RoEduNet 11th International Conference: Networking in Education and Research

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DICOM Network

Solution for Medical Imagistic Investigations Storage, Access and Processing

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DICOM image format

- DICOM (Digital Imaging and Communications in Medicine) is a standard for handling, storing, printing, and transmitting information in medical imaging. It includes a file format definition and a network communications protocol.
- The communication protocol is an application protocol that uses TCP/IP to communicate between systems. DICOM files can be exchanged between two entities that are capable of receiving image and patient data in DICOM format.
- The National Electrical Manufacturers Association (NEMA) holds the copyright to this standard. It was developed by the DICOM Standards Committee, whose members are also partly members of NEMA.

Background of medical images data collecting and processing system creation

During last years IT sector and eHealth made a big progress in Moldova:

- Hospitals and other medical Institutions acquire modern digitized equipment.
- Medical institutions are connected to the Internet and high speed connections available not only in the cities but in the country regions too.
- Many medical institutions are developing and implementing different information systems.
- One of the directions of eHealth developing is implementation of instruments for processing and systematization of various images produced as a result of medical examinations. E.g. only limited number of medical institutions in Moldova possesses modern tomography equipment that can be used for complex images processing. It often happens that tomographic examinations' images are needed to be transferred from one hospital to another for their analyzing and future use.
- At present images transmission technologies mainly based on writing data on photo films, CD and DVD, but a few installations are equipped by DICOM Viewers for qualitative information visualization.
- Creation of integrated system of DICOM images collection, systematization and visualization in unified form is a very actual task.

Background of medical images data collecting and processing system creation (2)

- Currently even in framework of one medical institution the exchange of imagistic investigations typically is performing only by printing the images on the paper that is not comfortable for medical personal because they are limited in number of copies and quality. As a result at the surgery are presented only the pictures printed by the doctor specialist in imagistic but not the doctor who care of the patient. It is often happens in practice that physicians are waiting in operating room for images to be printed from existing investigation.
- For transferring investigations to other medical institution, when patient is transferred or addressed to another medical entity or to another specialist, is also used printed version of investigation, because it is not always exist properly compatible DICOM Viewer with target investigation format. As a result, a part of investigation is not printed and the treating specialist does not have all necessary information; usually it causes making again expensive investigation. If there appears a need to transfer the investigation to the other country, for obtaining recommendations from foreign specialist in nowadays-medical institutions need to transfer these images via paper mail and it causes inexplicable delays.
- As a result, medical institutions have to spend many extra expenses for buying the needed materials for print and archive the results of investigations in non-convenient form.

DICOM Network concept

- Medical institutions that offer imagistic investigations have a number of problems with saving and distributing the results of investigations:
  - Sending the results to the patient's doctor
  - Creating archive
  - Consulting with other doctors and scientists
  - Exchange of information with other medical institutions
  - Collecting and calculating statistics
- DICOM Network will offer the possibility to solve in unified manner all these problems and issues. Also it will increase the quality of offered service and reduce the price of medical investigations.
- Instrumental support of DICOM Network implementation is based on utilization of the modern technologies of distributing computing – GRID computing.

Aims of DICOM Network

- The main aim of the proposed Distributed Network for Secure Exchanging of DICOM Format Images is creation of united system of exchanging DICOM medical examinations using distributed GRID technologies.
- Creation of facilities that offers a possibility to realize unified approach for storing, processing and distributing of medical examination in DICOM format for all medical institutions of the country.
- The essence of the system can be fully achieved in case the proposed network will integrate all main national institutions and hospitals that offer possibility of medical examinations in DICOM format (tomography, roentgen, photofluorography, ultrasonic, etc).

Basic approaches for the system realization

- There exist different kinds of applications for visualization and processing of the DICOM image files, but these applications and their algorithms are heavily depend on medical equipment and also on its vendor. Thus, access to these data files is restricted to computers that are connected to the specialized devices.
- One of the main feature of the proposed by authors approach is elaborating of a unified library for storing, visualizing and processing of DICOM images that will be made available for authorized medical personnel in medical institutions. These unified modules would provide the opportunity for every physician with the necessary access rights to examine results of the actual and precedent patient's investigations;
- The system on the other hand would allow students and residents to access the results of the investigations and see conclusions made by specialists

Basic approaches for the system realization (2)

- Development of DICOM Network system has to cover three aspects:
- high performance, large and reliable storage and high level of data security. Analysis proved that the most suitable solution is to use distributed computing resources which currently can be provided by Grid infrastructures, especially by scientific national and regional Grid infrastructures.
- It implies that all the algorithms and their code would be running on Grid Clusters (in the existing infrastructure) and major part of implemented modules should be gridified.
- The proposed innovative approach would have a significant impact in the future allowing realization of intellectual algorithms of searching for similar cases in precedent investigations and analysis of prescribed treatment or helping in making decisions to medical specialists.

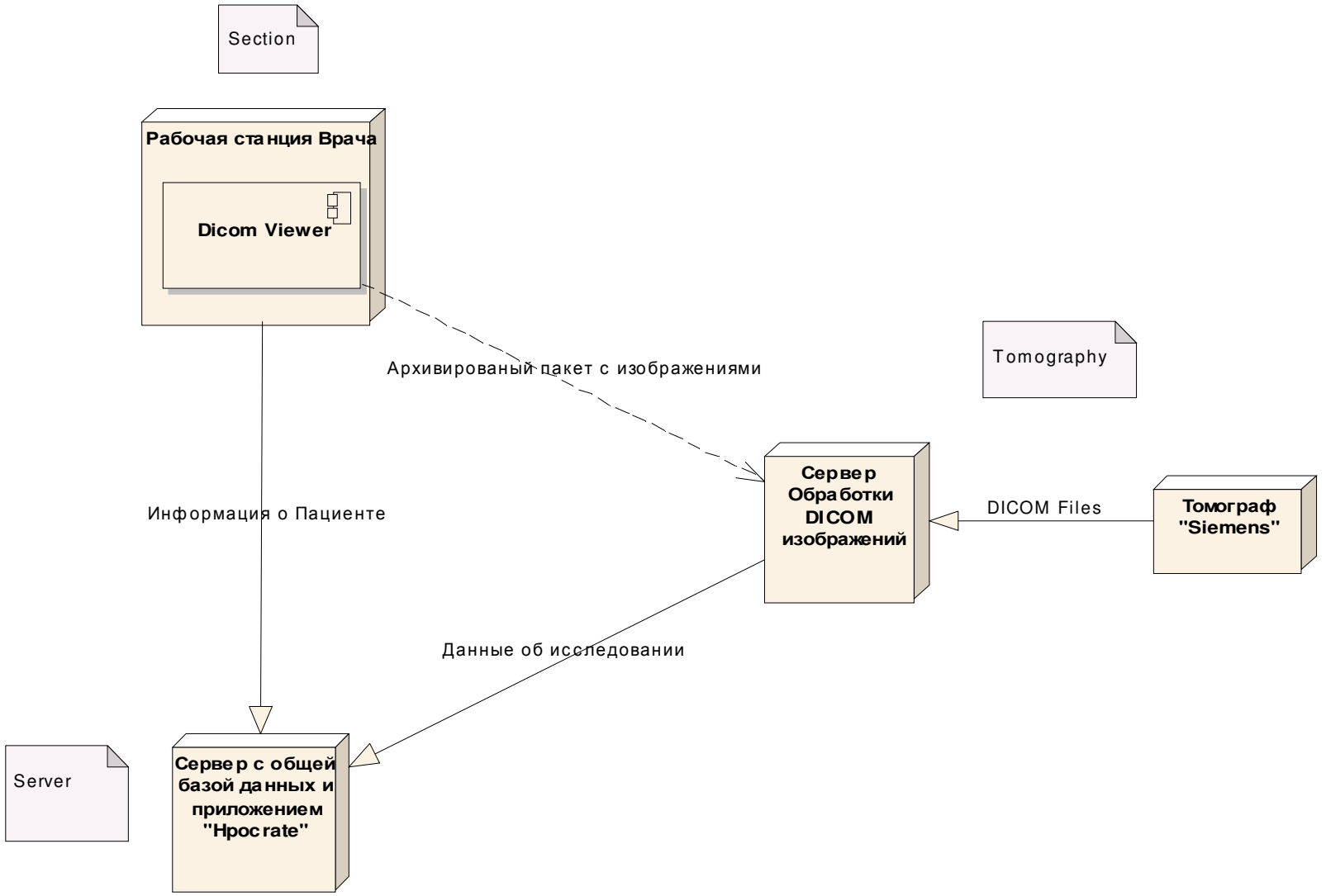
Basic approaches for the system realization (3)

- DICOM Network will work as SAAS system for all medical institutions from the Republic of Moldova connected to the system.
- The system will grant secured access to investigations that contains DICOM images and results of data processing.
- Current system concept represents only the first step of elaborating results sharing; the final idea is to create a common database of medical investigations and keep the patient medical card in the database hosted in distributed Grid infrastructure.

Features of DICOM Network software

- Ability to visualize various images acquired in DICOM format from different types of medical equipment;
- Ability to receive images from various medical installations and storing them in the unified DICOM format;
- Providing ability to exchange images in DICOM format among various institutions and working locations;
- Ability to systemize and roughly analyze acquired images in DICOM format for finding correlating dependences.

Previous realizations. Existing system of images collection and access in the National Scientific-Practical Center of Emergency Medicine



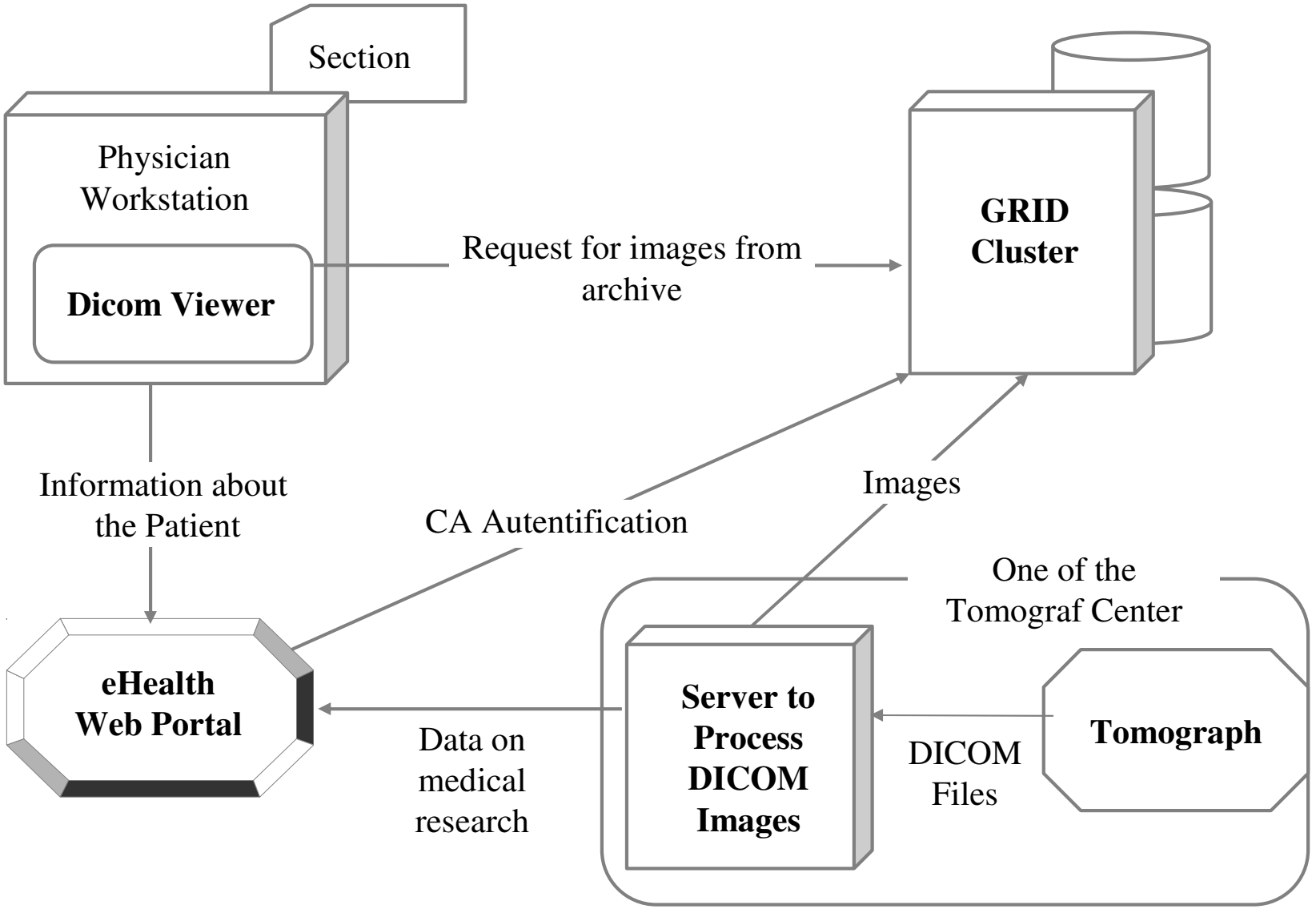
Disadvantages of the existing centralized server based realization of the system

- There is no of unified format DICOM Viewer that is qualitative enough and well adopted to the system needs;
- Extremely strong requirements to the storage capacity – centralized data storage system's capacity is the bottleneck;
- Problems with computational resources for large files processing
- Restricted number of on-line transactions processing and problems of scalability for new working places connection;
- Complicated procedure for results of investigations transmitting/exchange outside the existing centralized system

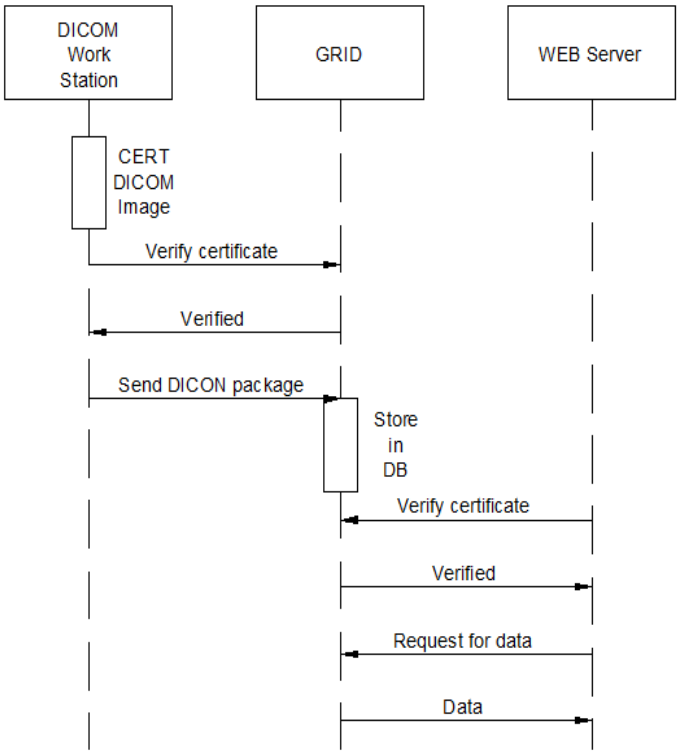
Realization approach base on GRID infrastructure

- Well scalable and adaptive for special data processing requests, computational and data storage resources;
- Possibility of using global computational resources for deep analysis of investigations and complex processing of collecting data;
- Ability to share data in a very convenient way among medical establishments at national level and internationally;
- Very reliable and unified procedure of users' identification and authorization.

DICOM Network-Grid solution



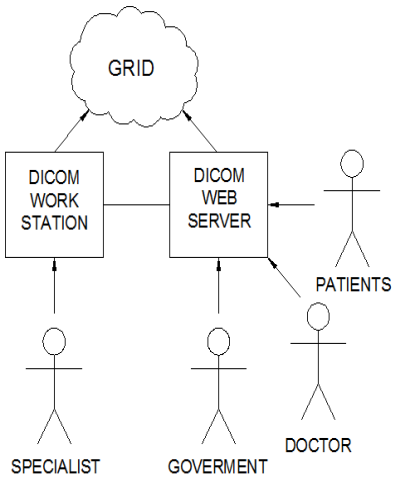
Grid - Cloud Benefits



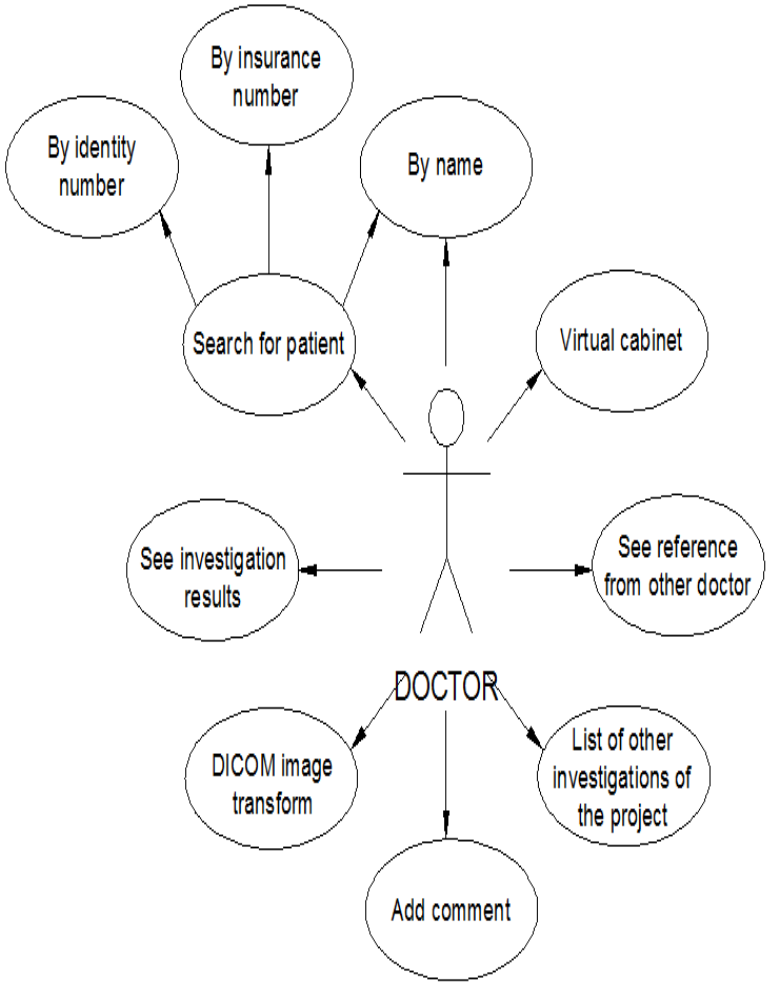
Entities interrelated with DICOM Network information system

Main entities of that use resources and interrelate with creating information system are:

- Patients – clients of one of the medical centers.
- Doctors – employees in the hospital
- Imagistics specialists – doctors specialized on working with DICOM images.
- Doctors who use the data results from DICOM Network for practical treatment
- Representatives of Government - Statistics Agency and the Ministry of Health



Functionality for medical doctor



The system WEB interface – as a component of e-Health portal

Web interface of the DICOM Network will be a part of National e-Health portal. This integrated solution allows:

- One unified resource of obtaining information and access to results of medical investigations for physicians;
- Well developed system of users' authentication and authorization;
- National level medical statistics collection and access
- Unified electron form of the medical card for every patient....

Thank you!

Questions ?

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