

Computers in Radiology: Few Recent Advances

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Abstract: Computers are an integral part of many activities within a Radiology Department. It is used fundamentally by different radiology modalities to acquire, process and post process imaging data. Newer processor technology enables more than one CPU core into a single chip for processing multiple instructions simultaneously, resulting in higher computational speeds. This are also called as multi-core CPU, which forms the basis of single core, dual core, Core2Duo, quad core etc. Healthcare standards assist the exchange, management and integration of different medical data (including radiology), that supports patient care. DICOM is a "cooperative standard" that allows compatibility between imaging systems, by connectivity of imaging and associated medical equipments of different vendors. The term DICOM stands for Digital Imaging and Communications in Medicine and the DICOM standard is developed by American College of Radiologists (ACR) and National Electrical Manufacturers Association (NEMA). It is important to understand that radiology requires more than DICOM for workflow. Consequently, three significant health care standards important to a Radiologist are DICOM, HL7 and IHE, Digital Imaging is integral to current Radiology practice, wherein images are acquired, processed, post processed and displayed, in black and white, grayscale, or colour, using binary numbers. Digital Imaging in Radiology handles imaging equipments like USG, CR, DR, CT, MRI etc, input devices like digital camera or scanners and output devices like printers, monitors and projectors. Workstations are the 'viewing boxes' of a modern radiologist. They are at the very core of a radiologist's daily work. Addressing the issue of wasteful expenditure of money and computer hardware resources within Radiology departments, a 'client' based workstations has become an implementable concept in recent times. In radiology practice, networks have been increasingly accepted, radically improving patient workflow and offering many advantages. Picture archival and communication systems (PACS) is a system for digital storage, transmission and retrieval of radiology images. Teleradiology requires a PACS workstation and a RIS platform, which participate in acquisition, compression, transfer and review of images. To summarize, a digital transformation in the current practice of Radiology and Imaging, is a result of an unprecedented impact of computers. A working knowledge of computers for a Radiologist will enhance modalities workflow practices to its full potential, as well as help in preparing for further innovations of a digital future.

INTRODUCTION

Computers are an integral part of many activities within a Radiology Department. It is used fundamentally by different radiology modalities to acquire, process and post process imaging data. It also includes scheduling, image creation, image processing and post processing, viewing, analyzing, CAD, multimedia integration, voice dictation, reporting, billing, transmitting, networking, electronic storage and in PACS, RIS/HIS and Teleradiology as well as image reviewing on hand held devices. For a practicing Radiologist a working knowledge of computers is an advantageous skill, which when exploited, enhances workflow.

ADVANCES IN COMPUTERS

A computer has a rectangular case, containing important components called hardware located within integrated circuits (IC) or a semiconductor 'chip'^{1,2}. Several ICs are interconnected on a rectangular circuit board or motherboard which also has other important items like power, CPU, memory, storage drives, adapter cards, ports etc³⁻⁵. The motherboard is interfaced with components like keyboard, mouse, drives, networks, etc

Newer processor technology enables more than one CPU core into a single chip for processing multiple instructions simultaneously, resulting in higher computational speeds. This are also called as multi-core CPU, which forms the basis of single core, dual core, Core2Duo, quad core etc. Amongst them Dual Core is a "class" or architecture of processors with two physical CPU cores on the same chip. A Core2Duo on the other hand is a registered trademark of Intel Corporation, of a second generation processor having improved efficiency.

When matched, Dual Core and Core2Duo have only one physical "technically" processor, but virtually both of them has 2 cores or 2 processors. When compared however, Core2Duo is better than Dual Core because of a separate cache memory that offers more throughput. Likewise, in a QuadCore, there is one physical processor but virtually 4 cores or processors⁵. The core processors are more powerful than entry-level Celeron and Pentium processors⁷. In Radiology, the CPUs used in main computers at consoles of equipment like CT and MRI, should ideally contain at least four to eight cores in one CPUs⁵⁻⁶.

The latest computers with Intel processors are broadly offered as three groups:

- Core processors such as the Intel Core I 7, Intel Core I 5, and Intel Core I 3⁷⁻⁹;
- Intel® Xeon® 3000, 5000, and 7000 sequence processors¹⁰ for server and workstation markets and;
- Intel® Atom™ processor for devices like tablets, netbooks, smartphones, handhelds, and entry-level desktop PCs¹¹.

DIGITAL IMAGING AND COMMUNICATIONS IN MEDICINE (DICOM)

The term DICOM stands for Digital Imaging and Communications in Medicine. The DICOM standard has been developed by American College of Radiologists (ACR) and National Electrical Manufacturers Association (NEMA).

DICOM is a "cooperative standard" that allows compatibility between imaging systems, by connectivity of imaging and associated medical equipments of different vendors. The current version of DICOM 2007 Standard is conveniently divided into sixteen parts. It enables integration of scanners, servers, workstations, printers, and network hardware from multiple vendors into a picture archiving and communication system. It promotes the development of PACS and Image Networking in a LAN and WAN scenario. Radiology needs DICOM for its uniform set of rules for communication of digital images¹². DICOM or any electronic communication is functionally divisible into a set of layers with each layer performing a defined set of functions (Table 1)¹³⁻¹⁵. The functions are achieved by parameters called DICOM Service Class (Table 2). DICOM Conformance identifies specific DICOM capabilities of an equipment or medical device. A Conformance Statement allows "a user to determine which optional components of the DICOM Standard are supported by a particular implementation and what additional extensions or specializations an implementation adds"²².

DICOM, HL7 AND IHE

Modern radiology modalities generate an enormous amount of a variety of data. To efficiently handle the sizeable data, and to improve workflow efficiency, healthcare standards have been created. Healthcare standards