

# The Baltic Health Network – taking secure, Internet-based healthcare networks to the next level

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## Abstract

*Internet-based health care networks are a step forward compared to first generation health care networks, which has been limited to pushing text-based messages between different systems. An Internet-based network can also “pull” data - and not only text but any digital data – for instance images and video sequences. The Internet-based networks can more effectively fulfil the vision of access to relevant data regardless of time and location. Although far from identical, the health delivery systems of Denmark, Norway and Sweden are similar. They also share a shortage of specialized health personnel – not least radiologists and in some regions obstetricians. Furthermore, over the past ten years they have implemented an IT-strategy to increase efficiency in the delivery of healthcare services. Part of this strategy has been to build three national networks on top of the existing regional, secure and Internet-based healthcare networks. These national networks connect not only all hospitals in the three countries, but also a majority of the other stakeholders in the healthcare sector (GPs, private specialists, laboratories, homecare services etc.). The organizations behind the three networks are now working on creating a trans-national network, the Baltic Health Network (BHN), which will be one of the outcomes of the **Baltic eHealth project** and will not only connect the three national networks but also add two hospital networks from Lithuania and Estonia. The BHN is expected to be operational by June 2005. One of major advantages of the BHN is that the many rural hospitals of the Baltic Sea Area with a few mouse clicks can reach a specialist for second opinion in any of the approximately 200 hospitals connected to the network. For instance the midwives in the rural areas of Västerbottan County, Sweden, are awaiting the establishment of BHN to get access to second opinions from specialists at National Center for Foetal Medicine at the University Hospital of Trondheim, Norway. The BHN will remove a very important technical barrier for collaboration between health professionals and the Baltic eHealth project hopes that this and other project initiatives will facilitate the large-scale usage of second opinion from available health care experts regardless of institutional, regional and even national borders. This will lift the quality of service to patients in the Baltic Sea Region – especially in the rural areas where highly specialized health professionals tend to be geographically far away.*

## Keywords:

Internet health care networks; Regional health care networks; Baltic eHealth; Rural health care.

## 1. Introduction – first generation regional health care networks

Modern healthcare is provided in close co-operation between many different institutions and professional groups – working together and using their specialised expertise in their common effort to deliver the best quality service and the most cost-effective care as

possible. Due to this specialisation and division of labour, the need for seamless electronic communication between the parties is still growing. An answer to this need is the development of regional health care networks (RHCN). An ideal RHCN should provide [1]:

- Daily communication of prescriptions, referrals, lab-results etc.
- Secure e-mail for patient related information
- Booking facilities for hospital and diagnostic information
- Shared Medical records
- Emergency and alert systems
- Tele-medicine facilities
- Protocols and guidelines for cross-sector treatment
- Health Information web-sites for professionals, patients and the public
- Administrative cross-sector information and management systems

Such comprehensive RHCN do not exist in Europe today. However, in the last 15 years several less comprehensive first generation RHCNs have been established. The first movers were UK and the Netherlands who already in the late eighties established links to communicate structured messages (based on the EDIFACT<sup>1</sup> standard) between hospitals and GPs. Today EDI-communication is being used in a number of European Regions – not least in Denmark, Norway and Sweden.

The basic idea behind EDI-messages is to send (push) structured electronic text-based messages from one computer to another. This means that data entered once can be re-used elsewhere in the health care sector. EDI-communication is therefore a very effective tool to increase efficiency in communication between GPs and their surroundings (hospitals, pharmacies, specialists, labs etc.) [2] as EDI can save much time in the communication of prescriptions, referrals, lab-results, discharge letters and reimbursement claims [3]. However, EDI-communication has two major shortcomings: First, it is largely text-based and can usually not handle the communication of data like images, ECGs, and video sequences. Second, EDI-messages are “pushed” from a sender to a receiver, which means that both parties have to be involved in the transaction. If a receiver had access to “pull” the data whenever needed, the sender would not have to be actively involved.

## **2. Next generation Regional Health Care Networks**

The Internet technology offers a solution to both shortcomings of the first generation RHCNs, as the Internet technology is capable of meeting a large number of additional communication needs. Some of the most important services are 1) forwarding (push) of e.g. text, pictures, X-rays, sounds, graphics and video sequences, 2) web notices (pull) of EHR-data, X-ray results, laboratory replies, ECGs etc., 3) videoconferences, 4) web-portals that gives access to medical information to relevant health professionals, as well as the individual citizen/patient, 5) appointment making for examinations and treatment, and 6) electronic reporting to quality registries, archives and clinical databases of aggregated and/or anonymized data.

Basically all elements in the above-described ideal RHCN can be handled in a network where the underlying infrastructure is based on the Internet technology. This is not to say, that other technologies could not provide the same features, but the obvious advantage of using the Internet-technology is its rapid spread – the Internet is becoming totally ubiquitous, which means that any IT-department is very familiar with the technology.

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<sup>1</sup> UN/EDIFACT = United Nations/Electronic Data Interchange for Administration, Commerce and Trade.

Since the late nineties, the above advantages of basing next generation Health Care Networks on Internet technology became obvious to policymakers in the three Nordic countries. The ambition in all three countries was the same: to build not only a *regional* second generation networks, but to create three *national* networks, that will be able to meet any communication need any healthcare provider might have.

However, when it comes to security, the Internet leaves something to be desired. Since patient related information is intended to cross borders between sectors, institutions and actors, security became a major concern in all three countries. The only way around these concerns has been to involve all relevant levels, institutions and actors in very difficult consensus processes and to find a common denominator for each country on the security issues. These consensus processes are reflected in the slightly different technical models that were chosen in each country. The three models are described below.

## **Sweden**

In Sweden the National Health Care Network is called Sjunet, which is an IP-based broadband network, connecting all Swedish hospitals, primary care centres and many other health services. Sjunet is built up of nodes connecting the firewalls in all 21 county councils and regions.

The network started as a regional project in 1998, involving only seven counties, where the Sjunet was set up as a virtual private network (VPN) with “tunnels” on the Swedish part of the Internet. The VPN technology guaranteed that information was not accessible from or communicated through the public Internet. The network provider guaranteed that the available bandwidth was sufficient for applications and services. Since 2003 the network is based on VLAN technology with built-in redundancy and is technically separated from the Internet. The separation from the Internet means better availability with regards to bandwidth [4].

The net is being used for many telemedicine services, including the secure transmission of X-rays, patient information, clinical rounds and collaboration between hospitals via videoconference or IP-telephony. The video conferencing service includes a video bridge for multi conferencing, a video number directory, gatekeepers (video switches), and a number of guidelines. Of special interest is the provision on security certificates, following the PKI standard, from a CA-server (Certified Authority) that allows decryption and authentication of messages sent on Sjunet. All hospitals connected to Sjunet can make use of this service [5].

By using Sjunet, local clinics and hospitals are able to consult specialists in neurophysiology from university hospitals for the analysis of EEG and nerve conduction studies. The specialist can access databases with patient information at referring clinics. Once the analysis has been done, the specialist sends the report to the referring physician. A cost-benefit study [6] of this example shows considerable savings - both within health care and for the patients.

## **Denmark**

The Danish network consists of a central hub that connects all existing closed secure networks in the Danish healthcare sector into one large national network. Contrary to the Sjunet, the Danish network does not only use Internet-technology, but is actually running on the Internet. This requires a high degree of security, which is ensured at three levels. To ensure the transmission security, connections to the central hub are established via VPN-

tunnels – this is the first level of security. At the second level an electronic “agreement system” controls the incoming and outgoing data flow from the local networks to the central point. When two parties wish to communicate via the central node, they can open a connection between each other in the agreement system. Other parties in the network will not have access to the data communicated between the two parties. The third security level is local user identification and password.

The network structure is established by reusing the existing IP structures. A wide range of public RIPE<sup>2</sup> IP addresses are available for the network and the local IP addresses are “translated” into a unique national network address using NAT (Network Address Translation). The use of VPN allows all parties in the network to reuse the existing Internet connections already in use by all organisations [7].

The Danish Internet-based Network has been running since 2003. All hospitals are using the network – not least for the legally required submission of patient data to clinical databases. With regards to GPs, private specialists, and homecare services, they are all connected to the network via their IT-providers, and the usage is increasing but still rather limited. The reason for this is the limited number of services that are offered to this group over the Internet-based network. Most of the communication needs of GPs and private specialists are still covered by the very widespread traditional EDI-based network<sup>3</sup>. However, several pilots like web-lookup of X-rays on the network indicate a strong demand for a more widespread dissemination. Today a large number of hospitals are getting ready to provide these services to the GPs and specialists in their region. With regards to the homecare sector, the network is being used in a few pilots to strengthen the communication flows between hospitals and homecare units. These pilots also look promising and will hopefully inspire others to initiate similar projects.

## Norway

In Norway, healthcare is delivered by the five regional health enterprises. In 1998 the first regional network was established and today all five regions have their own network. The health networks in the region North-Norway and in the region Mid-Norway have had a substantial traffic load for 3 to 4 years, but the development of the regional health networks of the other regions has been slower. This has partly been due to the fact that other types of infrastructure were preferred in these regions, such as county nets and electronic message exchange via a national mail-server. The types of services offered on the networks have also varied between the five regions.

The objective with the Norwegian National Health Network is to contribute to high quality and coherent health and social services, by being a sector network for effective cooperation between the different service sections in the sector. A basic principle of the National Health Network is that one connection point and one joint communication platform shall give access to a broad range of services for electronic exchange of information. Such services will, among other things, be secure e-mail and exchange of electronic messages, telemedicine services, use of common systems on the network and controlled access to the Internet. From one and the same connection point, users shall be able to communicate with all the other actors that are connected to the network.

A special strategy and action plan has been developed for the National Health Network. The network will be operated and further developed in line with this strategy. This involves connecting more actors and offering additional services. So far the main

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<sup>2</sup> RIPE = Réseaux IP Européens.

<sup>3</sup> Messages per year (2004): 32 million. Source: [www.medcom.dk](http://www.medcom.dk).

focus has been on connecting the hospitals and general practitioners to the network. A municipal programme for electronic interaction shall lead to closer and improved cooperation between primary health services, specialist health services and social services. Connecting the municipalities to the network is therefore also one focus area in the National Health Network strategy.

### **3. The Baltic Health Network**

The three networks described above are very similar but they also differ from each other - especially on two parameters:

- Internet: While the Danish network is based on VPN tunnels over existing Internet connections, the Swedish and to some extent the Norwegian networks are separated from the Internet – but they are still using the Internet-technology.
- Agreement-system: While Denmark has an agreement-system that automates the handling of connections in the network, Norway and Sweden are so far handling the connections manually.

Neither of the two points constitutes a major obstacle for a future connection of the three networks, and the cost of connecting them is estimated to be rather limited.<sup>4</sup> The potentials of a cross-national healthcare network are on the other hand very promising – not least because even today, without such a network, several cases of cross-national collaboration in the region can be pointed out.<sup>5</sup> The development of a transnational network including the Baltic states, the Baltic Health Network (BHN) is therefore currently ongoing and is expected to be finalized in June 2005, where not only the three Nordic countries will be connected to each other, but also two hospitals in Estonia (East-Tallinn Central Hospital) and Lithuania (Vilnius University Hospital).

The BHN is a significant deliverable in the Baltic eHealth project. The project's goal is to bring about fully developed eHealth solutions that can be directly put into use by health providers throughout the Baltic Sea Area. Any eligible stakeholder in the healthcare sector will be given free and unlimited access to the BHN, which therefore is expected to become a major eHealth facilitator in the Baltic Sea Area, as the establishment of eHealth solutions will become much easier now.

During the three year project period (2004 – 2007), Baltic eHealth will demonstrate the usefulness of the BHN in two clinical pilots. In the eRadiology pilot, specialists from East-Tallinn Central Hospital (Estonia) and Vilnius University Hospital (Lithuania) will assist the doctors at the Funen Hospital (Denmark). In the eUltrasound pilot, specialists from the National Center for Foetal Medicine at the University Hospital of Trondheim (Norway) will assist doctors and midwives at the hospitals in Västerbotten County (Sweden). The primary goal of the pilots is to inspire others to initiate similar eHealth services on the BHN.

The aim of the Baltic eHealth project is that the BHN will be widely used and even expanded in size, as other healthcare networks in the Baltic Sea Area will be encouraged to connect to the BHN. The vision for the BHN in the long run is that it will become a model for other national – and cross-national Internet-based healthcare networks in Europe. This would prove the establishment of a European-wide healthcare network to be a real option.

### **4. Questions to be answered**

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<sup>4</sup> Approximately 45.000 € for IT equipment.

<sup>5</sup> Examples: Danish and Swedish hospitals collaborate on ultrasound images. Norwegian and Swedish hospitals collaborate on radiology and Norwegian and Swedish hospitals collaborate with a radiology clinic in Barcelona, Spain.

The usage of a cross-national network like the BHN brings about a number of critical questions. The most frequent are:

1. Is it legal to send patient information between countries?
2. How does a hospital get reimbursed if it delivers a second opinion to another hospital?
3. How do we deal with cultural differences?
4. What if the two collaborating health professionals do not speak the same language?

These questions should be considered carefully before launching a cross-national collaboration. However, the problem is that the answers to the questions are still very unclear and this is a barrier to the full-scale usage of the BHN. Few decision makers will initiate such projects, if for instance the legal basis is unclear.

The Baltic eHealth project will only be successful in persuading decision makers to use the BHN for cross-national communication, if the project can give clear and unambiguous answers to the above questions. For this reason, the project will develop concrete guidelines on how to overcome legal, financial, cultural and linguistic barriers.

## 5. Conclusion

When operational in June 2005, the BHN will be the only cross-national healthcare network in Europe. At the same time, it will be the largest cross-sector network, as it will connect not only all the 200 hospitals of Denmark, Norway and Sweden, but also thousands of other healthcare stakeholders like GPs, specialist, laboratories, pharmacies and municipalities. The objective of BHN is to remove the technical barrier for collaboration between health professionals. The network and other results from the Baltic eHealth project like best practises from the two pilots and the guidelines on removal of other barriers for eHealth will be made available to decision makers in the Baltic Sea Region and this will hopefully contribute to the large-scale usage of second opinion from available experts regardless of institutional, regional and even national borders. Once the usefulness of the BHN is documented in the Baltic Sea Region, the BHN will be a strong candidate for a universal European model for the next generation health care network.

## 6. Acknowledgments

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