially during the first times of usage, provide hands-on technical support as well as clear and a concise user manual.

For the digital homecare users, the quality of care should be at least on the same level as in the traditional model of care without ICT technologies. Clients and patients should perceive the digital homecare as an integral part of homecare. Any fragmentation of homecare services into various entities with their own management, support and charging, causes confusion for the users.

In Connected for Health project, especially in the Pilot 2 where distance consultations between home care professionals and wound care nurse was done, the work processes and responsibilities clearly changed. It was possible to delegate some of the more demanding care tasks to auxiliary nurses instead of specialized wound care nurse. This showed potential for savings: specialized wound care nurse can have more appointments per day and patients need to visit the local health center less often. Also the digital client data recording activity tested in the Pilot 2 changed the work organization. The home care professionals did the data recording at the clients' home which resulted in the home care staff spending less time at the home care office.

All pilots had technical problems, especially at the beginning. For example in Pilot 4 the virtual waiting room had low quality video connection and the problem was assumed to come from the virtual meeting solution. Great effort is needed to solve these kinds of problems and at times they can caused by very unexpected factors as was the case in Pilot 2 where the sleep monitoring device had a WiFi chip that was prepared for the US market that has different standards from the European ones. These examples demonstrate the need for careful planning and piloting and especially at the beginning, strong technical support. A common request from many of the pilot participants was that they would like to have simple written instructions.

Clients and patients are not always willing to change from the previous way of service provision to digital homecare. This was obvious by looking at numbers of participants who refused to participate in Connected for Health pilots. For example in Pilot 1, the homecare video calls, out of 22 potential clients two refused due to delays in the pilot implementation, three were afraid that they could not learn how to manage the technology and two did not like the idea of technology taking over, they would rather have contact with a "real human being". This state of affairs may change in the future when the clients and patients are using the digital homecare services from the very beginning and if the service does not require ICT skills or equipment from the client's or patient's side. At present, considering the status of technology, ICT literacy in the population, and capability of homecare providers, it is recommended to maintain both the traditional care model and the ICT based, at least for a period of time. The clients/patients should be given the choice of the preferred way of care. Clients or patients and the family should also have sufficient information of the care models, and have a chance to alter the decision once made in the course of care.

An example of a separate organization for digital homecare comes from Pilot 3, when the diabetes patients were allowed not to pay user fees for the diabetes nurse appointment when it was done via video call. In the future, the user charges will be same for all appointments.

3 Lessons learned

In this section, a summary of the lessons learned during the project is given including examples from piloting activities as a background to the recommendations given. The methodology used to collect the

evidence on lessons learned was comprised of site visits, interviews with key stakeholders at the various sites, results collected from project deliverables, presentations prepared by staff from the pilot sites, and participation in project assemblies and workshops.

A number of challenges and achievements were identified during the project and these are delineated in the project deliverables of work packages 3 and 4[3]. The lessons learned from these challenges and achievements can be grouped into three major areas: strategic and clinical issues, technical issues and issues concerning pilot operation and evaluation.

3.1 Strategic and clinical issues

In order to receive support for digital home care services, it is important that the planned changes in service delivery are in line with the national/regional strategies and where relevant also to digitalisation agendas. This helps, as during the pilots, developing local and even national digital structures within the eHealth area. As an example, the Danish government has decided on an ambitious plan for a nationwide implementation for telemedicine for patients with COPD (Chronic Obstructive Pulmonary Disease) by 2019.

Regarding employees, digital services not only demand IT skills for the care workers, but also good professional skills. For example when consultation is done from distance with a video call, as was done in all pilots the professional must be able to read the nonverbal communication and signs of emergency via the screen. Video call is not exactly the same as face-to-face communication, but it is more personal and offers better information on client's and patient's status than a phone call.

Setting up digital homecare requires the involvement of end users which in this project were health care staff, clients/patients and management. The recruitment process needs to take into account that the users should be suitable for the services, i.e. have the need for services and ability to engage in the usage of new technologies. There were some examples of clients/patients leaving the pilot or not being motivated enough to provide the needed information (for example blood pressure readings) for the virtual meetings. This shows the importance of selecting services that meet real needs and preferred modes for care. It is also a fact that not all clients/patients want to use digital services.

3.2 Technical issues

Within the project, the pilots focused on the end users of the tested digital homecare services and worked both with solutions already on the market and with new developments made by local industry. This approach appears realistic in many regions in Europe and therefore gives the Connected for Health project specific value. One of the aims of digital health care services is to save personnel time. In some cases, the pilots required more staff or more time for the staff in comparison with the usual service delivery. This was mainly due to technical challenges. In some cases, there were difficulties in deploying the services in the municipal networks. Both pilot 1 and pilot 3 experienced problems with firewalls, for example, hindering the pilot activities. There were also problems related to hardware and software. In pilot 3, the virtual appointments suffered from low video quality due to the web cameras used. Pilot 1 had major issues with the video call service, due to software bugs.

[3] All the approved public deliverables of the CfH project can be found on the project website: http://www.epliitto.fi/connectedforhealth_en

The technical problems can also be end-user related, for example when services were used by clients with impaired hearing or vision, or stiff fingers, leading to difficulties in holding slippery tablets or pressing small icons on a touch screen. In many cases, the issues could be solved by simple expedients: for example in pilot 1 where the hearing difficulties experienced by some of the clients were solved by adding external audio loops.

When it comes to technical issues regarding connectivity, there are a number of factors to consider. Within this project, FTTH was primarily used and to a minor extent mobile broadband solutions to provide connectivity to the end user. In many cases, if FTTH is used for home access, WiFi is then used to connect specific devices within the home. Resolving network issues can thus be difficult since the problem can exist in any part of the delivery chain or even result from hardware. For example in Pilot 2, the video calls between home care and clients suffered from some delay in the video image, thus the voice and the video were not in sync.

Within the Connected for Health project, the broadband connectivity provided has been adequate, both for the FTTH and the mobile broadband solutions for the services deployed in the project. Given the short time period and boundary conditions of the project and the small number of users involved in the piloting activities, a full-scale and statistically robust investigation into the underlying quality metrics has not been possible within the project framework. The results from the pilots however indicate that FTTH gives a more stable and robust connection than mobile broadband.

3.3 Pilot operation and evaluation

From the pilot evaluations it can be seen that there are many positive aspects as well as challenges when introducing digital homecare in areas such as interactions between patients/clients and healthcare and social care professionals. For example, equality can both increase and decrease between clients. Digital homecare can bring services to remote areas, where they would not otherwise be available. It can also mean that only those who are able to use technological gadgets are given the chance to use them. For professionals, digital homecare may generate more positions with higher technical expertise, e.g. in technical support or installation of homecare devices. Thus in some ways it may block career development for some while offering new possibilities for those who are capable, interested and willing to work with new technologies.

The project involved some patients with memory disorders. This of course raised the question if the digital services offered were in agreement with ethical guidelines and legal frameworks. To resolve this, consent was sought not only from the participants but also from family members and/or official guardians in these cases.

In the evaluation of the pilot activities, the participating clients felt safe in terms of data safety when using the services. Those clients who have tested the video call services where they can connect to friends and relatives also say that this increases the quality of their social life. There are also patients who report that they save both time and money not having to travel. However, there are clients who prefer to go to the health care clinic or hospital for their appointments. Some feel more comfortable this way and some also feel that they like to get out and about. Therefore, the service delivery needs to adapt to the needs and preferences of clients who can be empowered to make a choice regarding their care situation.

The potential for increasing quality of service for the clients has been addressed within the project. Due to the short time span, the evaluation would need further input. When using video calls, they can easily recognise whom they are speaking to and contact health care or their friends and family easily. Services can give the clients a greater freedom of choice for example in scheduling their appointment or needing to spend less time and money on travelling.

Even though there have been technical issues and delays, most of the clients and personnel are positive towards the new digital enabled services. This might be different in countries with less generalized trust and trust in public bodies[4]. In pilot 1, which had the largest technical difficulties, a majority of the clients involved wanted to continue after the piloting. All of the pilots plan for continuation of the activities in some way. Pilot 1 with video calls instead of social visits is planning for a procurement process during fall 2016. In pilot 2, the wound care, electronic recording activities and perhaps night-time monitoring will continue. Pilot 3 will keep the diabetes distance care model and offer clients a choice between regular and distance care. There are also plans to offer distance appointments to other kinds of patients as well. The results of pilot 4 will be used in support of large scale ongoing telemedicine implementation.

4 APPENDIX – Business case for digital homecare services over open FTTH networks

This appendix presents the business case for three of the digital homecare services tested during the project, in Sections 4.1-4.5. The appendix is intended to give some insight into the business model and cost-benefit analyses findings that contributed to the recommendations in this report.

For ease of reading, we provide a short overview of the business model overview in Section 4.1, while we refer the reader to deliverable D4.2 [1] for further details and for the definition of the relevant stakeholders, business models and open network concepts. The business case is made for the homecare authority. For considerations on other stakeholders, please refer to deliverable D4.2 [1].

The overall business case for the homecare authority is summarised in the table below. In the following sections, we detail the calculation of each of the cost and benefit figures. Note that these costs do not include general training costs, or administration, coordination and management costs for the healthcare authority, which are hard to evaluate. These are general not cash-out costs, but may require to temporarily reassign HR resources.

	Yearly cost for the HC authority	Yearly benefit per user for the HC authority
Platform	€1350	
Broadband	€360	
Night supervision service	€2,500	€11,086
Social calls service	€750	€4,052
Wound treatment service	€192	€667

[4] See for example Trust creates a welfare state at http://sciencenordic.com/trust-creates-welfare-state-%E2%80%93-not-vice-versa)

4.1 Background: the building blocks of the open platform and business model for the delivery of digital homecare services

As was argued in our reports [1]-[2] an open platform model for digital homecare makes it possible to use network resources in a more efficient way and puts in place an open market for the procurement and delivery of digital homecare services. The goal is to deliver the digital homecare services over one FTTH connection, guaranteeing the quality of service and the security needed for such critical and sensitive services. The open platform concept is implemented through a digital homecare gateway at the client's premises, which aggregates and properly prioritises the communication streams from the sensors and communication units in the home and transports them securely over a dedicated IP network (alongside three optional commercial networks – for Internet, TV and telephony) to a so-called "Welfare Router".

In it can be seen that – unlike a simple solution with VPN over the public best-effort Internet connection – this solution creates a fourth parallel IP network over an open FTTH network. The different IP networks and corresponding end-user connectivity are maintained by the provider, which is the actor responsible to activate the dark fibre in an open network, and to enable independent service providers to deliver their services to the end-users. The homecare services are delivered over a dedicated IP network, completely isolated from the other networks. This delivers the necessary QoS, privacy and security, better bandwidth efficiency (no need for VPN overhead), flexibility and scalability.

The business model that was chosen for our pilot was a simple one, in which homecare authority (municipality, regional council, or other local authority) procures all the components of the digital service package: meaning the provider of the open platform (also known as Trusted Service Operator), as well as the providers of the services themselves. This is the model that was put in place in pilot 1 in the project, and we called it "Full-procurement model".

The procurement for the open platform has to be designed such that the platform delivered has open standardised interfaces, to enable the service procurement from the largest possible number of digital homecare providers (DHP). Typically money flows from the homecare authority towards the open platform provider, the DHPs, and the network provider, as shown in Figure 2. In case the end-user already has an active broadband connection, the latter transaction may not be needed.

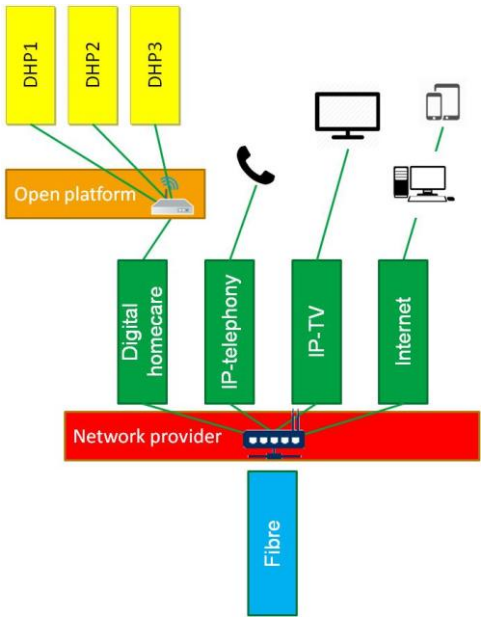

Figure 1 – The open platform model for digital homecare in the context of the open FTTH environment.

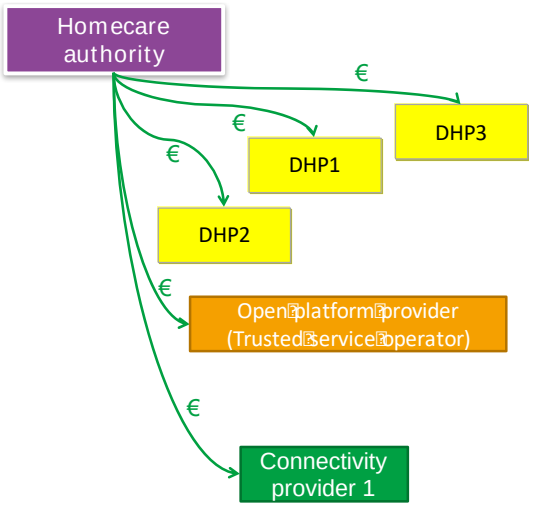

Figure 2 – The "full procurement business model": the homecare authority directly procures all the components of the model, including the open platform.

4.2 The business case for three services: basic costs and benefits

In the project we have assessed the socio-economic benefits, which are thoroughly reported in [1]. Here we highlight the financial costs and benefits for the homecare authority.

The costs analysed refer to the delivery of the services, the platform and the broadband connection. To put it in formulas, the annual cost per user is:

$$K = K_{NS} + K_{SC} + K_{WT} + K_{plat} + K_{bb}$$

where K_{WT} refers to the wound treatment service, K_{NS} to the night supervision service, K_{SC} to the social calls service, K_{plat} to the platform and K_{bb} to the broadband connection.

In this annex we present a business case based on figures and experiences in Hudiksvall (Sweden) and Alavus (Finland). The open platform and the broadband connection represent fixed costs, independently of how many services are activated.

The **open platform** provider in the project, Alleato has indicated that a gateway price under €150 and a management and technical support fee of around €650 per year as amply sustainable levels to cover capital and operational costs, or alternatively a **€1350** per year for the whole platform and sensor package:

$$K_{plat} = \textbf{€1350}$$

The connectivity provider fee is in the order of **€200–500** annually for the open FTTH network provider in Hudiksvall (*Fiberstaden*), which was involved directly in the pilot, as external partner. Similar figures are obtained in the case of Alavus, where the monthly fee is **€30**. We use this latter value in the business case analysis, hence:

$$K_{bb} = \textbf{€360}$$

When it comes to benefits, three types have been identified for the homecare authority: reduced transportation time (when virtual visits are performed), reduced transportation costs (vehicle costs in terms of fuel, maintenance and depreciation) and reduced intervention time. These savings only show up when services are introduced over the platform and will sum up as annual savings per user:

$$S = S_{NS} + S_{SC} + S_{WT}$$

These are analysed in detail for each service in the following sections.

4.3 Marginal cost and benefit of the night-supervision service

The municipality of Hudiksvall procured the **night-supervision service** from the market in 2015 for an annual user fee of

$$K_{NS} = \textbf{€2,500}$$

The procurement was successfully aligned with the Connected for Health project: among the requirements in the tender, was that the service should work also over the open platform being tested in the project. The service was then tested within the framework for the project (in pilot 1) and the open platform proved successful in carrying the night supervision service.

Night supervision by night vision camera generally takes 1 minute, as opposed to a physical visit; remote communications tend to go to the core of the issue faster than physical visits in which courtesy formalities are generally longer, leading to significant reductions in intervention time. Reduced transport is the other significant benefit. The **yearly savings per user for the night vision camera (NS)**, S_{NS}, are calculated as follows:

$$S_{NS} = \varepsilon_{NS} \cdot N \cdot v_n \cdot \left(\Delta t_{NS} \cdot k_{P,n} + d_{v,n} \cdot k_v\right) = €10{,}429 + €658 = \textbf{€11,086}$$

where the variables in the formula are defined below, together with the values they take for the Hudiksvall pilot:

- $\varepsilon_{NS} = 95\%$ saving efficiency[5]
- $\Delta t_{NS} = 2 \cdot 15'$ reduced intervention time per visit[6]
- $v_n = 1.28$ average number of visits per user per night
- $N = 365$ number of nights in a year

[5] In 95% of the cases a remote visit is possible, in the remaining 5% of the cases a physical visit is needed nonetheless

[6] Night supervision by night vision camera generally takes 1 minute, as opposed to 16 minutes for a physical visit (8 minutes driving and 8 minutes visit), time is double because two-person teams are used at night

- $k_{P,n} = €47/\text{h}$ personnel cost[7]
- $k_v = €0.39/\text{km}$ vehicle cost[8]
- $d_{v,n} = 3.8\ \text{km}$ average driven distance for each visit

4.4 Marginal cost and benefit of the social-call service

The video-communication service is preliminarily priced by nWise at €500 per user per year, excluding the tablets at the end-users, at €750, or €250 per user per year for a three-year depreciation. Hence a total annual cost per user for the **video-communication service** is

$$K_{NS} = \textbf{€750}$$

When it comes to the benefits, in this case it is mainly transport savings (time and car): the intervention time are hard to quantify at present. The **yearly savings per user,** S_{SC}, that can be expected are:

$$S_{SC} = \varepsilon_{SC} \cdot N \cdot v_d \cdot \left(\Delta t_{SC} \cdot k_{P,d} + d_{v,d} \cdot k_v\right) = €2{,}909 + €1{,}143 = \textbf{€4,052},$$

where the new variables in the formula are defined below, together with the values they take the Hudiksvall pilot:

- $\varepsilon_{SC} = 90\%$ saving efficiency[9]
- $\Delta t_{SC} = 8'$ reduced intervention time per visit
- $v_d = 1.5$ average number of visits per user per day
- $P_d = 1$ number of personnel per visit
- $k_{P,d} = €44/\text{h}$ personnel cost[10]
- $d_{v,d} = 5.95\ \text{km}$ average driven distance for each visit

4.5 Marginal cost and benefit of the wound-treatment remote support service

This is mainly down to tablets for the home care personnel (€300 in this case, over a 36 month life time) plus a €30 fee for training/operation and management, and the service fee (€18/month). Hence – assuming a 1:3 ratio of customers to homecare nurses – total annual cost per user for the **wound treatment service** is

$$K_{NS} = €(300/3 + 30 \cdot 12 + 18 \cdot 12)/3 \ = \textbf{€192}$$

Coming to benefits, the transport reduction benefits are significant here. As an example, one customer in Alavus had 10 taxi trips during the pilot costing €500 (€300 out of their pocket, €200 subsidised). These, however, are down to the end-user (the customer), or to KELA (the Social Insurance Institution of Finland), so – while they will provide precious support to the initiative – we do not factor them in for the homecare authority business case.

[7] Calculated at 435 SEK, and €/SEK=9.26
[8] Including fuel, maintenance and depreciation, for a Skoda Yeti; using €/SEK=9.26
[9] In 90% of the cases a remote visit is possible, in the remaining 10% of the cases a physical visit is needed nonetheless
[10] Calculated at 410 SEK, and €/SEK=9.26

The main benefit for the homecare authority is reduced intervention times. One distance consultation for the wound nurse takes approximately 15-20 minutes of her time, whereas a regular patient appointment at the health centre takes 45 minutes. During the regular visits, extra time goes for the client's undressing, opening the bandage, cleaning the wound and for patient's dressing up. During the distance consultation, the home care nurses did this work already as part of their routine assignment, thus the wound nurse's work load is reduced. Thus, the **yearly savings per user,** S_{WT}, for the homecare authority are:

$$S_{WT} = \varepsilon_{WT} \cdot N_w \cdot v_w \cdot \Delta t_{WT} \cdot \ k_{P,d} = \textbf{€667}$$

where the new variables in the formula are defined below, together with the values they take the Alavus pilot:

- $\varepsilon_{WT} = 70\%$ saving efficiency[11]
- $N_w = 52$ weeks in a year[12]
- $\Delta t_{WT} = 22'$ reduced intervention time per visit
- $v_w = 1$ average number of visits per user per week
- $k_{P,d} = €50/\mathrm{h}$ personnel cost[13]

5 Bibliography

[1] Connected for Health: D4.2. Business model

[2] Connected for Health: D4.1. Evaluation of the pilots

[11] In some cases a physical visit is needed nonetheless

[12] A single patient may not need this a whole year, but then costs and benefits will move to the next patient using the service

[13] Calculated at 410 SEK, and €/SEK=9.26