Picture archiving and communication systems

Transmission of radiological images using broadband communications

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Abstract. The aim of our work was to implement and validate a system for the acquisition, local management and remote transmission of diagnostic images using two interconnected broadband Metropolitan Area Networks (MANs). The MAN technology is compliant with the IEEE 802.6 standard, also known as Distributed Queue Dual Bus (DQDB). Application domains included teleradiology and teleprocessing of diagnostic images. Teleradiology was focused on the enhancement of the radiologist-to-clinician information flow within the framework of the European Project EurIPACS. An intranstitutional scenario was taken as a paradigm in the field of staging, nonsurgical treatment, and follow-up of hepatocellular carcinoma. Remote processing of diagnostic images using the broadband MAN allowed a cooperative work with scientific institutions in an area often limited by the complexity of image transfer and the lack of timely feedback concerning the clinical usefulness of processed images. Our preliminary experience demonstrated that the DQDB MAN provided a fast and reliable means for transmitting diagnostic images.

Key words: Teleradiology – Metropolitan Area Network – Remote processing – Image database

Introduction

The practicability of a special network interconnecting hospitals and physicians’ offices in order to speed up the exchange of roentgenologic information should be considered and investigated without delay [1]. Since 1959, when Jutras reported his initial experiences, teleradiology has been widely employed and evaluated as a tool for allowing the exchange of radiological information by means of telecommunication and information technologies.

The continuous technological advances in the acquisition and transmission of diagnostic images have increased the ambitions and scope of teleradiology [2, 3]. However, the most successful teleradiology implementations are those that have been medically driven. In these cases the aim has been to exploit the available technological tools in order to achieve a better and faster diagnosis [4–9]. Moreover teleradiology may improve diagnostic quality by allowing the consultation of experts not available on site [10], or by enabling access to data bases of reference images [11].

However, until recently the scarce availability and high cost of high speed or broadband communications has made it very difficult to compromise between image quality and transmission speed. In the past few years broadband links have been made available to radiologists for efficiently transmitting diagnostic images [10–17].

Following the installation at our site of a broadband Metropolitan Area Network (MAN) our aim has been to develop a scenario and accordingly implement and validate a suitable system for the acquisition, local management and remote transmission of diagnostic images using a MAN. Preliminary results of this work are reported.

Materials and methods

The University of Pisa Department of Radiology is divided in two main radiological units: the first is located in Santa Chiara hospital and the second is in Cisanello hospital, which is about 5 km away. The two radiological units have different functional specializations: in the first conventional radiographical examinations, angiographical procedures and US examinations are performed. In the second radiological unit only CT, MR and US examinations are performed.

In each of the two units an Ethernet Local Area Network (LAN) [18] for the acquisition and local management of diagnostic images was implemented. A simpli-
Fig. 1. Diagram showing the Local Area Networks used for image transmission in the two radiological units in the hospitals of Santa Chiara (left) and Cisanello (right).

Fig. 2. Interconnected Metropolitan Area Networks MAN of Pisa and Florence.

Fig. 3. Distributed Queue Dual Bus architecture. The distributed queuing protocol requires that a continuous record is kept at the level of each node ($N$) that holds information awaiting access to the network. This record is used to determine the segment within the distributed queue in which to put the information that must be transmitted onto Bus A or Bus B.