MEDUSA

DELIVERABLE
D121 Demonstrator plan
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medusa

Medical Distributed Utilization of Services & Applications

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1 Introduction

1.1 Aim of activity

This document provides the demonstration plan in which all the Medusa demonstrators are described in detail. Per demonstration is described what functionality and usefulness will be demonstrated. For each demonstration a detailed demonstration narrative is provided and the platform and data needed for the demonstration is described. The demonstrations are based on the five Medusa use cases (D111).

2 Medusa demonstrator

The Medusa demonstrators are based on the narratives and the five use cases (See D111). Since the use cases are all based on the basic medusa flow [UCMedusa0101] (see below) there is quite some overlap between the use cases and therefore also between the functionality and usefulness that is demonstrated per demonstration. The similarity between the use cases is indicated per sub-use case (e.g. UCMedusa0201). Because of the overlap between the use cases it is desired, from the clinical user perspective, to use 1 main "framework" for all the demonstrations which combines multiple platforms or uses the results produced by a certain platform.

Basic Medusa flow [UCMedusa0101]:
- Authentification (UCMedusa0201)
  o Is similar for all use cases
- Identification (UCMedusa0301)
  o Is similar for all use cases
- Data collection (UCMedusa0401)
  o The collected data is different for each use case but the flow is similar for all use cases
- Automatically post processing (UCMedusa0501)
  o Each use case needs it own specific post-processing but the general flow is similar for all use cases
- Decision support (UCMedusa0601)
  o Each use case needs specific rules for the decision support but the general flow is similar for all use cases
- Collaboration workspace (UCMedusa0701)
  o The applications used in the Collaboration workspace is different for each use case. Off course some applications are used in multiple use cases.

3 Acute Scenario: Ischemic stroke demonstration (1)

Owner: Academic Medical Center (AMC), location of demonstration: AMC
Use case: Decision on treatment in the acute scenario illustrated by the ischemic stroke narrative [UCStroke0101], but also applicable to Trauma and Oncology (See D111).

3.1 Main functionality and usefulness that should be demonstrated:

- Authentication
- Identification
- User selects Stroke protocol to activate decision support
- User can switch off selected medical protocol to disable decision support messages/alerts
- Data collection
- Decision support collects data needed for applying the rules defined in the medical protocol
- Post processing for stroke (specific types of postprocessing to be defined)
- Extra manual input for post-processing
- Read patient history
- View stroke protocol
- Analyse sensor information of the patient
- Automated post-processing of Computed Tomography (CT) Perfusion
- View and analyse image data
- Work on patient record
- Work in cloud-based collaboration workspace
- Analyze and interview patient in the ambulance(optional, can be a remote location with Medusa)) via live video stream
- Make treatment decision with remote college

3.2 Step by step demonstration narrative

The demonstration starts when the patient suspected of a stroke arrives at the Emergency Room (ER) of the local hospital. Optionally an ambulance can be added, then the narrative starts when the patient enters the ambulance.

- User A (in this demonstration the radiologist @ the local hospital) authenticates himself (*UCMedusa0201*)
- User A identifies the patient (The patient has a passport with him, the user enters the sex, date of birth and name in Medusa) (*UCMedusa0301*)
- Medusa Decision support prompts for selection of protocol (*UCMedusa0601*)
- User A selects the Stroke Protocol and automatically the decision support is activated.(The patient is suspected of having a Stroke) (*UCMedusa0601*)
- User A switches the decision support off.
- User A switches the decision support on.
- Patient history and previous imaging is automatically collected by Medusa (Data Collection (UCMedusa0401))
- Decision support automatically collects the available data needed for applying the rules defined in the medical protocol (*UCMedusa0601*)

- User A reads the patient history (UCMedusa0701)
- *Meanwhile the neurologist examines the patient and confirms a Stroke. (for the story)*
- The finding of the neurological examination are digitized (Work on patient records) (UCMedusa0701)
- User A views the Stroke Protocol (UCMedusa0701)
- *Sensors where already attached to the patient (for the story)*
- User A analysis sensor information of the patient
- *The patient receives a non-contrast enhanced CT of the brain.(for the story)*
- The CT scan is automatically made available for all the users (UCMedusa0401)
- The CT scan is automatically post-processed (Auto infarct core detection, Auto Haemorrhage detection, Early ischemic stroke detection (ASPECTS) (UCMedusa0501)
- User A views and analyses the (derived) image data (UCMedusa0701)
- *Since there is no bleeding the patient receives thrombolysis*
- The patient does not respond to the Intravenous (IV) thrombolysis, this is digitized in the patient record .(UCMedusa0701)
- *The patient does not respond to the medication therefore a transfer to a specialized hospital (AMC) for intra-arterial treatment must be discussed (somehow the decision support must be activated so the Neuroradiologist and Neurologist of the specialized hospital will receive an alert/notification. The non-response of the patient is digitized in the patient's record. . Are the contacted by phone to notify them of the Medusa collaboration?)*
- The neuroradiologist and neurologist of the specialized hospital receive a message from the medusa decision support *(UCMedusa0601)* or phone call from the neuroradiologist @ the local hospital.
- User B (neuroradiologist from specialized hospital) authenticates himself *(UCMedusa0201)*
- User B identifies the patient *(UCMedusa0301)*
- User A and b discuss the patient casus in the virtual collaboration workspace and decide extra imaging is needed to determine if the patient is eligible for intra-arterial treatment. They decide that at the local hospital a CT *Angiography (CTA)* and CTP must be performed. (UCMedusa0701)
- *The patient receives an CTA and CTP*
- The CTA and CTP are automatically made available for all the users (UCMedusa0401)
- The CTA scan is automatically post-processed (Thrombus segmentation, (UCMedusa0501)
- The CTP scan is automatically post-processed (Perfusion analysis) (UCMedusa0501)
- User A and B view and analyse together the (derived) image data (UCMedusa0701)
- User A and B decide that the patient is eligible for intra-arterial treatment and must be transferred to the specialized hospital.

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3.3 Platform

Medusa collaboration Framework (Technolution): Medusa consists of a combination of stand-alone applications, cooperating in a single environment. The applications vary from 3D-imaging applications till decision support and video conferencing. The coordination between the applications is handled by the Medusa Collaboration Framework.

The framework acts as a glue, to let the applications act as if they were a single large application. The framework synchronizes the active applications and keeps track of the users connected to a session. It shares important information like the patient ID and important actions like 'collaboration session starts' with the active applications.'

Prologue's Cloud Collaboration Management Platform: To orchestrate the allocation and deallocation of resources on the Cloud, a Cloud collaboration management platform (CCMP) is conceived to act as an intermediary between the Client environment and the Cloud resources. The CCMP translates Client requests into available hardware and software for application execution by invoking the CompatibleOne APIs. It also oversees the lifecycle of the deployed resources and links back the virtualized legacy applications to the Client environment.

Philips Processing Prototype Platform: The 'Philips Processing Prototype Platform' offers a Multi-Modality Medical Imaging Software Platform, a Remote Serviceability Platform, a common look and feel toolkit, and the Interoperability Competences to address the common requirements in all imaging modalities.

Some of the most important guidelines the Unified Platform adheres to are:

- Provide both ease of use and power through a layered design
- Keep simple things simple and complicated things possible
- Design user scenario driven

This platforms offers new applications a rich set of functionality to significantly improve time to market for new applications.

Within the Medusa consortium the platform is used as common rapid prototyping environment to support the development, verification and clinical validation of algorithms and to enable deployment of prototypes based on CE labeled platforms to be validated at clinical sites.

SoftwareLinux Virtual Machines hosted on Bull platform (for decision support system (Sopheon))

The Decision Support System uses Virtual Machines hosted on Bull servers. The Decision Support System (DSS) component currently runs on Node.js Node.js is a platform built on Google Chrome's JavaScript runtime for easily building fast, scalable network applications. Node.js uses an event-driven, non-blocking I/O model that makes it suitable for data-intensive real-time applications running across distributed devices. The Decision Support System is is being developed and deployed on Fedora, an operating system based on the Linux kernel.

BULL super computers

3.4 Data needed for demonstration

The following data (imaging data, sensor data, text data) is needed during the demonstration so that the demonstrations are a good reflection of clinical practice and to show the complete functionality of Medusa (for example the automated post processing of image data and the analyses of sensor data by the decision support system)

Authentication information
Identification information (AMC)
- Sex
- Date of birth
- Name
- Medusa patient number

Imaging data (AMC)
- Non contrast enhanced CT brain
- CTA of the brain
- CTP of the brain

Sensor information (Sopheon)
- Heart rate
- Blood pressure
- ECG
- Saturation (optional)

Decision support protocol (text file) (Sopheon)
Patient History (text file) (AMC)

4 *Acute scenario:* Trauma demonstration (2)

Owner: AMC, location of demonstration: AMC
Use case: Decision on treatment of Trauma patient [UCTrauma0101] (see D111).
The trauma use case is very similar to the ischemic stroke use case. Maybe we should only demonstrate trauma decision support and trauma post-processing)

4.1 Main functionality and usefulness that should be demonstrated:

- Authentification
- Identification
- Trauma decision support
- Read patient medical history (optional)
- View the medical trauma protocol (optional)
- Analyse real time sensor information of the patient from a remote location
- Post processing for Trauma (automatic blood detection in full body CT(optional))
- View and analyse image data (optional)
- Make treatment decision with remote college through cloud-based collaboration

4.2 Step by step demonstration narrative

The demonstrator starts when the patient, who was involved in a high speed car accident, is in the ambulance (equipped with Medusa). The ambulance staff (User A) was already logged on to Medusa. The patient is connected to sensors that monitor his vital signs (Electrocardiogram (ECG), Saturation, blood pressure). User B is located in the specialized trauma center. When user B receives the notification about the trauma he will rush to the trauma room located in the emergency department. The trauma room is equipped with a Medusa workstation and large monitors to ensure all members of the trauma team can see the information (vital signs, imaging data, patient history, use of medication). The Trauma radiologist is located in the room next to the trauma room.

- User B (the Trauma Leader @ the specialized hospital) authenticates himself (*UCMedusa0201*)
- User B identifies the patient (*UCMedusa0301*)
- User C (the Emergency Radiologist @ the specialized hospital) authenticates himself (*UCMedusa0201*)
- User C identifies the patient (*UCMedusa0301*)
- Medusa Decision support prompts for selection of a protocol (*UCMedusa0601*)
- User B selects the Trauma Protocol and automatically the decision support is activated. (*UCMedusa0601*)
- Patient history and previous imaging is automatically collected by Medusa (Data Collection (UCMedusa0401))
- Decision support automatically collects the available data needed for applying the rules defined in the medical protocol (*UCMedusa0601*)
- User B views the sensor information of the patient in the ambulance that is driving towards the hospital (UCMedusa0701)

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- All users receive a warning from Decision Support that the patient is instable *(heart rate increases while blood pressure decreases).*
- User B advices the ambulance staff to administer saline solution and give the patient Norepinephrine (medicine to increase the blood pressure).
- *After treatment with the saline infusion and Norepinephrine the patient is stable.*
- *The trauma patient arrives at the hospital.*
- *The patient receives a full body contrast enhanced CT scan .(for the story)*
- The CT scan is automatically made available for all the users (UCMedusa0401)
- The CT scan is automatically post-processed (automatic blood detection) (UCMedusa0501)
- User C views and analyses the (derived) image data (UCMedusa0701)
- *The patient has traumatic aorta injury*
- User B and C decide that the patient needs surgery.

4.3 Platform

Medusa collaboration Framework (Technolution).(see chapter 3.3 for description)

Prologue's Cloud Collaboration Management Platform (see chapter 3.3 for description)

Philips Processing Prototype Platform (see chapter 3.3 for description)

SoftwareLinux Virtual Machines hosted on Bull platform (for decision support system (Sopheon)) (see chapter 3.3 for description)

BULL super computers

4.4 Data needed for demonstration

The following data (imaging data, sensor data, text data) is needed during the demonstration so that the demonstrations are a good reflection of clinical practice and to show the complete functionality of Medusa (for example the automated post processing of image data and the analyses of sensor data by the decision support system)

Authentication information
Identification information (AMC)
- Sex
- Date of birth
- Name

- Medusa patient number

Imaging data (AMC)
- Full body CT of trauma patient

Sensor information (Sopheon)
- Heart rate
- Blood pressure
- ECG
- Respiratory rate
- Temperature
- Saturation (optional)

Decision support protocol (text file) (Sopheon)

Patient History (text file) (AMC)

5 Post traumatic coma demonstration (3)

Owner: Pitié Salpêtrière Hospital (HSP) & Institut Mines & Telecom (IMT), location of demonstration: BULL Cloud and IMT
Use case: [UCPost-Trauma0101]

5.1 Main functionality and usefulness that should be demonstrated:

- The remote access to the application using thin clients (tablet, smartphones)
- The loading of the patient Diffusion Tensor Imaging (DTI) data into the application
- The selection of the one of the three available etiologies:
  - Traumatic brain injury
  - Cardiac arrest
  - Subarachnoid Hemorrhage
- The launch of DTI processing according selected etiology
- The report generation
- The viewing and analysing of the resulted (post-processing) report
- The cloud-based collaborative access of the results
- The cloud-based collaborative decision making within the remote physicians

5.2 Step by step demonstration narrative

- User A connects to the MEDUSA platform using [UCMedusa0201] and securely access the post traumatic application.
- The application processes a huge amount of data:
  - A set of files (10000 to 20000 images in DICOM format and the underlying metadata);
  - The data transfer and/or storage is made under security solutions provided in WP4;
- These data are processed on the BULL Cloud:
  - An internal file format conversion
  - A pre-examination according to the medical know-how and a selection of some processing parameters
  - The processing per-se
- Final report generation:
  - As a result of the processing, a report is generated
  - This report is in the current day solution composed of a large set of DTI-Neuroimaging Informatics Technology Initiative (NIfTI) files of quite small size (2000 to 10000), metadata and text; it is encapsulated as a pdf/xml file.
- The data transmission on uplink and the report transmission on the downlink

5.3 Platform

This demonstrator will be instantiated on a platform of the type client-server. The server will accommodate all the computational intensive tasks required by the demo, be they related to the post-traumatic coma application itself or to the related MEDUSA components. The client will be in charge only with the display of the graphical content generated by the post-traumatic coma application and of the capturing of the user interaction events (mouse clicks, etc). The server and the client are connected through a network. Details follows.

Server side
- MEDUSA Platform (see chapter 3.3 for description)
- BULL Cloud servers, running in parallel 2 Linux instances (Ubuntu 12.04 LTE):
  - Instance 1:
    - Application Execution/Processing
  - Instance 2:
    - Collaborative Virtual Environnement
- Prologue's Cloud Collaboration Management Platform

Client side
- Two tablets for remote collaborative access, of two different types (hardware/OS):
  - Samsung 10.1 - Android OS based
  - iPad – iOS based

Network
- WiFi 802.11n access point

5.4 Data needed for demonstration

The following data (imaging data, sensor data, text data) is needed during the demonstration so that the demonstrations are a good reflection of clinical practice and to show the complete functionality of Medusa (for example the automated post processing of image data and the analyses of sensor data by the decision support system)

The data for the demo is made available by HSP, and it is in DTI of the brain – NIfTI format.

6 Contouring for oncology demonstration (4)

Owner: Gustave Roussy & DOSIsoft, location of demonstration Gustave Roussy

Use case: Contouring for Lymphoma [UCContouringLymphoma0101] and Contouring for Therapy Response [UCContouringTherapyResponse0101] (see D111), including real time and scheduled second opinion.

6.1 Main functionality and usefulness that should be demonstrated:

- Authentification of the actors
- Patient Identification
- Read patient history
- Data collection
- Contouring post-processing (automatic thorax and abdomen volume extraction to prepare registration tasks, standardised uptake volume (SUV) computation)
- Contouring decision support (to be defined: may be empty)
- View and analyse image data
- Use DOSIsoft's PLANET application for registration and contouring
- Make contour decision with remote college through cloud-based collaboration
- Export the contours as DICOM RT Struct files
- Export DICOM Screen captures or DICOM PDF encapsulated report

6.2 Step by step demonstration narrative

6.2.1 Contouring for Lymphoma [UCContouringLymphoma0102]

The basic flow includes the Medusa use case [UCMedusa0101].
- Authentication of the actors. *(UCMedusa0201)*
- Patient identification. *(UCMedusa0301)*
- Data collection *(UCMedusa0401).*
- Data post processing *(UCMedusa0501).*
- The actors work together in the collaboration workspace to decide the best treatment *(UCMedusa0701)*
    - The radiotherapist (first actor) creates a new study (named Study Pre) including pre chemo series: $CT0_{RT}$ and CT0 and PT0 in the Collaboration Workspace.
    - The radiotherapist performs the co-registration of CT0 and PT0 to $CT0_{RT}$, the new registered series are named $PT0_R$ / $CT0_R$.
    - The radiotherapist uses the available segmentation tools to perform contours on the series $CT0_{RT}$ and $PT0_R$ which are in the same coordinate system.
    - The radiotherapist changes the status of the study to mark it as "Performed by + his name"
    - The radiotherapist saves Study Pre.
    - The radiotherapist exports to the database the performed contours as a DICOM RT Struct file (named RTStruct Pre).

- o The radiotherapist quits the application.
- o After the chemotherapy treatment (3 - 6 months after), the radiotherapist creates a new study (named Study Post) including post chemo series: $CT1_{RT}$, CT1 and PT1.
- o The radiotherapist performs the co-registration of CT1 and PT1 to $CT1_{RT}$, the new registered series are named $PT1_R$ and $CT1_R$.
- o The radiotherapist imports to Study Post the series $CT0_{RT}$ and its associated contours RTStruct Pre.
- o The radiotherapist performs the co-registration of $CT0_{RT}$ to $CT1_{RT}$.
- o The associated contours of $CT0_{RT}$ are carried over to $CT1_{RT}$.
- o The radiotherapist updates the contours on $CT1_{RT}$ to fit the anatomy of the patient after the chemotherapy treatment using also the $PT1_R$ series.
- o The radiotherapist changes the status of the study to mark it as "Validated by + his name"
- o The radiotherapist saves Study Post.
- o The radiotherapist exports to the database the performed contours as a DICOM RT Struct file (named RTStruct Post). The produced contours will be the input data for the ballistic beams for the treatment planning of radiotherapy.
- o The radiotherapist quits the application.

Successful Alternative Flows: Contouring for lymphoma

A1: Real time second opinion during pre / post chemo stage
[UCContouringLymphoma0103]
A1.1: The radiotherapist asks for a second opinion for contouring in real time. He may ask a radiologist for his skill for anatomical series or a nuclear medicine physician for functional series
A1.2: Authentication of the second actor. *(UCMedusa0201)*
A1.3: The collaboration workspace allows the users with the ability to modify manually the contours already drawn.
A1.4: The actors comment the modifications
A1.5: The radiotherapist changes the status of the study to mark it as "Performed by + all names"

A2: Scheduled second opinion asked during pre / post chemo stage
[UCContouringLymphoma0104]
A2.1: The radiotherapist plans a scheduled second opinion for contouring. The first actor sets the contours visible or not by the second actor in order to not influence the result.
A2.2: Authentication of the second actor. *(UCMedusa0201)*
A2.3: The second actor uses the available segmentation tools to perform contours on the series.
A2.4: The second actor changes the status of the study to mark it as "Performed by + his name"
A2.5: The new performed contours are saved into the study.
A2.6: The radiotherapist reviews the contours. The actor opens a study with the status "Performed by someone else"
A2.7: The application displays the series in a standard layout including all available contours.
A2.8: The actor uses the acceptance tool to check and edit the contours on the series and produces validated contours.

6.2.2 Contouring for Therapy Response [UCContouringTherapy Response0102]

The basic flow includes the Medusa use case [UCMedusa0101].
- Authentication of the actors. *(UCMedusa0201)*
- Patient identification. *(UCMedusa0301)*
- Data collection *(UCMedusa0401).*
- Data post processing *(UCMedusa0501).*
- Decision support *(UCMedusa0601)*
- The actors work together in the collaboration workspace to evaluate the response of the tumour to the treatment *(UCMedusa0701).*
  - The physician creates a new study including the series of the time point 0: CT0 and PT0 in the Collaboration Workspace.
  - The physician uses the available tools in order to segment, on the series PT0 the tumors (SUV volumes)
    - The corresponding results may be displayed by the actor through a result table and/or a graph.
    - The results may be saved as screen captures to the database.
    - The physician saves the study.
    - The physician quits the application.
    - When available, the actor inserts the new PT/CT series to the study (associated to a new time point).
    - The physician performs the co-registration of CT1 and PT1 to CT0 and the PT0 new registered series are named $PT1_R$ / $CT1_R$.
    - The identified tumors at time point 0 are automatically segmented in the registered time point 1.
    - All results may be displayed by the actor through a result table and/or a graph.
    - The results may be saved as screen captures to the database.
    - The physician can compare the previous and current images.
    - The physician saves the study and quits the application.

Successful Alternative Flows: Contouring for therapy response
A1: Real time second opinion
[UCContouringTherapyResponse0103] Follow the use case *(UCContouringLymphoma0103)*
A2: Scheduled second opinion
UCContouringTherapyResponse0104] Follow the use case *(UCContouringLymphoma0104)*

6.3 Platform

Medusa collaboration Framework (Technolution) (see chapter 3.3 for description)
Prologue Prologue's Cloud Collaboration Management Platform (see chapter 3.3

for description)

DOSIsoft's PLANET application:PLANET Onco is a software platform dedicated to the review and the analysis of image series from the Nuclear Medicine. The application allows, especially, to address the acquisition series from hybrid machines PET / CT and SPECT / CT.

It includes a set of tools specific to oncology, for the review of image series for the diagnosis of cancer, but also for tumor quantification and response assessment of the patient to therapy within the monitoring of the disease.

The PLANET Onco application provides the following main advantages:
- Provides user-friendly tools for the simultaneous examination of multiple fused imaging modalities;
- Offers original methods for segmentation of tumors using functional and anatomical modalities;
- Improves the identification and precise delineation of tumors;
- Performs the monitoring treatment and facilitates adaptive processing;
- Guides the treatment decisions;
- Exports the contour files to TPS for treatment plans implementation in radiotherapy.

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6.4 Data needed for demonstration

The following imaging data is needed during the demonstration so that the demonstration is a good reflection of clinical practice and to show the complete functionality of Medusa (for example the contouring of image data)

Imaging data (provided by Gustave Roussy)
- DICOM anatomical CT / Magnetic resonance imaging (MRI) series
- DICOM functional Single-photon emission computed tomography (SPECT) / pet positron emission tomography (PET) series

7 Computer assisted in vitro diagnostics demonstration (5)

Owner: Imstar.

7.1 Preparation of data for the computer-assisted in-vitro diagnostic

Location: Imstar premises in Paris.
Use Case: [UCInVitroDiagnostic0101]

7.1.1 Main functionality and usefulness that should be demonstrated:

1. Authentication
2. Identification
3. Automated microscopic slides digitisation; making the digitised slides available for the processing and/or observation (storing them in a stand-alone server or in a cloud).
4. Automated image processing for the slide visualisation optimisation (running either on a stand-alone server or in a cloud).
5. Automated detection and classification of the cells (running either on a stand-alone server or in a cloud).

7.1.2 Step by step demonstration narrative

1. User runs the Pathfinder scanning application and logs in to the Medusa (to be able to upload the digitized slides).
2. User starts the scanning, choosing the image processing/analysis to be automatically performed on the scanned images.
3. As the scanning progresses, the slides become available for the review.

7.1.3 Platform

- Imstar Pathfinder hardware, including motorised microscope, XY stage, slide loader and camera, all connected to the computer running Imstar Pathfinder application under Win7/64 for the slide digitisation.
- Bull-hosted cloud providing Win64/7 virtual machines for the Imstar Pathfinder BatchProc application, to perform automated massively parallel image processing in the cloud.
- Prologue Cloud Collaboration Management Platform, to manage the Bull-hosted cloud.

7.1.4 Data needed for demonstration

No digital data is required for this demo, only the sample slides with the preparation.

7.2 Establishing the diagnostic based on the digitized and processed slide images

Location: Any location connected to Internet
Use Case: [UCInVitroDiagnostic0102]

7.2.1 Main functionality and usefulness that should be demonstrated:

1. Authentication
2. Identification

3. Selection of the slides to review from the database. Use of multiple available views into the slide database.

4. Visual slide examination using the dedicated high-resolution image viewer (~10^{10} pixels).

5. Interactive review of the selected type (class) of cells (thumbnails of the preselected cells are presented to the user), with possibility to confirm or reject the results of the automatic classification.

6. Collaborative review: another user may review the same cells, either seeing or not the results of the previous review(s).

7.2.2 Step by step demonstration narrative

1. User runs the Pathfinder analysis application and logs in to the Medusa (to be able to retrieve the digitized slides).

2. User requests the table of slides referenced in the database. He may choose from different table views representing different aspects of the slides, set the sorting and filtering criteria.

3. User selects the slide(s) to review.

4. User visually browses the image of the selected slide, sets annotations and produces the diagnostic

5. User requests the review of the (pre-detected and pre-classified) cells of certain class.

6. The cell images appear in the dedicated gallery and user reviews and validates the cell classification.

7. Using the cell classification report, user sets the diagnostic.

7.2.3 Platform

- Technolution Medusa collaboration platform, to provide remote access to the images, segmentation and diagnostic data used for the review.
- Bull (image) file storage.

7.2.4 Data needed for demonstration

Scanned set of slide images. If the demo is performed together with the 7.1, no digital data is required for this demo, only the sample slides with the preparation.

7.3 Remote Extemporaneous diagnostic using the remote microscope solution

Location: Imstar premises in Paris for the microscope and any other location with Internet connection for the view/control workstations.

Use case: [UCInVitroDiagnostic0103]

7.3.1 Main functionality and usefulness that should be demonstrated:

1. Authentication
2. Identification
3. Remote microscope control and slide image observation at different magnifications
4. Possibility to connect multiple users to collaborate at the same slide on the same microscope

7.3.2 Step by step demonstration narrative

1. During the surgery, surgeon cuts a piece of the tissue that has to be visually analysed by the pathologist under the microscope.

2. User1 (technician) makes the slice from the tissue, colours it and places the slide at the microscope.

3. User1 runs the Transmitter software component on the computer connected to the microscope and requests the diagnostic to be performed on this slide by pathologist.

4. User2 (pathologist) runs the Receiver software component, receives the request and obtains the authorisation (authentication/identification) to connect to the Transmitter.

5. User2 browses through the slide, remotely moving the microscope XY stage, changing focus, illumination conditions and nosepiece in use.

6. User2 requests help (second opinion) from another Pathologist (User3) at another location.

7. User3 runs the Receiver software component, receives the request and obtains the authorisation (authentication/identification) to connect to the same Transmitter.

8. Both User2 and User3 can alternatively control the microscope, annotate the image and discuss the diagnostic.

9. Final diagnostic is established and communication to the User1.

10. User1 communicates the diagnostic to the surgeon at the operation block, the surgeon continues the operation accordingly to the diagnostic

Note: pp 1-2 and 10 are out of the scope of the demo.

7.3.3 Platform

- One instance of the Imstar e-mage/Transmitter and two instance of the e-mage/Receiver remote microscope application running on Win7/64 machines.
- Rendez-Vous server software running on the Imstar-hosted Win7/64 computer.

7.3.4 Data needed for demonstration

No digital data is required for this demo, only the sample slide with the preparation.

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8 The Remote Visit scenario demonstration (6)

Owner: Sopheon, location not yet known.
Use case: Decision on treatment in the remote visit scenario illustrated by the remote oncology visit narrative.

8.1 Main functionality and usefulness that should be demonstrated:

- Authentification
- Identification
- User selects relevant oncology protocol to activate decision support
- User can switch off selected medical protocol to disable decision support messages/alerts
- Decision support collects data needed for applying the rules defined in the medical protocol
- User views patient history, including historical images and videos
- User can view relevant oncology protocol
- User analyzes and interviews patient at the remote location via live video stream
- User analyzes sensor information of the patient
- User views and analyzes actual image data generated by the live video stream
- Image comparison is applied to identify differences in the face of the patient between the previous and the current visit
- User decides on the next steps in the cancer treatment

8.2 Step by step demonstration narrative

The demonstration starts when a patient with cancer in an advanced stage is at a local hospital or medical office to monitor his condition. At another hospital is the specialized oncologist by whom the patient is being treated by a far from where he lives, but the oncologist can monitor the patient remotely making use of MEDUSA (as traveling is very cumbersome for the patient).

- User A (in this demonstration the local doctor) authenticates himself (*UCMedusa0201*)
- User B (in this demonstration the oncologist @ the remote hospital) authenticates himself (*UCMedusa0201*)
- User A identifies the patient and enters the sex, date of birth and name in Medusa) (*UCMedusa0301*)
- User A weighs the patient and enters the actual weight in the patient record
- User A attaches sensors to the patient and establishes a live video connection with the patient. (*UCMedusa0401*)
- Medusa Decision support prompts for selection of protocol (*UCMedusa0601*)
- User B selects the Remote Diagnosis Protocol and automatically the decision support is activated. (*UCMedusa0601*)
- Patient history and previous imaging is automatically collected by Medusa (Data Collection (*UCMedusa0401*))
- Decision support automatically collects the available data needed for applying the rules defined in the medical protocol (*UCMedusa0601*)

- User B interviews the patient and analyses his face and posture in the live video (UCMedusa0701)
- User B consults the patient history (UCMedusa0701) , esp. videos and images made during the last and the second last visit
- User A and User B receive a warning from Decision Support that [.. to be determined ..]
- User A and User B discuss the patient casus in the virtual collaboration workspace and decide if the cancer treatment the patient is following should be continued, adapted or stopped. (UCMedusa0701)

8.3 Platform

Medusa collaboration Framework (Technolution). (see chapter 3.3 for description)

Prologue's Cloud Collaboration Management Platform (see chapter 3.3 for description)

Philips Processing Prototype Platform (see chapter 3.3 for description)

SoftwareLinux Virtual Machines hosted on Bull platform (for decision support system (Sopheon)) (see chapter 3.3 for description)

BULL super computers

8.4 Data needed for demonstration

The following data (sensor data, text data) is needed during the demonstration so that the demonstrations are a good reflection of clinical practice and to show the complete functionality of Medusa (for example the analyses of sensor data by the decision support system)

- Live video and images of the face
- Sensor data (simulated or real)
  - Heart rate
  - Blood pressure
- Also: Weight loss
- Protocol data for decision support (rules in text format)
- Patient history (text)

9 Collaborative decision making for oncology demonstrator (7)

Owner: IMT
Location: IMT, Evry France or Bull, Grenoble France.
Use case: multidisciplinary concertation meetings (MCM) - remote visit story 2, (D1.1.1)

9.1 Main functionality and usefulness that should be demonstrated:

- Authentification
- Identification
- Selection of Multidisciplinary decision support for oncology
- Read patient medical history (optional)
- View the medical protocol (optional)
- View patient image data from a remote location
- Post processing during collaborative meeting (alignment, segmentation, contouring, measuring, annotations (optional))
- Make treatment decision with remote colleagues

9.2 Step by step demonstration narrative

The demonstration has two parts: offline and online usage.
The offline usage (not demonstrated) starts when new image data is collected from a patient submitted to a therapeutic protocol and for whom a diagnostic decision is requested from a college of experts during multidisciplinary concertation meeting (MCM).
- User A (service requester) authenticates himself
- User A either identifies the patient and creates a new follw-up instance (folder), or creates a new entry (baseline) for a new patient;
- User A runs the MCM application (ideally deployable on the local site), loads the original DICOM dataset and runs the compression protocol. The compressed data is then stored in the patient new follow-up instance folder;
- User A updates the patient status as "Feed-back requested";
- User A disconnects.

The online usage starts when a multidisciplinary concertation meeting is organized (generally each week), in order to assess the status of different therapeutic protocols involving patients with cancer (follow-up procedure).
- User A (meeting initiator) authenticates himself and invites the other experts;
- Several Users (experts from different disciplines) authenticate themselves. The access to the MCM application is allowed if the minimum of disciplines is present and the session can start.
- User A access the patient list labeled "Feed-back requested". For each patient in the list the following operations are performed;
- User A displays the patient report including clinical information from previous investigations (and previous MCMs)

- User B (radiologist expert) opens the image platform application (here MedView or P4) and access the image data from the last (follow-up) radiologic exam and previous (baseline) one(s). User B "points to" the tumour region(s) detected from previous exams (the information is available in the metadata flow). Automatically, the corresponding image from the last CT examination is displayed. Interactive adjustment of slice position may be performed if needed. The tumour is (automatically or interactively) segmented on the last CT exam and its morphological parameters computed and displayed. The segmented region is labelled consistently with previous exams and information is saved into the metadata flow.

- User B scrolls into the last CT exam image series to check for tumour segmentation accuracy and to perform a whole visual examination. The findings are discussed with the expert panel and decision on pursuing or changing the treatment is done.

- User A updates the patient report and modifies the status to "Updated".

- User A closes the patient file. The metadata flow is updated on the server (new follow-up instance folder). A message is automatically sent to the healthcare team having requested the expertise, notifying the update (from this moment the treating team can connect on Medusa and retrieve the decision).

9.3 Platform

Medusa collaboration Framework (Technolution). (see chapter 3.3 for description)

Server side

- MCM image data application: MedView Platform (or Philips Processing Prototype Platform according to integration advances) on a Windows virtual machine. The MCM image data application is the end-user platform that is exploited for image analysis by the radiologist during the online session. For the demonstrator purposes, the IMT *Medview* software will be used (or the Philips Processing Prototype Platform according to integration advances). They are both running on a Windows OS. Such application has to be able to access remotely the image data which is compressed and encoded based on the JPEG 2000 2D standard. This allows defining several quality layers associated with regions of interest (ROIs) in the image which can be accessed independently.

- image decoding server (OpenJPEG library)

- eventually, JPIP server installed (OpenJPIP + FCGI module for an existing Web server - e.g. Apache) for direct data transfer (without virtualisation, if this option is desired)

Any part (ROI) of the encoded stream can be accessed at the desired quality level by exploiting the JPEG 2000 Interactive Protocol (JPIP), (see D 3x2, Fig. 5.1.2). This protocol implies the deployment of a JPIP server at the remote site hosting the compressed data and a local image decoding server at the client side which manages the part of the stream already decoded. When a request for an ROI in the encoded stream is sent by the application to the JPIP server, the local server first checks for the existence of the ROI in the already decoded data. When the data is partially present (e.g. at a coarse quality level), only the remaining information required to reconstruct the desired quality level of the ROI at the client side will be requested from and fetched via the JPIP server.

Note that in our case, an ROI can be a whole (axial) image or part of it, according to the settings chosen and used by the encoder.

The solution includes a JPIP server implementation based on the open-source code named OpenJPIP (http://www.openjpeg.org/). OpenJPIP software is an implementation of JPEG 2000 Part9. Since it does not implement a fully server architecture, as it is designed as a FCGI module for an existing Web server, Apache was selected to fulfill this requirement (http://www.apache.org/). OpenJPEG library is also required for the compression/decompression of the images and their storage on the server side.

- Virtualisation (see chapter 5.3 for description)

    - BULL Cloud servers running 2 Linux instances
    - Ubuntu 12.04 LTE – Application Execution/Processing
    - Ubuntu 12.04 LTE – Collaborative Virtual Environment

Client side
- Ideally, an instance of MCM image data application: MedView Platform (or P4) allowing faster access to native DICOM data for image compression from Medusa MCM application;
- JPIP server installed (OpenJPIP + FCGI module for an existing Web server - e.g. Apache)

- eventually, image decoding server (OpenJPEG library), if direct data transfer (without virtualisation) is required from the server to client.

9.4 Data needed for demonstration

- DICOM datasets for baseline and follow-up (provided by PSP)
- Compressed datasets for baseline and follow-up in JPEG 2000 format (*.jp2) and the associated metadata – provided by the offline usage of Medusa (MedView Platform)

10 Overview of demonstrated functionality

Table 1. Overview of demonstrated functionality.

Functionality	Can be demonstrated in use case?(1 t/m6)	Application in collaboration workspace	Will be demonstrated in demonstration?	Via scenario/flow ?	Demonstrated by	What information, data or post processing is needed?	Demonstration location
Authentification	1,2,3,4,5,6,7		1,2,3,4,5,6	UCMedusa0 202	All	Username Password	All
Identification	1,2,3,4,5,6,7		1,2,3,4,5,6	UCMedusa0 302 UCMedusa0 303 UCMedusa0 304 UCMedusa0 305	All	Date of birth of patient Sex of patient Pre name of patient Family name of patient Medusa Patient number	All
Data collection				UCMedusa0 402 UCMedusa0 403			
Imaging data	1,2,3,4,5,6,7		1,2,3,4,5,6,7		All		All
Sensor data	1,2,6		1,2,6		AMC	Heart rate, blood pressure, Oxygen Saturation, ECG.	AMC
Patient history	1,2,3,4,5,6		1,2,6				AMC, IGR
Protocol data	1,2,3,4,5		1,2,6		AMC	Stroke protocol, trauma protocol, remote diagnosis protocol	AMC
Automated				UCMedusa0			

postprocessing/image analysis				502 UCMedusa0 503 UCMedusa0 504			
Stroke	1		1		AMC	Auto infarct core detection, Auto Haemorrhage detection, Thrombus segmentation, Early ischemic stroke detection (ASPECTS) CTP	AMC
Trauma	2 (optinal)		2 (optional)		AMC	Automatic blood detection full body CT (optinal)	AMC
Post traumatic coma	3	ComaSoft	3		IMT, Bull, HSP	Patient Nifti DTI record	BULL, IMT
Contouring for oncology	4		4		IGR		IGR
In vitro	5		5		Imstar		Imstar
Remote visit	6		6		IGR/Sopheon	Face recognition	not yet known
Remote visit 2 (MCM)	7	MedView	7		IMT, Bull, PSP	Compressed image data; additional metadata if available	Bull, IMT
Decision support				UCMedusa0 602			
Stroke	1		1		AMC/Sopheon	Not yet known	AMC
Trauma	2		2		AMC/Sopheon	Real time sensor information	AMC
Remote visit	6		6		Sopheon/IGR		not yet known

Collaboration workspace				UCMedusa0702			
Read patient history	1,2,3,4,5,6,7	Viewing of patient history	1,2,6		AMC/Sopheon IGR		AMC/HSP
View protocol	1,2,3,4,5,6,7	Viewing of medical protocols	1,2,6		AMC/Sopheon IGR		AMC/HSP
View imaging data and results from postprocessing	1,2,3,4,5,6,7	Viewer of DICOM data (2D and 3D dataset) & Image comparison	1,2,6,7		AMC/Sopheon IGR		AMC/HSP
Analyze sensor information	1,2,3,5,6	Real time sensor stream	1,2,6		AMC/Sopheon IGR	Heart rate, blood pressure, Oxygen Saturation, ECG.	AMC/HSP
Video conferencing	1,2,3,4,5,6,7	Live video stream	1,2,6		AMC/Sopheon IGR		AMC/HSP
Analyze and interview patient via live video stream	1,2,3,5,6	Live video stream	1,2,6		AMC/Sopheon IGR		AM
Work on patient status	1,2,3,4,5,6,7	Status reporting	1,2,6		AMC/Sopheon IGR		AMC/HSP
Audit trail	1,2,3,4,5,6,7		1,2,6		AMC		AMC
Miscellaneous							
Contouring for oncology	4	Semi-Automatic contouring PLANET application	4		IGR		IGR
Export DICOM files as result	4	PLANETapplication	4		IGR		IGR
Remote extemporaneous examination	5	Shared annotations on the images from the	5		Imstar		Imstar

		remote microscope				
Automated cell detection and classification	5		5		Imstar		Imstar
Review of the automatically preselected abnormal cells	5	Shared classification from different users	5		Imstar		Imstar
Cloud-based collaborative application control	3	ComaSoft	3		IMT, HSP, BULL, Prologue		BULL, IMT
Cloud-based collaborative data access	3	Synchronous collaborative data preview	3		IMT,HSP, BULL, Prologue		BULL, IMT
Post traumatic coma	3	ComaSoft	3		IMT, BULL, HSP	Automatic report generation	BULL, IMT
Face Recognition (Remote visit)	6	Face recognition	6		Sopheon IGR		not yet known
MCM (Remote visit 2)	7	MedView	7		IMT, Bull, PSP		Bull, IMT

11 Summary

This document gives a detailed overview of the Medusa demonstrations.

12 References

Reference	Document ID	Title
D111	V3.0	Use case scenarios and User requirements