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Application oriented formatting and communication requirements for electrocardiography. Necessary and desirable modifications on the SCP-ECG Standard

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1. Introduction

The European Standard Communications Protocol for computer-assisted Electrocardiography has been designed within an AIM project supported by the European Commission (DGXIII/F from June 1989 until December 1990. It has its roots in a “Universal ECG Transmission protocol”, developed by mainly seven American electrocardiograph manufacturers and the Veterans Administration in the United States in 1986 and 1987. The European design was carried out by developers from six university centres, major manufacturers and users from 11 countries. Based on the final report a specific CEN TC251/WG5 project team has then worked out the Standard Document which was finally approved by CEN TC251 in 1993 as preENV 1064.

As clearly described in the scope the standard was designed for use in diagnostic resting electrocardiography with a potential two way transmission of ECGs and a few queries in cart to host communication scenarios. It did specify an interchange format with a couple of options and a set of query messages using for communication an “enhanced” X-Modem protocol.

Aside from some editorial clarifications and minor additional specification (Rev. 1.3) the SCP interchange format has proven to be very useful in a number of projects and installations where the application was close to the original concept. Meanwhile significant additional requirements from new applications have come up, in particular the communication tools and procedures have dramatically changed. With increasing urgency also information integration, i.e., interoperability with other devices or information systems becomes an issue.

The new application scenarios are accompanied by very rapid changes of storage and communication technology. Obviously under these circumstances substantial, application oriented modifications of SCP are necessary.

2. The Limitations of the actual SCP

The SCP-ECG starts from the assumption that the ECG is to be treated and analysed further at the receiving station of an ECG transmission. Since it is used in the context of a resting diagnostic ECG, the fidelity has to be basically the same as for the registration of the ECG.

The SCP-ECG is used in the context of a resting ECG. Some manufacturers have used the protocol to transmit also other measurements related to electrocardiography, as exercise tests or Holter recordings. This leads to incompatibilities between different applications of the protocol.

The SCP-ECG has been developed for cart-to-host applications mainly. In some instances, one would like to have a cart-to-cart connection, which imposes a heavy burden on the software on the receiving side to accommodate all possible permutations of SCP-ECG that can be sent.

There are many other attempts to standardise the transmission of ECG and related physiological waveforms. We name DICOM, HL7, the FDA-sponsored XML-format, or the Vital Signs standard. This makes an adherence to a specific standard particularly difficult.

3. Possible uses of ECG transmission

In the following we try to give some of the possible uses for ECG transmission:

- Transmission of a elective diagnostic resting ECG for interpretation e.g. in a hospital, to an overread service or to a core lab.
- Transmission of an emergency diagnostic resting ECG from an ambulance to an emergency ward in a hospital for evaluation of measures like thrombolysis or transferral to an specialised institution to perform emergency PTCA.
- Transmission of a diagnostic resting ECG from a central site (repository) to an ECG cart for serial comparison.

- Transmission of a diagnostic resting ECG from an ICU ward to some overread place.
- Transmission of ECG for the detection and supervision of acute coronary syndromes.
- Transmission of rhythm ECGs, often with a reduced lead set, for the evaluation of cardiac rhythms in Holter registrations or in patient monitoring.
- Transmission of exercise ECGs, including full disclosure registrations, to obtain expert advice.
- Transmission of ECGs for home monitoring.
- Transmission of ECGs, diagnostic resting or others, for documentation and reference purposes only. This includes transmission to the referring physician or department, to a notified body or a governmental agency etc.

All these procedures may be different with regard to the information content needed to come to an useful conclusion. As long as the transmission time and, to a lesser degree, the storage space is of minor importance, one would advocate to transmit the data with the highest resolution in time and amplitude required for a diagnostic resting ECG. Since many different ways of transmission may be used (LAN, WLAN, WAN, Internet over different transmission means, phone lines (analogue, ISDN, DSL, etc.), cellular phones (GSM, GPRS, UMTS), not all of them very wideband and fast) and since not all of the uses need the full resolution of the ECG, a transmission protocol standard has to be adaptable to the different uses. It has also to accommodate the different line protocols that may be used (e.g. XML), and the techniques to allow for an easy rendering of the ECG on the receiving site (e.g. SVG).

4. Recommended Revisions to the SCP-ECG

We propose to essentially preserve the interchange format from SCP-ECG. However we need to adapt it to the different applications as IMEX etc.

We have to specify use cases to obtain meaningful message definitions. This may result in using an object oriented approach for the definition of possible record instantiations.

We propose to specify and eventually develop program modules to allow for the exchange of the recently evolved record formats. This allows for a multiple use of the same modules on different ECG equipment, without putting too heavy a burden on the equipment. With such a solution the older equipment is easily updateable to new transmission protocols.

We propose to develop a specific communications specification for ECG sources and for multiple receiving stations as DIS, HIS, service centres for home care, overread services etc.

5. Conclusion

The need for paperless distribution of ECGs and other health related information, as well as the rapid progress in communication has led to a need for a standard to freely exchange information from different sources. One attempt to standardise the transmission is the development of the SCP-ECG, which is putting the emphasis on the fidelity of the information transmitted, to allow to accomplish a responsible work with the information transmitted. With some improvements as outlined above, it can be used in the future. Even in developing other standards for the same purpose, not using SCP-ECG, one should bear in mind the emphasis of SCP-ECG, the fidelity of the information transmission.

It is desirable, to accommodate all future needs in this field, to have a panel that follows the technical evolution and the changing needs in this field closely, as has been demonstrated by the DICOM working group. This could be accomplished by the OpenECG initiative.

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