Business Unit MR

 Component Specification

**RTgo 5.13**

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# Introduction

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| FOLDER 58777  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hulkkonen, Emma (310201279) on 2017-03-09 11:26:06 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  This specification follows the practice defined in [RDRS]. |
| INFO 58781  Rev: 1  **✓** | Purpose  Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2016-02-12 09:47:23 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-11 10:25:59 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The purpose of this document is to describe the specifications of P6 software components. |
| INFO 58782  Rev: 1  **✓** | Scope  Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2016-02-12 09:47:27 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-11 10:26:00 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The scope of this document is restricted to describe the component functionality. |
| INFO 60550  Rev: 1  **✓** | Terms, Definitions and Abbreviations\_v1  Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:15 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 11:50:43 Meaning: SME Approved - (Technical) Signed by: Jayapalan, Manivannan (320055918) on 2025-05-21 15:27:49 Meaning: SME Approved - (Business)::Bulk Transitions  Approval Status: [Approved]   |  |  | | --- | --- | | **Term** | **Explanation** | | API | Application Program Interface | | PINNACLE3 | Treatment Planning System. Philips Product - R56 - NM Fitchburg, HealthTech | |
| INFO 60553  Rev: 1  **✓** | Reference\_v1  Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:16 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 11:38:34 Meaning: SME Approved - (Technical) Signed by: Jayapalan, Manivannan (320055918) on 2025-05-21 15:27:53 Meaning: SME Approved - (Business)::Bulk Transitions  Approval Status: [Approved]   |  |  |  | | --- | --- | --- | | **Reference** | **Title of Document** | **Id** | | ICRU 46 | Photon, Electron, Proton and Neutron Interaction Data for Body Tissues (Report 46) | ISBN 0-913394-41-6 | |

# Component Overview

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| FOLDER 58778  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hulkkonen, Emma (310201279) on 2017-03-15 08:29:11 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  In P6 software, the software system implementing an application is divided into logical subsystems.  The subsystems are, in turn, implemented with a set of software components and auxiliary utility and data routing code.  The interfaces of the components are detailed in component specifications, and  interface requirements between P6 components or between P6 components and other subsystems are captured in the subsystem requirements.  The requirements stemming from interfacing between P6 components and SOUP components are captured in the SOUP component specifications.  The context in which a P6 component is used in the P6 system is described in the Decomposition Description chapter of the design specification of the containing subsystem . SOUP component contexts are  detailed in the P6 component specifications. |

# Specifications

## Functional Specifications

### SWCMP.Algorithm

#### Description

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| FOLDER 58927  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:38:59 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The P6 Algorithm Module is a software component that is responsible for complex calculations needed in data analysis. It is used for:   * Calculating MRCAT images from input mDIXON images *Rationale: MRCAT images can be used for manual therapy plans when exported out as a CT DICOM image series. The MRCAT images can also be used in automatic generation of therapy plans, when Pinnacle3 communication is used to trigger a plan creation with MRCAT data as a primary input series.* * Calculating contours for target organs and organs at risk, using mDIXON and T2-weighted images as input. *Rationale: Contours can be exported as DICOM RT structure sets, which can be used in treatment plans.* |

#### Detailed Design

##### Execution Environment

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| FOLDER 58933  Rev: 2  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:42 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The Algorithm Module is used to run "Native" algorithms written in C++. This is in contrast to newer AEP (Algorithm Execution Platform) based algorithms written in Python.  The Algorithm Module consists of a .NET front-end, which talks to the Infra subsystem. The front-end launches a calculation process for the duration of a calculation task.  The communication from Infra to the native process is handled with a named pipe and protobuf messages.  *Rationale: the separate process segragates code from memory leaks and corruption.*    The calculation process can be a native C++ algorithm process, or an algorithm emulator process written in .NET.  *Rationale: emulated algorithm execution is useful in service use, where emulated data needs to be generated for connectivity testing and the slower execution speed of .NET managed code is not an issue.*    The native C++ process consists of a console application executable that delegates the processing to a dynamically loadable library P6Native.dll.  *Rationale: The separation of the executable and dynamically loadable library has been done in order to facilitate testing.*        The library handles a calculation task with a synchronous, task-specific function call.  The function call has task-specific implementation code in the dynamically loadable library, and the code relies on subroutines and auxiliary classes found in  a separate static library.  *Rationale: The static library offers a palette of mathematical tools for image analysis purposes and can be separately updated with improvements to the said palette.* |

##### MRCAT.Prostate

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| FOLDER 58935  Rev: 2  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:58:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The MRCAT analysis C++ subroutine creates an attenuation images based on input mDixon MR images in a sychronous function call. The algorithm classifies the image to air and 4 different tissue types: water, fat, bone marrow and cortical bone. The tissues types are given CT/HU values consistent with the CT/HU values of those tissues in CT images. In addition the algorithm has built-in sanity checks to discard MRCAT images which are likely erroneous. |

###### High level design

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| INFO 59258  Rev: 2  **✓** | Interfacing to plugin  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:43 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  This algorithm is written in C++ and is managed by the Algorithm Module on the plugin side.    The algorithm communicates with the plugin via named pipes as Protobuf messages which are used to transfer input and output data including logging data. |
| INFO 59256  Rev: 1  **✓** | Input data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:31 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  mDixon images are used as input for MRCAT. To avoid incorrect input to the algorithm, user is not allowed to change the mDixon parameters, except the stack location. The restrictions are based on a new scan property that is used in Methods code. When the MRCAT post-processing step is added to an mDixon scan, “MRCAT” is added to the ApprovedFeatures property of the scan.  User is allowed to scan the MRCAT mDixon scan with the MRCAT software option, even without mDixon software option. |
| INFO 59257  Rev: 1  **✓** | Output data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  MRCAT images are generated with an ExamCard postprocessing step. New 3D images with voxel intensity corresponding to Hounsfield units are generated by the MRCAT algorithm. |
| INFO 59259  Rev: 1  **✓** | Editing limitations  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:33 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The data and configuration files used by the algorithm are protected with check sums to prevent user modifications to the intended behavior of the algorithm. The atlas files used by the algorithm are encrypted to safeguard intellectual property. |

###### MRCAT algorithm design

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| FOLDER 59255  Rev: 1  **✓** | Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:39 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The algorithm can be divided into two main parts: tissue classification and HU value assignment to the tissue classes. The tissue classification can further be subdivided into four different steps: body outline segmentation, soft tissue classification, bone segmentation, compact bone classification. All voxels in the MRCAT images are classified into five tissue classes: background air, fat, water-like tissue, spongy bone and compact bone. |
| INFO 59265  Rev: 1  **✓** | References  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:34 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Ecabert et al.                “Automatic model-based segmentation of the heart in CT images,” IEEE Transactions on Medical Imaging, 27(9):1189–1201 (2008).  Ecabert et al.                “Segmentation of the heart and great vessels in CT images using a model-based adaptation framework”, Medical Image Analysis, 15:863–876 (2011). |
| INFO 59260  Rev: 1  **✓** | Body outline segmentation  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:35 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The body outline is the first structure delineated as the body mask is needed in subsequent steps. In-phase and water 3D image sets are used as input. A model-based hierarchical segmentation approach is used to determine the body outline mesh position. The body mask is generated from this mesh. |
| INFO 59261  Rev: 1  **✓** | Soft tissue classification  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:36 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  All voxels inside the body mask (including voxels determined as bone in subsequent steps) are classified as either fat or water-equivalent tissue using the water and fat 3D image sets as input. A voxel-by-voxel comparison of the in-phase and fat images is used to determine whether a given voxel contains mainly water-rich or mainly fatty tissue.  If the voxel is found to mainly contain water, then it is assigned as being water-rich soft tissue. On the other hand, if the voxel is found to contain mainly fat, it is classified as fat tissue. Each voxel is thus classified as being either water-rich or fatty tissue |
| INFO 59262  Rev: 1  **✓** | Bone segmentation  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:37 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The pelvic bone structures including femurs, femur heads, ischium, ilium, pubic bones, sacrum and the lowest lumbar vertebrae are then delineated as a separate step, using the in-phase and water 3D image sets as input. A model-based hierarchical segmentation approach, as in the body outline segmentation, is used to delineate the different bone structures. All of the bone outlines are adapted jointly to obtain an efficient, coherent and robust segmentation. The bone masks are created from the generated mesh. |
| INFO 59263  Rev: 1  **✓** | Compact bone classification  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:37 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Bone voxels with an mDixon in-phase image intensity below a threshold value are classified as high-density bone and those with voxel intensity above the threshold are classified as low-density bone. The low density bone class is named spongy bone whereas the high density bone class is named compact bone. Note that this distinction is somewhat arbitrary and should not be taken as an indication of what is actual compact or spongy bone in the biological sense. |
| INFO 59264  Rev: 1  **✓** | Hounsfield unit assignment  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:47:38 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  All voxels in the MRCAT image are now labelled as either fat, water-rich tissue, spongy bone, compact bone or background air. In the remaining step of the algorithm, each of the tissue classes is assigned a default HU value with a corresponding default mass density.  The default HU values for the five classes are -968 HU, -95 HU, 34 HU, 152 HU and 803 HU corresponding to physical mass densities of 0.032 g/ cm3, 0.905 g/cm3, 1.036 g/cm3, 1.140 g/cm3 and 1.550 g/cm3 for air, fat, water, spongy bone and compact bone, respectively. These default mass density values correlate with those found in ICRU 46. The default HU values can be modified in any TPS according to the operator’s preferences. |

##### AutoContouring.Prostate

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| FOLDER 59033  Rev: 3 | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures:  Approval Status: [Cancelled]  The AutoContouring C++ subroutine calculates contours for target organs and organs at risk. |

###### High level design

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| INFO 59242  Rev: 2  **✓** | Interfacing to plugin  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  This algorithm is written in C++ and is managed by the Algorithm Module on the plugin side.    The algorithm communicates with the plugin via named pipes as Protobuf messages which are used to transfer input and output data including logging data. |
| INFO 59243  Rev: 1  **✓** | Input data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:54:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm needs as input dedicated mDixon-based “MRCAT source” image and a T2 weighted image, as well as the body inline mesh, bone mesh, and the MRCAT image produced by the MRCAT algorithm. |
| INFO 59244  Rev: 1  **✓** | Output data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:54:19 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm generates output in the form of 2D Contours for RT structures. In addition volumetric organ meshes can be stored in a private DICOM tag. DICOM tag (2005,1589) is available to store arbitrary byte data for this purpose. The volumetric meshes can be used, for example, for manual editing of the meshes if necessary. The algorithm may also provide technical information of the auto-contouring (e.g. performance and sanity check results). These may be communicated to the plugin using Protobuf messages. |
| INFO 59245  Rev: 1  **✓** | Editing Limitations  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:54:20 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The data and configuration files used by the algorithm are protected with check sums to prevent user modifications to the intended behavior of the algorithm. The atlas files used by the algorithm are encrypted to safeguard intellectual property. |

###### Undefined : Editing Limitations\_v1

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| 60533  Rev: 1 | Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:17 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-21 15:27:56 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-20 16:23:25 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The configuration files used by the algorithm are protected with check sums to prevent user modifications to the intended behavior of the algorithm. The atlas files used by the algorithm are encrypted to safeguard intellectual property.  For Autocontouring Prostate T2 is not editable, user is expected to use default T2 provided as part of MRCAT Examcards.  For Autocontouring Pelvis, user is allowed to edit T2 scans.  Background: |

###### AutoContouring algorithm design

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| FOLDER 59249  Rev: 2  **✓** | Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-09 07:25:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Flow diagram for the AutoContouring algorithm |
| INFO 59246  Rev: 1  **✓** | Registration of T2 weighted image to MRCAT source image  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:54:21 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The alignment of the T1- and T2-weighted images is checked through rigid registration of the pelvic bones.  The MRCAT algorithm produces a segmentation of the bones based on the T1-weighted inphase image. The outcome is a triangulated bone mesh, which is provided to the auto-contouring algorithm as an input argument. The submesh corresponding to pelvic bones is matched to the T2 image via a rigid transformation. If significant rigid motion is detected, the position and orientation of the T2-weighted image are compensated accordingly. |
| INFO 59247  Rev: 2  **✓** | Estimation of registration reliability  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-15 08:03:48 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The reliability of the motion estimate is assessed using confidence scores. The bone boundaries detected in the vicinity of the bone mesh in the T2-weighted image are recorded. The distance distribution of the boundary points is compared to an idealized reference distribution, and the difference is cast into a confidence score. A high value of the confidence scores means strong deviations from the reference distribution, implying that the motion estimate is not reliable. The magnitude of the estimated motion and the confidence on the reliability of the estimate are indicated in the status value returned by the algorithm. |
| INFO 59250  Rev: 1  **✓** | Input image intensity calibration  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:54:23 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The body inline mesh segmented by the MRCAT algorithm is used to determine calibration information for the T1- and T2-weighted image intensities. The body inline mesh excludes the subcutaneous fat regions from affecting the intensity calibration. This provides the algorithm with consistent scaling of the image intensities across patients. |
| INFO 59342  Rev: 1  **✓** | Bladder mask  Model: [Ingenia] FS: [] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Kohler, Max (fir00380) on 2017-03-06 13:49:31 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Bladder mask is an artificial image, which is used to help detect correct bladder boundaries.    To form the bladder mask, the bone mesh segmented by the MRCAT algorithm is used to estimate initial bounds for the volume occupied by bladder. A dedicated bladder classification algorithm is used to identify voxels containing urine. The classification algorithm combines T1- and T2-weighted intensity information with statistical modeling and connected-component analysis.    The bladder mask is entirely supplementary in nature; the segmentation of bladder may proceed even with an empty bladder mask, using only the image contrasts visible in T1- and T2-weighted images. |
| INFO 59251  Rev: 2  **✓** | Organ segmentation  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 08:10:38 Meaning: SME Approved - (Technical)  Approval Status: [Approved]   * The bone mesh segmented by the MRCAT algorithm is used to estimate the initial position of the penile bulb. A penile bulb mesh is segmented with the MBS and PRIMA libraries using the initial estimate, the penile bulb model, and the T1- and T2-weighted images. * Meshes for the inner bladder, outer bladder, prostate, seminal vesicles, rectum, and anal canal are segmented using MBS and PRIMA libraries using the respective models, the bone mesh segmentation by the MRCAT algorithm, the T1- and T2-weighted images, and the bladder mask. Similarly to the penile bulb, the bone mesh segmentation by the MRCAT algorithm is used to estimate the initial position of the organs. * A femoral head mesh is acquired from the bone mesh segmented by the MRCAT algorithm. |
| INFO 59252  Rev: 1  **✓** | Contour generation  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-26 08:54:25 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]   * Axial slice-by-slice contours for the anatomic structures mentioned in 59251 are formed based on the segmented meshes. The reference slices for the structures are the MRCAT image slices. * Axial slice-by-slice contours for the body outline are constructed based on the MRCAT image. * The DICOM contour point data (3006,0050) may not exceed 65534 bytes in size as defined in the DICOM standard. To ensure this, the precision and number of contour point coordinates will be limited so that the contour point data does not exceed 65534 bytes. |
| INFO 59253  Rev: 3  **✓** | Algorithm status output  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-15 08:05:27 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The algorithm indicates if:   * + Algorithm created contours successfully.   + No reliable motion estimate was possible to established.   + The input images were angulated.   + Algorithm detected other errors in the input data.   In case the algorithm is executed successfully, countours will be generated and provided as output. In case any of the above errors realizes, then no contours will be generated. |

##### MRCAT.Pelvis

###### High level design

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| INFO 59509  Rev: 2  **✓** | Interfacing to plugin  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  This algorithm is written in C++ and is managed by the Algorithm Module on the plugin side.    The algorithm communicates with the plugin via named pipes as Protobuf messages which are used to transfer input and output data including logging data. |
| INFO 59510  Rev: 1  **✓** | Input data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 12:04:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  mDixon images are used as input for MRCAT Pelvis. To avoid incorrect input to the algorithm, user is not allowed to change the mDixon parameters, except the stack location. The restrictions are based on a new scan property that is used in Methods code. When the MRCAT Pelvis post-processing step is added to an mDixon scan, “MRCAT” is added to the ApprovedFeatures property of the scan.  User is allowed to scan the MRCAT pelvis mDixon scan with the MRCAT software option, even without "mDixon" and "mDixon MRA" software options. |
| INFO 59511  Rev: 1  **✓** | Output data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 12:04:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  MRCAT images are generated with an ExamCard postprocessing step. New 3D images with voxel intensity corresponding to Hounsfield units are generated by the MRCAT algorithm. |
| INFO 59512  Rev: 1  **✓** | Editing limitations  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 12:04:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The data and configuration files used by the algorithm are protected with check sums to prevent user modifications to the intended behavior of the algorithm. The atlas files used by the algorithm are encrypted to safeguard intellectual property. |

###### MRCAT algorithm design

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| INFO 59513  Rev: 1  **✓** | References  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 12:04:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Ecabert et al.                “Automatic model-based segmentation of the heart in CT images,” IEEE Transactions on Medical Imaging, 27(9):1189–1201 (2008).  Ecabert et al.                “Segmentation of the heart and great vessels in CT images using a model-based adaptation framework”, Medical Image Analysis, 15:863–876 (2011). |
| INFO 59514  Rev: 1  **✓** | Body outline segmentation  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 12:04:07 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The body outline is the first structure delineated as the body mask is needed in subsequent steps. In-phase and water 3D image sets are used as input. A model-based hierarchical segmentation approach is used to determine the body outline mesh position. The body mask is generated from this mesh. |
| INFO 59517  Rev: 1  **✓** | Bone classification  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 12:04:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The pelvic bone structures including femurs, femur heads, ischium, ilium, pubic bones, sacrum and the lumbar vertebrae are delineated using the in-phase and water 3D image sets as input. A model-based hierarchical segmentation approach, as in the body outline segmentation, is used to delineate the different bone structures. All of the bone outlines are adapted jointly to obtain an efficient, coherent and robust segmentation. The bone masks are created from the generated mesh.  Similarly to soft tissue, bone classification is based on the fat and water intensities of the voxels. Dense bone manifests in mDixon images as voxels with low signal intensity in both fat and water images. Hence, the voxels within the bone mask are classified according to the fat and water intensity of the voxel relative to the fat and water tissue intensities determined for the patient. Voxels with low intensities represent dense cortical bone where as voxels with higher intensity represent spongy bone. The CT value for a bone voxel is interpolated between the CT values of dense and spongy bone based on the relative intensity of the voxel. The CT values for dense and spongy bone are calibrated using patient data from multiple sites. |
| INFO 59515  Rev: 1  **✓** | Soft tissue classification  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 12:04:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Voxels which are within the body mask but not within the bone mask are considered soft tissue voxels. Their classification between fat tissue and water tissue is based on the fat and water intensities in the respective MRCAT source images. Since the reconstruction of the mDixon image components and their scaling are suspect to change from one scanner software version to another the algorithm does not use absolute values in classifying soft tissue. Instead, the fat and water intensities for fat tissue and water tissue are identified for each patient separately. Fat fraction is calculated for each soft tissue voxel based on the relative fat and water intensity of that voxel. The CT value for a voxel is interpolated between the CT values of fat and water tissue based on the fat fraction of the voxel. The CT values for fat and water tissue are calibrated using patient data from multiple sites. |

##### MRCAT.Brain

###### High level design

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| INFO 59728  Rev: 1  **✓** | Input data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:11:51 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  mDixon images are used as input for MRCAT Brain. To avoid incorrect input to the algorithm, user is not allowed to change the mDixon parameters, except the stack location. The restrictions are based on a new scan property that is used in Methods code. When the MRCAT Brain post-processing step is added to an mDixon scan, “MRCAT” is added to the ApprovedFeatures property of the scan.  User is allowed to scan the MRCAT Brain mDixon scan with the MRCAT software option, even without "mDixon" software option. |
| INFO 59729  Rev: 1  **✓** | Output data  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:12:27 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  MRCAT images are generated with an ExamCard postprocessing step. New 3D images with voxel intensity corresponding to Hounsfield units are generated by the MRCAT algorithm. |
| INFO 59730  Rev: 1  **✓** | Editing limitations  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:12:51 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The data and configuration files used by the algorithm are protected with check sums to prevent user modifications to the intended behavior of the algorithm. The algororithm files are encrypted to safeguard intellectual property. |

###### MRCAT algorithm design

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| INFO 59813  Rev: 1  **✓** | References  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:13:39 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Han, X. (2017). MR-based synthetic CT generation using a deep convolutional neural network method. Medical physics, 44(4), 1408-1419. |
| INFO 59814  Rev: 1  **✓** | Model architecture  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:14:04 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The algorithm uses deep convolutional neural network for MRCAT generation. The network architecture is called U-Net, it is typically used for semantic segmentation. The network comprises of two main parts, called encoder and decoder. The encoder encodes and down-samples the input data. The decoder up-samples and decodes the encoded data. |

#### Requirements

##### Alarms and Notifications Requirements

###### Failure Notification

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| FOLDER 58946  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** If the failure code is not transmitted from the algorithm, user may miss a warning about the quality of the results. As a result, the patient may need to be rescanned in another imaging session.  **Sequence of Events:**  A sanity check failure is not sent and the algorithm returns success value instead. The patient is dismissed and the missing data detected only when a manual DICOM export is attempted. |
| SPEC 58947  Rev: 1  **✓** | SWCMP.Algorithm.FailureNotification  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 10:53:01 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  A failure return value from the calculation routines shall lead to a failure code being transmitted from the Algorithm Module.  Background:  N/A |

##### Boundary Condition Requirements

###### MRCAT Sanity Checks

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| FOLDER 58944  Rev: 3  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Kohler, Max (fir00380) on 2017-03-09 06:07:13 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Potential Contributions to Hazards:** Incorrect MRCAT image can cause incorrect dose to the target or OARs    **Sequence of Events:** If patient bone structure is abnormal, motion artifacts occur, MR image quality is poor or patient setup is incorrect then the resulting bone or body outline segmentation may be inaccurate. If sanity checks do not work correctly this could lead to an erroneous MRCAT image.    **Linked to:**   SRAS58155, SRAS58420, SRAS58163, SRAS58164, SRAS58165 |
| SPEC 59732  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.Brain.SanityCheck  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Susi, Tuomas (320026513) on 2019-06-05 15:58:46 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The MRCAT Brain algorithm shall indicate if body outline or positioning of the image FOV does not fulfill the specified accuracy.  Background:  N/A |
| SPEC 59792  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.ProstatePelvis.SanityCheck  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:14:30 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The Prostate and Pelvis algorithms shall indicate if the bone or body outline segmentation does not fulfill the specified accuracy.  Background:  N/A |

##### Data and Control Flow Requirements

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| FOLDER 58938  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The control flow is a linear execution of the algorithm. |

##### Data Definition Requirements

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| FOLDER 58939  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The application data has been checksummed for integrity checking. |

##### Event Sequencing Requirements

###### Execution Priority

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| FOLDER 59074  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Robustness of Functionality - If algorithms use a high priority in CPU scheduling, the MR userinterface can become unusable.  **Sequence of Events:**  Effective use of all threads with high priority can stall the CPU for other processes running on the host. |
| SPEC 59793  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.ProstatePelvis.ExecutionPriority  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:15:04 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The MRCAT Prostate and Pelvis algorithm processes shall execute on idle-priority  Background:  N/A |

##### Fault Condition Handling Requirements

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| FOLDER 58941  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:07 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicaple. Fault conditions are handled by returning error codes, which are covered by Alarms and Notifications Requirements. |

##### Functional and Capability Requirements

###### Compilation

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| FOLDER 58932  Rev: 2  **✓** | Model: [Any] FS: [] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Kohler, Max (fir00380) on 2017-03-09 06:15:11 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Potential Contributions to Hazards:** invalid command line options to the compiler can produce interlinked binaries that are incompatible with each other, leading to program faults, imprecise calculation results, or degraded performance.  **Sequence of Events:** The compiler arguments governing floating point arithmetics can select a model that provide large, cumulative rounding errors that lead to noticeable errors in the algorithm output data.    **Linked to:**   SRAS58155, SRAS58345 |
| SPEC 58930  Rev: 1  **✓** | SWCMP.Algorithm.CompilationOptions  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2016-05-02 07:30:13 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The compiler floating point arithmetics model shall be precise and the compiler tool chain common with P6 components.  Background:  N/A |

###### SWCMP.Algorithm.MRCAT.Prostate

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| FOLDER 59224  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-09 07:25:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Potential Contributions to Hazards:** Incorrect MRCAT image can cause incorrect dose to the target or OARs    **Sequence of Events:** If patient bone structure is abnormal, motion artifacts occur, MR image quality is poor or patient setup is incorrect then the resulting bone or body outline segmentation may be inaccurate, leading to an erroneous MRCAT image    **Linked to:** SRAS58155, SRAS58420, SRAS58161, SRAS58163, SRAS58164, SRAS58165, SRAS58186 |
| SPEC 59229  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.HounsfieldUnit  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Kohler, Max (fir00380) on 2017-01-25 13:12:26 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Each tissue type in the MRCAT image shall be assigned with Hounsfield units (HU) typical for that tissue type: Air: -968 Fat: -95 Other soft tissue: 34 Cortical Bone: 803 Bone marrow: 152  Background:  N/A |
| SPEC 59231  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.BodyOutline  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Kohler, Max (fir00380) on 2017-01-25 13:12:28 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The body outline in the MRCAT image shall match the body outline in the original mDixon images. The largest continuous area with a distance more than 5 mm between the MRCAT and manually  segmented body outline mesh must be less than 900 mm2.  Background:  N/A |
| SPEC 59551  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.BoneOutline\_v2  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hame, Yrjo (310274475) on 2018-05-30 14:38:55 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The bones in the MRCAT image shall match the bones in the original mDixon images. The largest continuous area with a distance more than 3 mm between the MRCAT and manually segmented bone mesh must be less than listed below for each bone:  Femur:                                   400 mm2  FemurHead:                         400 mm2  FemurWhole:                        400 mm2  LumbarVertebra5:               1000 mm2  LumbarVertebra4:               No requirement  Pelvis:                                    600 mm2  PelvisIllium:                          600 mm2  PelvisPubic:                          200 mm2  PelvisWhole:                         800 mm2  SacrumAnterior:                   300 mm2  Sacrum:                                 2000 mm2  SacrumWhole:                     2000 mm2  The lower limit of the indicated pass rate range shall be at least 89.4% using the Exact Binomial test with 95% confidence level, separately for each bone structure. Surpassing the lower limit of the range requires a verification set of at least 33 cases, for which the indicated pass rate range is equal to 89.4%-100.0% when all cases pass.  Background:  N/A |

###### SWCMP.Algorithm.AutoContouring.Prostate

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| FOLDER 59225  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 08:16:26 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Potential Contributions to Hazards:** Incorrect organ segmentations can lead to these delineations being used for RT plan generation, leading to an incorrect dose to the target or OARs    **Sequence of Events:** If the anatomy is unconventional, MR image quality is poor or there is substantial motion between the images used for AutoContouring, the generated contours may be incorrect    **Linked to:**   SRAS58345 |
| SPEC 59234  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Prostate.Registration  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-25 12:25:17 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm for the prostate shall register the T2 input image with the T1 input image if a substantial and reliable rigid transformation can be established.    Background:  N/A |
| SPEC 59235  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Prostate.Contours  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-25 12:25:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm shall produce RT structures as slice-wise contour stacks compatible with PINNACLE3.  Background:  N/A |
| SPEC 59236  Rev: 2  **✓** | SWCMP.Algorithm.AutoContouring.Prostate.Status  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-02-27 11:49:41 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The algorithm shall indicate if:   * + Algorithm created contours successfully. The contours have been created and provided as output   + Angulation of input images has been detected. No contours have been created.   + No reliable motion estimate could be established. No contours have been created.   + Algorithm detected errors in input data. No contours have been created.     Background:  N/A |
| SPEC 59237  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Prostate.Organs  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-25 12:25:20 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The AutoContouring algorithm shall make the following contours available for the plugin:     * PROSTATE * SEM\_VES * BLADDER\_INSIDE * BLADDER\_OUTSIDE * RECTUM * PENILE\_BULB * FEMUR\_HEAD\_L * FEMUR\_HEAD\_R * SKIN   Background:  N/A |
| SPEC 59429  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Prostate.Outlines\_v1  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Kohler, Max (fir00380) on 2017-10-19 12:49:58 Meaning: SME Approved - (Technical)  Approval Status: [Approved]   * Contours generated by AutoContouring are compared to manually generated ground truth contours. * There is a predefined set of patients with manually defined contours. * Comparison is done using modified bidirectional 3D Hausdorff distance using the absolute 99th, absolute 95th, signed  1st and signed 99th percentile in place of the maximum   + Negative signed distance indicates the autosegmentation extending into the ground truth delineation, i.e. the autocountouring of the organ is smaller than intended, whereas positive indicates how much larger the autocontouring is than intended     **Requirements for the prostate and organs at risk**     * The requirement is that 70% or more of the following organs at risk are successfully delineated.   + Prostate   + Femur heads     - Left and right femur heads shall be counted as single organ. Both left and right femur head shall fulfill the criteria independently.   + Bladder     - Inner and outer bladder shall be counted as single organ. Both inner and outer bladder shall fulfill their respective criteria.   + Rectum   + Penile bulb      * The criteria for the organs are:   + For the prostate:     - For the whole prostate, the 95% percentile for the difference shall be < 5 mm   + For the bladder:     - For the whole outer bladder, the 99% percentile for the difference shall be < 6 mm     - For the part of the outer bladder proximal to the prostate, the signed 1% percentile for the difference shall be > -5 mm     - For the part of the outer bladder proximal to the prostate, the signed 99% percentile for the difference shall be < 3 mm     - For the whole inner bladder, the 99% percentile for the difference shall be < 6 mm     - For the part of the inner bladder proximal to the prostate, the 95% percentile for the difference shall be < 4 mm   + For the RT planning relevant part of the rectum:     - For the whole rectum, the 99% percentile for the difference shall be < 8 mm     - For the part of the rectum proximal to the prostate, the 99% percentile for the difference shall be < 4 mm   + For the penile bulb:     - For the whole penile bulb, the 95% percentile for the difference shall be < 6 mm     - For the part of the penile bulb proximal to the prostate, the 99% percentile for the difference shall be < 5 mm   + For femur heads:     - For both left and right femur head the 95% percentile for the difference shall be < 3 mm.      * There is no requirement for the following organs:   + The seminal vesicles   + The body outline as it is defined by MRCAT image      The above criteria were selected as figures of merit since they characterize the maximum error in segmentation and thus indicate the cases where segmentation needs to be corrected. Other figures of merit, like Dice similarity coefficient or mean Hausdorff distance are considered too insensitive for this purpose.    Background:  N/A |

###### SWCMP.Algorithm.MRCAT.Pelvis

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| SPEC 59502  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.Pelvis.HounsfieldUnit  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-24 08:09:26 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Each tissue type in the MRCAT image shall be assigned Hounsfield units (HU) within the range that is typical for that tissue type: Air: -968 HU (+- 50 HU) Fat: -85 (+- 50 HU) Other soft tissue: 40 (+- 50 HU) Cortical Bone: between 700 HU and 3000 HU  Bone marrow: 150 (+- 100 HU)    Background:  N/A |
| SPEC 59503  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.Pelvis.BodyOutline  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-24 08:11:42 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The body outline in the MRCAT image shall match the body outline in the original mDixon images. The largest continuous area with a distance more than 5 mm between the MRCAT and manually  segmented body outline mesh must be less than 900 mm2.    The lower limit of the indicated pass rate range shall be at least 83.9% using the Exact Binomial test with 95% confidence level.    Background:  N/A |
| SPEC 59504  Rev: 2  **✓** | SWCMP.Algorithm.MRCAT.Pelvis.BoneOutline  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-29 09:34:01 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The bones in the MRCAT image shall match the bones in the original mDixon images. The largest continuous area with a distance more than 3 mm between the MRCAT and manually segmented bone mesh must be less than listed below for each bone:    Sacrum whole                       2000 mm2  Sacrum  anterior                 300 mm2  Coccyx                                 1000 mm2  Sacrum   (rest)                    2000 mm2  Pelvis whole                         800 mm2  Pelvis illium                          600 mm2  Pelvis pubic                          200 mm2  Pelvis (rest)                           600 mm2  Femur whole                         400 mm2  Femur head                           400 mm2  Femur (rest)                          400 mm2  Lumbar vertebrae\*\*              1000 mm2    The lower limit of the indicated pass rate range shall be at least 89.4% using the Exact Binomial test with 95% confidence level, separately for each bone structure. Surpassing the lower limit of the range requires a verification set of at least 33 cases, for which the indicated pass rate range is equal to 89.4%-100.0% when all cases pass.  Bones with anomalies shall be excluded    \*\*Each lumbar vertebra that is fully within the MRCAT field-of-view (up to lumbar vertebra 1) shall pass the requirement individually for the requirement to be fulfilled.    Background:  N/A |

###### SWCMP.Algorithm.MRCAT.Brain

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| SPEC 59762  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.Brain.HounsfieldUnit  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:16:02 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Each tissue type in the MRCAT image shall be assigned Hounsfield units (HU) within the range that is typical for that tissue type: Background air: -968 HU (+- 50 HU) Brain tissue: 40 (+- 50 HU) Cortical Bone: between 700 HU and 9000 HU  Background:  N/A |

###### SWCMP.Algorithm.AutoContouring.Pelvis

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| FOLDER 60518  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jayapalan, Manivannan (320055918) on 2025-05-21 15:28:19 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-14 17:54:47 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Potential Contributions to Hazards:** Incorrect organ segmentations can lead to these delineations being used for RT plan generation, leading to an incorrect dose to the target or OARs    **Sequence of Events:** If the anatomy is unconventional, MR image quality is poor or there is substantial motion between the images used for AutoContouring, the generated contours may be incorrect    **Linked to:**   SRAS58345 |
| SPEC 60519  Rev: 2  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Registration  Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:19 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 14:20:06 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 14:15:59 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm for the pelvis(male) shall register the T2 input image with the T1 input image if a substantial and reliable rigid transformation can be established.  Background:  NA |
| SPEC 60520  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Contours  Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:20 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-21 15:28:03 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-20 16:21:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm shall produce RT structures as slice-wise contour stacks compatible with PINNACLE3.  Background:  NA |
| SPEC 60521  Rev: 2  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Status  Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:21 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 14:20:08 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 14:16:00 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The algorithm shall indicate if:                  Algorithm created contours successfully. The contours have been created and provided as output                  Angulation of input images has been detected. No contours have been created.                  No reliable motion estimate could be established. No contours have been created.                  Algorithm detected errors in input data. No contours have been created.    Background:  NA |
| SPEC 60522  Rev: 2  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Organs  Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:23 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 14:20:09 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 14:16:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The AutoContouring algorithm shall make the following contours available for the plugin:   * PROSTATE * SEM\_VES * BLADDER\_INSIDE * BLADDER\_OUTSIDE * RECTUM * PENILE\_BULB * FEMUR\_HEAD\_L * FEMUR\_HEAD\_R * SKIN     Background:  NA |
| SPEC 60523  Rev: 2  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Outlines  Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:24 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 14:20:10 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 14:16:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]   * Contours generated by AutoContouring are compared to manually generated ground truth contours. * There is a predefined set of patients with manually defined contours. * Comparison is done using modified bidirectional 3D Hausdorff distance using the absolute 99th, absolute 95th, signed  1st and signed 99th percentile in place of the maximum   + Negative signed distance indicates the autosegmentation extending into the ground truth delineation, i.e. the autocountouring of the organ is smaller than intended, whereas positive indicates how much larger the autocontouring is than intended     **Requirements for the pelvis and organs at risk**     * The requirement is that 70% or more of the following organs at risk are successfully delineated.   + Prostate   + Femur heads     - Left and right femur heads shall be counted as single organ. Both left and right femur head shall fulfill the criteria independently.   + Bladder     - Inner and outer bladder shall be counted as single organ. Both inner and outer bladder shall fulfill their respective criteria.   + Rectum   + Penile bulb      * The criteria for the organs are:   + For the prostate:     - For the whole prostate, the 95% percentile for the difference shall be < 5 mm   + For the bladder:     - For the whole outer bladder, the 99% percentile for the difference shall be < 6 mm     - For the part of the outer bladder proximal to the prostate, the signed 1% percentile for the difference shall be > -5 mm     - For the part of the outer bladder proximal to the prostate, the signed 99% percentile for the difference shall be < 3 mm     - For the whole inner bladder, the 99% percentile for the difference shall be < 6 mm     - For the part of the inner bladder proximal to the prostate, the 95% percentile for the difference shall be < 4 mm   + For the RT planning relevant part of the rectum:     - For the whole rectum, the 99% percentile for the difference shall be < 8 mm     - For the part of the rectum proximal to the prostate, the 99% percentile for the difference shall be < 4 mm   + For the penile bulb:     - For the whole penile bulb, the 95% percentile for the difference shall be < 6 mm     - For the part of the penile bulb proximal to the prostate, the 99% percentile for the difference shall be < 5 mm   + For femur heads:     - For both left and right femur head the 95% percentile for the difference shall be < 3 mm.      * There is no requirement for the following organs:   + The seminal vesicles   + The body outline as it is defined by MRCAT image      The above criteria were selected as figures of merit since they characterize the maximum error in segmentation and thus indicate the cases where segmentation needs to be corrected. Other figures of merit, like Dice similarity coefficient or mean Hausdorff distance are considered too insensitive for this purpose.    Background:  NA |
| SPEC 60542  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Inputs  Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:25 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-21 15:28:16 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-20 16:21:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm for the pelvis shall require the following input image datasets:  Source MRCAT  MRCAT  T2-weighted (T2w) images  The algorithm shall support T2w images acquired using non-default imaging parameters. However, it shall not support T2w images acquired with angulated slice orientations. All T2w images must be aligned with standard anatomical planes(TRA, SAG, COR) to ensure compatibility with the auto-contouring workflow.    Note:  As editing T2W scans may impact the contours due to insufficient registration of T2W images with MRCAT source and MRCAT source images, stringent review of the ROIs is warranted.  Background:  Requirement defining inputs for Pelvis AC. |

##### Installation Requirements

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| FOLDER 58956  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The implementation is copied as a part of P6 installation without extra installation steps. |

##### Interfaces Requirements

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| --- | --- |
| FOLDER 58948  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The Algorithm Module uses .NET directly for interfacing with the Infra subsystem, without any additional .NET requirements. |

##### Memory Management and Overflow Requirements

###### MRCAT Memory

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| --- | --- |
| FOLDER 58957  Rev: 2  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Kohler, Max (fir00380) on 2017-03-08 13:40:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Robustness of Functionality - If algorithms use too much system memory the MR userinterface can become unusable.  **Sequence of Events:**  Large memory usage can lead to long memory access times making MR userinterface unusable. |
| SPEC 59788  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.ProstatePelvis.Memory  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Design Review/Check]  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:22:18 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The MRCAT Prostate and Pelvis processes shall not use more than 3.0 GB of system memory.    Background:  N/A |

###### AutoContouring Memory

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| FOLDER 59239  Rev: 3  **✓** | Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-09 07:25:13 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Robustness of Functionality - If algorithms use too much system memory the MR userinterface can become unusable.  **Sequence of Events:**  Large memory usage can lead to long memory access times making MR userinterface unusable. |
| SPEC 59240  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Prostate.Memory  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-25 12:14:39 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The algorithm shall use no more than 3 GB memory.  Background:  N/A |
| SPEC 60524  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Memory  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:27 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 14:20:11 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 14:16:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The algorithm shall use no more than 3 GB memory.    Background:  NA |

##### Performance Requirements

###### MRCAT Performance

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| FOLDER 58959  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 09:52:43 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** If the MRCAT algorithm takes too long to execute, patient may experience unduly discomfort lying on the tabletop.  **Sequence of Events:**  A failure to utilize the parallel processing capabilities of modern CPUs may lead to long calculation times. |
| SPEC 58960  Rev: 2  **✓** | SWCMP.Algorithm.MRCAT.Prostate.Performance  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 08:21:47 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  MRCAT image generation from 528x528x120 px prostate mDixon MR images shall take less than  210 seconds.    Background:  N/A |
| SPEC 59519  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.Pelvis.Performance  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2018-05-24 08:04:42 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  MRCAT image generation from 480 x 480 x 317 px pelvis mDixon MR images shall take less than 300 seconds.  Background:  N/A |
| SPEC 59724  Rev: 1  **✓** | SWCMP.Algorithm.MRCAT.Brain.Performance  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:24:21 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  MRCAT image generation from 400 x 400 x 260 px brain mDixon MR images shall take less than 300 seconds.    Background:  N/A |

###### AutoContouring Performance

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| FOLDER 59238  Rev: 2  **✓** | Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 09:52:43 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** If the AutoContouring algorithm takes too long to execute, patient may experience unduly discomfort lying on the tabletop.  **Sequence of Events:**  A failure to utilize the parallel processing capabilities of modern CPUs may lead to long calculation times. |
| SPEC 59233  Rev: 1  **✓** | SWCMP.Algorithm.AutoContouring.Prostate.Performance  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-01-25 12:27:59 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The algorithm shall take less than 5 min to execute.  Background:  N/A |
| SPEC 60525  Rev: 2  **✓** | SWCMP.Algorithm.AutoContouring.Pelvis.Performance  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:28 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 14:20:13 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Kumar, Prasanna (310218471) on 2025-05-23 14:16:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The algorithm shall take less than 5 min to execute.  Background:  NA |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58951  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The resource requirements of the components are part of the total system resource requirements. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58952  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component uses only intrahost communication. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58953  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:13 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58954  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

###### Dynamic Code Analysis

|  |  |
| --- | --- |
| FOLDER 58963  Rev: 3  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-09 07:25:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Potential Contributions to Hazards:** Complex memory variable arithmetics at runtime can lead to arbitrary data being used by the algorithm, and ultimately to corrupt algorithm output data.    **Sequence of Events:**  With variable input data, range assumptions can turn out to be false, leading to buffer overruns and invalid data being used to produce algorithm output.    **Linked to:**   SRAS59321, SRAS59175 |
| SPEC 58964  Rev: 1  **✓** | SWCMP.Algorithm.DynamicCodeAnalysis  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-07 11:39:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The native parts of the application shall be successfully executed when the code has been compiled with dynamic code analysis functionality enabled.  Background:  N/A |

###### Static Code Analysis

|  |  |
| --- | --- |
| FOLDER 58961  Rev: 3  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-09 07:25:15 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Potential Contributions to Hazards:** Variable initialization failures can lead to arbitrary data being used by the algorithm, and ultimately to corrupt algorithm output data.    **Sequence of Events:**  An uninitialized variable in C++ release compilation is not reset to the default value, but reads in arbitrary memory content that can propagate to the algorithm output.    **Linked to:**  SRAS59321, SRAS59175 |

### SWCMP.AEP

#### Description

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| --- | --- |
| FOLDER 59699  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:25:53 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The Algorithm Execution Platform (AEP) is a software component that is responsible for hosting and executing complex calculation algoritms. |

#### Detailed Design

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| --- | --- |
| FOLDER 59700  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:48 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The Algorithm Exection Platform (AEP) is a HTTP server hosting a REST API for running arbitrary algorithms. The AEP is especially designed for running Python applications for machine learning purposes, but any other kinds of calculations can be performed as well.    The AEP is intended to be used in P6 by creating an algorithm proxy class for uploading, running, and fetching results for each algorithm.  Currently, AEP is used to run the following algorithms:   * MRCAT Brain * MRCAT Head and Neck algorithms. |

**Attachment:**

|  |
| --- |
| [AEP\_detailed\_design.pptx](file:///C:\TEMP\TD_80\alm11p(1)\35f93d0d\Reports\CS%20SWCMP%20P6%20(3667)\attach\REQ_59700_AEP_detailed_design.pptx) |

##### REST API Interface

|  |  |
| --- | --- |
| FOLDER 59822  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:37 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The base URL (Internet address) for AEP is local: http://127.0.0.1/aep/v1/    The fundamental objects in the API are *Algoritms* and *Runs*    Algorithms form the lowest level REST hierarchy:  Collection:                /aep/v1/algorithms/  Algorithm:                /aep/v1/algorithms/{Algorithm Unique GUID}  When an algorithm has been created by HTTP POST in the algorithm collection, the algorithm can be executed by creating runs under the corresponging algorithm:  Collection:                /aep/v1/algorithms/{Algorithm Unique GUID}/runs/  Run:                         /aep/v1/algorithms/{Algorithm Unique GUID}/runs/{Run Unique GUID}  Runs can have arbitrary input data, and can produce arbitrary output data. These have correspongin REST containers:  Input:        /aep/v1/algorithms/{Algorithm Unique GUID}/runs/{Run Unique GUID}/input/  Output:     /aep/v1/algorithms/{Algorithm Unique GUID}/runs/{Run Unique GUID}/output/  Algoritm setup and run execution as UML sequence diabrams: |

#### Requirements

##### Alarms and Notifications Requirements

###### Failure Notification

|  |  |
| --- | --- |
| FOLDER 59763  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:38 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Analysis:** If the failure code is not transmitted from the algorithm run in AEP, user may miss a warning about the quality of the results. As a result, the patient may need to be rescanned in another imaging session.  **Sequence of Events:** A failure code is received from the algorithm, but is not propagated. The patient is dismissed and the missing data detected only when a manual DICOM export is attempted. |
| SPEC 59764  Rev: 1  **✓** | SWCMP.AEP.FailureNotification  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:29:42 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  A failure return value from the algorithm shall lead to a failure code being transmitted from the AEP.  Background: |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 59703  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:39 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is implemented with Python managed language with implicit boundary condition checks and exceptions. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 59704  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The control flow is a linear execution of the algorithm run in the AEP HTTP REST API. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 59705  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The application data has been checksummed for integrity checking. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 59706  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:41 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The interfaces use HTTP REST API, which is stateless and does not have event sequencing. |

##### Fault Condition Handling Requirements

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| FOLDER 59707  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:42 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicaple. Fault conditions are handled by returning error codes, which are covered by Alarms and Notifications Requirements. |

##### Functional and Capability Requirements

###### Functional

|  |  |
| --- | --- |
| SPEC 59796  Rev: 1  **✓** | SWCMP.AEP.Functional.Run  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  There shall be means for uploading an algorithm and running it.  Background: |
| SPEC 59797  Rev: 1  **✓** | SWCMP.AEP.Functional.ReadOutput  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  There shall be means for reading output from a finished algorithm run.  Background: |
| SPEC 60104  Rev: 1  **✓** | SWCMP.AEP.Functional.MRImageDataScaling  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:49 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  AEP shall properly handle scaling of MR input image data, as defined by RescaleSlope and RescaleIntercept DICOM tags. Specifically, AEP implementation shall check that RescaleIntercept is zero or close to zero, and Water and Fat MDIXON contrasts (if used) are rescaled to same scaling as used by the MDIXON InPhase contrast.  Background:  DICOM MR images have a scaling mechanism for converting pixel data values to intensity values as follows:      Intensity = PixelValue \* RescaleSlope + RescaleIntercept    RescaleSlope and RescaleIntercept are stored in MR DICOM objects as tags.    MR software typically produces single-station MR images that use value of RescaleSlope greater than 1, except for fused two-station images for which the RescaleSlope is typically 1. In MR software versions encountered so far, value of RescaleIntercept has been set to zero.    In current versions of MR software, the RescaleSlope is equal for all contrasts (Water, Fat, InPhase) of MDIXON images, but there has been versions in past for which this is not true.    To preserve compatibility with old and future MR software versions, the following rules shall be followed:   * Only images with RescaleIntercept == 0 are accepted for processing. * Only images with RescaleSlope > 0 are accepted for processing. * If RescaleSlope value differs between images of different MDIXON contrasts, they are rescaled such that scaling is equivalent to the scaling of InPhase contrast.   Note: Numerical limitations of floating-point values shall be taken into account when comparing values.    Images should not be rescaled to unity scaling because this could result in loss of numerical precision during Uint16 conversion. AEP-based MRCAT algorithms apply a separate re-normalization on image data and thus the absolute values of pixels are not relevant. However, it is important that pixel value X in contrasts A and B maps to the same intensity value Y. |

##### Installation Requirements

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| FOLDER 59709  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The implementation is copied as a part of P6 installation without extra installation steps. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 59710  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The interface provided by the component is the AEP REST API. The API functionality is covered by Functional and Capability Requirements. |

##### Memory Management and Overflow Requirements

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| --- | --- |
| FOLDER 59711  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:50 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the component is implemented with python, which provides garbage collection and overflow exceptions. Also, AEP process(es) are restarted between each post-processing step, which ensures that all allocated resources get freed. |

##### Performance Requirements

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| FOLDER 59712  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The processing requirements of the underlying algorithm are significant compared to AEP. |

##### Resource Allocation Requirements

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| --- | --- |
| FOLDER 59713  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:46 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the component does not allocate files or other resources that have to be claimed.  The component uses memory, which is not significant compared to the underlying algorithm. The component s implemented with python, which provides garbage collection and automated memory management. |

##### Security Requirements

|  |  |
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| FOLDER 59714  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:47 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The AEP connectivity is used inside the console loopback network only. |

##### Self-Diagnostics Requirements

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| --- | --- |
| FOLDER 59715  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:51 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  AEP-based algorithms typically support a self-test mode, which allows basic functionality of an algorithm and its dependencies (including GPU and related drivers) to be tested quickly. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 59716  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This component does not expose user interface functionality. |

##### Variable Initialization Requirements

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| --- | --- |
| FOLDER 59717  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:15 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is implemented with Python, which guarantees variable initialization. |

### SWCMP.DicomCommunication

#### Description

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| --- | --- |
| FOLDER 58968  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hulkkonen, Emma (310201279) on 2017-03-01 11:07:36 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The P6 DICOM Communication is a software component that is responsible for exchanging data in DICOM format. It is used for:   * Transmitting CT images and RT Structures to the Treatment Planning System or other remote network nodes, or to DICOM files.   *Rationale: MRCAT images are CT images and sending them from MR DICOM export would require the MR SW to support CT format, something that is not normally available on MR. RT Structures are also not commonly produced on MR.*   * Reading DICOM data and providing it in more accessible format to the rest of P6 software items.   *Rationale: Input DICOM data from MR scanner contains the patient and scan information, which needs, e.g., to be displayed to the user* |

#### Detailed Design

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| FOLDER 58969  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hulkkonen, Emma (310201279) on 2017-03-01 11:08:13 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The actual, low-level DICOM communication is implemented with DICOM Library SOUP component.  DICOM Communication component exposes the library as a set of high level functions via .NET interfaces assembly.  The component itself is implemented in C#. |

##### DICOM Object Creation and Export v3

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| FOLDER 59613  Rev: 2  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:52 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  P6 uses DICOM Communication Component for exchanging data with an MR scanner and therapy planning systems using DICOM files and network nodes. The files can be written to persistent media or on network shares, whereas the network nodes can link P6 directly to the receiving end over a computer network.  The component also provides an AlgorithmConverter utility, which converts DICOM images to Protobuf messages and Protobuf messages back to DICOM images. It is designed for processing input and output of an external algorithm process.  **Philips DICOM Library**  The DICOM connectivity is implemented with a Philips HSDP-provided DICOM Library. The library also supports TLS secure transfer and anonymization, which are used by the Dicom Communication Component.  **AlgorithmConverter**  AlgorithmConverter creates MRCAT images and RT structure sets. The created objects are tagged to be compatible with MR database, i.e. Modality (0008,0060) is "MR" and SOP Class UID (0008,0016) is one of the SOP classes supported by MR database. During DICOM export, the attribute values are changed to corresponding CT and RT structure set values. A private PIIM tag PIIM\_RT\_GENERATED\_SERIES is added to the objects. It is used to detect objects that should be exported by MR-RT plug-in and this DICOM Communication Component.  **MRCAT creation**  AlgorithmConverter combines data from multiple sources when creating MRCAT DICOM instances:   * MR scan - most of the DICOM attributes are copied from corresponding mDIXON images * MRCAT algorithm - Protobuf messages containing the following data:   + MRCAT pixel data   + list of series or image-level attributes * Post-processing step   + Series UID   + timestamp of MRCAT run * Constants - hard-coded constants in DICOM Communication Component   **RT structure set creation**  AlgorithmConverter combines data from multiple sources when creating RT structure set DICOM instances:   * Image series   + T2 - common DICOM tags are read from T2 image instances   + MRCAT - contours are linked to MRCAT images * Auto-segmentation algorithm - Protobuf messages containing the following data   + lists of contour points, calculated to be on MRCAT slices * Configuration XML files - names and colors for ROIs are read from configuration files * Post-processing step   + Series UID   **RT Blob, a DICOM Attribute**  When new CT or RT Struct DICOM instances are created, the DICOM Communication component adds a private PIIM tag PIIM\_RT\_BLOB\_DATA to the instances. The content byte-array is actually utf-8 encoded XML. The XML uses RTBlob.xsd as a namespace-version controlled schema: the XML needs to be backwards compatible as the image data can outlive the software version.  **Checksums**  To ensure that the transmitted data does not contain systematic pixel value errors that could have been introduced in external MR database, DICOM image instances are checksummed and the checksums are stored in RT blob. The checksumming is done with a pseudorandom sampler: It uses a 64-bit XORShift Random Number Generator to select samples from a large buffer into a smaller sample buffer, in this case into a buffer of 256 bytes. The middle byte in the large buffer will act as a seed that selects the shift triplet for the generator. The sampled vector is then SHA1-checksummed. Sampling checksum detects systematic failures in pixel data while keeping the computation requirements low.  When MRCAT images are converted to CT images in DICOM export, checksum is re-calculated and compared to the original value. A mismatch causes the conversion to fail, and images are not exported.  **Image Position**  Image position used in dicom objects is expected to been defined according to Nema Dicom standard: *Image Position (0020,0032) specifies the x, y, and z coordinates of the upper left hand corner of the image; it is the center of the first voxel transmitted* This differs from MR sw internal implementation where image position coordinate is defined in upper left corner of the first voxel. For algorithm use, image position coordinate is converted to Dicom LPH coordinate which origin is in the middle of the slice. Dicom tags used for position definition and coordinate transformation   * Pixel spacing (0028,0030) - Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm. * Image Orientation (0020,0037) - The direction cosines of the first row and the first column with respect to the patient * Image Position (0020,0032) - The x, y, and z coordinates of the upper left hand corner (center of the first voxel transmitted) of the image, in mm * Columns (0028,0011) - Number of columns in the image * Rows (0028,0010) - Number of rows in the image.   **Instance Number**  Instance Number (0020,0013) values 1..N are used for MRCAT images. The numbering order is based on the source mDixon images: if they were scanned with the default feet-to-head display order, image with smallest z coordinate gets instance number 1. With head-to-feet order, image with largest z coordinate gets instance number 1.  **DICOM Export**  DICOM Communication Component supports exporting MRCAT images as classic CT images, and RT structure sets. Supported transfer syntaxes are Implicit VR Little Endian, Explicit VR Little Endian and Explicit VR Big Endian. During export, only attributes belonging to a predefined list are included in the exported objects.  All unsupported DICOM object types (for example: Grayscale Softcopy Presentation State) are filtered out from exports.  **DICOM File Export**  DICOM Communication Component provides an interfaces for storing DICOM instances as files to a folder. DICOMDIR file is updated after storing the files. If a given DICOM instance is already found from DICOMDIR, the file is not rewritten. The files are named "IM\_*xxxx*", where *xxxx* is a number between 0 and 9999. When a DICOM instance is written to a file, the Instance Creation Date (0008,0012) and InstanceCreationTime (0008,0013) attributes are updated.  The file export functionality can be called with delegates for audit logging and progress notifications, so that HIPAA requirements can be fullfilled and progress of long-lasting operations can be followed.  **DICOM Network Export**  DICOM Communication Component provides an interface for sending DICOM instances to a network node. After successful export, DICOM storage commitment can be performed.    The export functionality can be called with delegates for audit logging and progress notifications, so that HIPAA requirements can be fullfilled and progress of long-lasting operations can be followed.  **Network Export Limitations**  Concurrent export to the same target node (as judged by the IP-address and the port number) has been disabled on purpose. It was observed that different SCP implementations reacted badly to concurrency. For example, DICOM toolkit sequences the operations, which leads to DICOM connect timeouts if a lengthy export is ongoing. DVTk implementation aborts incoming connection attempts, which leads to false DICOM export failures.  **Storage Commitment**  DICOM Communication Component implements DICOM storage commitment using the Philips DICOM Library. Storage commitment is done if a storage commitment service has been configured for the network node. Storage commitment request is sent in a separate DICOM association after the whole series has been sent. If all DICOM instances are found from the storage commitment response, the export is reported as successful, otherwise as a failure. |

#### Requirements

##### Alarms and Notifications Requirements

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| --- | --- |
| FOLDER 58971  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:26:37 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are not issued from the headless DICOM Communication component. |

##### Boundary Condition Requirements

###### Contour points

|  |  |
| --- | --- |
| FOLDER 59378  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-14 16:01:00 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** A failure to check the number of points in the contour may cause a failure when importing the contour into treatment planning systems.  **Sequence of Events:** If the Autocontouring algorithm is run on a particularly large-sized patient, the resulting body outline contour may exceed the maximum number of points defined in the DICOM standard. |
| SPEC 59377  Rev: 1  **✓** | SWCMP.DicomCommunication.BoundaryCondition.ContourPoints  Model: [Ingenia] FS: [T15, T30] GS: [All] Options: [MR-RT] Quality Attributes: [N.A.] Type of Test: [Development Test]  Signatures: Signed by: Halkola, Aleksi (300228695) on 2017-03-14 16:00:59 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The auto-contouring algorithm shall produce DICOM contour point data, where the number of points per slice for each contour shall not exceed 2730.    Background:  N/A |

##### Data and Control Flow Requirements

###### Storage Commit

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| --- | --- |
| FOLDER 59031  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:51:48 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Risk Analysis:** A failure to invoke storage commit at the end of DICOM export may lead to partial data being used in therapy planning.  **Sequence of Events:** If the storage commit step is omitted from the DICOM export due to invalid logic, the auto-plan triggering scripts can run too early, before the therapy planning system has access to all classic DICOM image files needed for the primary image set. |
| SPEC 59040  Rev: 2  **✓** | SWCMP.DicomCommunication.Data.StorageCommit  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hulkkonen, Emma (310201279) on 2017-03-01 11:09:35 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Dicom network export shall support storage commitment after storage in a remote archive.  Background:  N/A |

##### Data Definition Requirements

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| --- | --- |
| FOLDER 58974  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:52:06 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The DICOM Communication component does not modify application data based on data definitions in the component. |

##### Event Sequencing Requirements

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| --- | --- |
| FOLDER 58975  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:55:07 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The DICOM Communication component provides simple procedural methods for converting data and exporting data. |

##### Fault Condition Handling Requirements

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| --- | --- |
| FOLDER 58976  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:54:53 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The DICOM Communication component provides simple procedural methods for converting data and exporting data, where fault conditions are handled as return values and exceptions. |

##### Functional and Capability Requirements

###### Transfer Syntax

|  |  |
| --- | --- |
| FOLDER 59030  Rev: 2  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-02-13 12:50:50 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Potential Contributions to Hazards:** DICOM Standard supports multiple transfer syntaxes. Invalid data decoding will corrupt transmitted DICOM data.    **Sequence of Events which could lead to a Hazard:** If the Hounsfield-related DICOM attributes get corrupted due to invalid endianess used in data transfer, the treatment plan will be calculated with wrong values.    **Linked to:** SRAS59175 |
| SPEC 59039  Rev: 2  **✓** | SWCMP.DicomCommunication.Functional.TransferSyntax  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-02-13 12:50:26 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  There shall be support for implicit little endian (ILE), explicit little endian (ELE) and explicit big endian (EBE) transfer syntaxes.  Background:  N/A |

###### Image Positions

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| --- | --- |
| FOLDER 59205  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-15 08:22:41 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Potential Contributions to Hazards:** If the plug-in alters the image data when it is being exported,  unexpected data modifications can result in corrupt data being exported.  **Sequence of Events which could lead to a Hazard:** MRCAT image location is calculated differently in the plug-in compared to mDixon, which results in a corrupt MRCAT when the data is retrieved and sent with DICOM export as DICOM CT Image to a treatment planning system.  **Linked to:** SRAS59175 |

###### Configuration Handling

|  |  |
| --- | --- |
| FOLDER 59217  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-15 08:23:20 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Potential Contributions to Hazards:**  Treatment planning system (TPS - Pinnacle3) uses contour clinical names for plan generation. If configuration handling fails so, that ROI clinical names are mixed with each other, it may lead invalid dose plan calculation in treatment planning system.    **Sequence of Events which could lead to a Hazard:**  Plug-in gets ROI contours from algorithm and links them to user defined clinical names. Each ROI received from algorithm has unique identifier, which is mapped to clinical name, given by user, in configuration xml file. Plug-in fails in mapping and switches ROI names, etc. between prostate and bladder. Countours are then send to TPS within dicom RT structure set. TPS starts dose plan calculation using wrong ROIs and as an end result invalid plan is generated.  **Linked to:** SRAS59175 |
| SPEC 59218  Rev: 1  **✓** | SWCMP.DicomCommunication.Functional.RTStructConfigurabilityAndValidity  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-02-13 12:50:01 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The application shall read the Autocontour configuration file values and create and export the RT structs accordingly.  Background:  N/A |

##### Installation Requirements

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| --- | --- |
| FOLDER 58984  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:54:33 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The implementation is copied as a part of P6 installation without extra installation steps. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58977  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:54:19 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The memory requirements for DICOM exports are modest. The memory management is handled with .NET framework, which has a safe failure modes for overflow situations. |

##### Performance Requirements

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| --- | --- |
| FOLDER 58978  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:54:06 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The DICOM export takes place as a background job and is not time-critical. |

##### Resource Allocation Requirements

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| --- | --- |
| FOLDER 58979  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-02-15 13:08:58 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The DICOM Communication component uses .NET framework, which has a safe failure modes for resource allocation conflicts. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58980  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-02-15 13:07:53 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The DICOM communication takes place over unencrypted TCP/IP ports to support therapy planning systems with limited security capabilities. |

###### Personal Data De-Identification

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| --- | --- |
| FOLDER 59199  Rev: 1  **✓** | Model: [] FS: [Any] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-02-15 13:07:42 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Risk Analysis:**  User can unintentionally export sensitive patient information, if the sending of personal data is not prevented  when the user requests exported data to be anonymized.  **Sequence of Events:**   If user data, such as the patient id or birth date, is not suppressed when the user selects anonymized data export to removable media, it is possible to leak patient data from a hospital. |
| SPEC 59619  Rev: 3  **✓** | SWCMP.DicomCommunication.Security.DeIdentification v1  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Taiminen, Toni (320026757) on 2019-03-13 11:34:17 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  When file export with Supress Patient Data option is requested, the plugin shall de-identify personal data in the exported as defined in the attach sheet.  UIDs shall be hashed using MD5 algorithm.  All other attributes shall not be changed.    Background:  N/A |

**Attachment:**

|  |
| --- |
| [Req.xls](file:///C:\TEMP\TD_80\alm11p(1)\35f93d0d\Reports\CS%20SWCMP%20P6%20(3667)\attach\REQ_59619_Req.xls) |

###### Secure Transfer

|  |  |
| --- | --- |
| FOLDER 59598  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:17 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Unsecure data transfer can lead to confidential patient data loss or corruption.  **Sequence of Events:** Dicom data sent over unsecure connection is sniffed or modified by an unauthorized person. |
| SPEC 59599  Rev: 1  **✓** | SWCMP.DicomCommunication.Security.DataEncryption  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Taiminen, Toni (320026757) on 2018-12-07 12:06:28 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Plug-in shall support data encryption when exporting data to an external Dicom node.  Background:  N/A |
| SPEC 59600  Rev: 1  **✓** | SWCMP.DicomCommunication.Security.NodeAuthentication  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Taiminen, Toni (320026757) on 2018-12-07 12:07:11 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Plug-in shall support node authentication when exporting data to an external Dicom node.  Background:  N/A |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58981  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:53:05 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The component does not implement features that could be diagnosed at field. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58982  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2016-07-01 08:52:54 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. This component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58983  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hulkkonen, Emma (310201279) on 2017-03-01 11:10:49 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The component is implemented with C#, which guarantees variable initialization. |

### SWCMP.MRCommunication

#### Description

|  |  |
| --- | --- |
| FOLDER 58664  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:38:34 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  P6 uses MR Communication Component for exchanging data with an MR scanner using protobuf messages over ZeroMQ sockets. Protobuf and ZeroMQ are needed for interprocess communication: P6 application runs in a separate process and MR services can be hosted on multiple processes. Using an industry standard protocols prevents technology lock-in.  **MR Interfaces**  The following diagram describes the custom MR interfaces developed for P6 plugin: |

##### ExamCard Post-Processing Interface

|  |  |
| --- | --- |
| FOLDER 58852  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:38:31 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  ExamCard Post-Processing interface implementation interacts with MR scanner exam card engine. It is used for:   * Adding P6 post-processing steps to exam card scan protocol at the factory.   *Rationale: P6 post-processing steps contain algorithms that have been optimized for development-time defined scan protocols and cannot be executed as a part of any scan protocol. Hence the steps can only be added to protocol as a part of product development.*   * Executing P6 post-processing steps as a part of exam card  execution.   *Rationale: P6 post-processing steps need to integrate with exam card execution to provide a seamless workflow.*    ExamCard Post-Processing interface is implemented with ZeroMQ and Protobuf messaging. |

##### Logging Interface

|  |  |
| --- | --- |
| FOLDER 58665  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:38:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Logging interface implementation interacts with MR scanner logging service. It is used for:   * Creating utility, service, and trace log entries into MR scanner log database.   *Rationale: The MR scanner log database can be remotely accessed and the contents analyzed e.g., for product improvement purposes.*   * Audit logging DICOM network and file export events using MR scanner audit logger.   *Rationale: The audit logging is needed for HIPAA compliance.*    The need to produce stable log entries for version-independent service and utility measurements necessitates separation of development logs from service and utility logs:  - MR scanner log database entry formats are explicitly controlled.    Logging interface is implemented with ZeroMQ and Protobuf messaging. |

##### Z-Order Interface

|  |  |
| --- | --- |
| FOLDER 58842  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:14:29 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Z-Order interface implementation interacts with MR scanner user interface services. It is used for:   * Submitting P6 user interface windows into MR user interface managing framework, so that P6 windows interact with MR windows as a one application.   *Rationale: P6 software is a separate process. On Windows operating system, each process manages its own windows as a separate application. The active application hides windows from non-active applications, which prevents seamless workflow and can hide important windows.*  Z-Order interface is implemented with ZeroMQ and Protobuf messaging. |

##### Database Interface

|  |  |
| --- | --- |
| FOLDER 59308  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:14:30 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Database interface implementation interacts with MR host background infra database service:   * It creates new series in MR database   *Rationale: Output of plug-in post processing step is Dicom series, which needs to be stored in MR database.*   * It stores instances under newly created series as standard Dicom objects   *Rationale: Single series may contain several instances (images), which are stored in MR database one by one. Plug-in handles data objects as standard Dicom objects and MR interface provides means to store Dicoms as MR database objects.*   * It retrieves instances from MR database   *Rationale: Post processing steps needs existing scan data as an input for algorithm execution and export jobs needs to access series instances they are exporing to Dicom network node or other media.* |

##### ServiceDiscovery Interface

|  |  |
| --- | --- |
| FOLDER 59310  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:14:30 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  ServiceDiscovery interface implementation interacts with MR host background discovery service:   * It is used to query communication addresses for other known MR plug-in services, such as database service.   *Rationale: MR host service addresses may change over time or ports may be dynamically allocated. To ensure communication with all services plug-in needs to request addresses at each start up. Discovery service itself is guaranteed to serve always in same agreed address.* |

##### SoftwareOptions Interface

|  |  |
| --- | --- |
| FOLDER 59313  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:14:31 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  SoftwareOptions interface implementation interacts with MR host licensing service. |

##### Menu Interface

|  |  |
| --- | --- |
| FOLDER 59324  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:38:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Menu interface implementation interacts with MR ExamCards process. It is used for   * Adding menu items to MR top-level menus * Triggering plug-in actions when user selects a plug-in-provided menu item   *Rationale: Menu items provide a way to launch plug-in windows, which can be used to show important information to user.* |

##### Versioning Interface

|  |  |
| --- | --- |
| FOLDER 59325  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:38:33 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Versioning interface implementation interacts with MR background infra services. It is used for   * Querying MR software version, product model and system type.     *Rationale: Plug-in needs version information for preventing the use of plug-in in systems for which plug-in verification has not been done.* |

##### Foreground Process Interface

|  |  |
| --- | --- |
| FOLDER 59328  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:38:34 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Foreground Process Interface implementation interacts with MR application. It is used for   * Querying the path for plug-in foreground executable     *Rationale: Plug-in process is run as a service, and it cannot launch UI windows. Another executable is provided for UI purposes.* |

#### Detailed Design

|  |  |
| --- | --- |
| FOLDER 58668  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The MRCommunication component is implemented with C# programming language. |

##### ExamCard Post-Processing Interface

|  |  |
| --- | --- |
| FOLDER 58853  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:39:00 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  MR Component serves the MR scanner exam card instance by listening on a ZeroMQ REQ server. An incoming command is routed to the ExamCardManager, which takes action on the valid exam card commands and passes on the unknown commands. The manager orchestrates the control flow that ensues from post-process start request.    ExamCardManager encodes post-processing step type to the binary blob which is stored in ExamCard data. A validate request contains the blob, and ExamCardManager creates an appropriate post-processing step instance. A following start request launches the step, identified by a unique step ID.    **Post-procesing Step Execution**    Before post processing step can be started, each step will receive a validation request. In addition of step type, validation request PPValidateRequest contains list of approved features which is used to identify valid examcard and prevent execution for steps attached to non-factory default scans. This information is stored and will be checked when step is started. Validation checks also software options and in case that required option is not enabled, step status will be set to an invalid state and descriptive user error message is delivered in validation response.  When ExamCardManager receives PPStepStartRequest, it acknowledges sender with success response and launches step execution in separate task. On step start, approved features are checked and if required feature is not present, step is reported as failed. In communication to MR host, step execution is using database service interface to retrieve data from database and store data into database. Progress reporting is using examcard plugin performer service.  Preconditions for post processing step execution:   * License check (Step specific options needs to be enabled in MR configuration) * System Integrity check (P6 Application integrity is validated by calculating checksums over a set of relevant files and comparing these to precalculated values) * Version Compatibility check (Versions of interacting systems, MR Scanner, Pinnacle, P6 plug-in, needs to comply with the matrix of supported configurations)   In start request, progress update service host address is provided and progress percentage including final execution status is updated using ProgressReporter. In execution failure, detailed localized description can be provided to be shown to user. Display message type defines how message will appear on MR host. More detailed sequence presentation about step execution and progress update can be found under Database Access.  **MR Control Flow**  When MR interfaces are used for post-process execution, MR Component participates in the following control flow: |

###### Data Storage

|  |  |
| --- | --- |
| FOLDER 58965  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:01 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  When the post-processing steps are added to an ExamCard at the factory, the P6 application needs to store machine-readable information about a post processing step functionality it provides.  This data is stored as an opaque binary blob to the ExamCard via the ExamCard Post-Processing Interface. That is, the MR software is unaware of the contents of the data and is only responsible  for storing the data and offering the data when a P6-governed step is being executed.  Internally to P6, the blob is an XML-structure that is converted to a byte array via UTF8-encoding. |

###### Message Routing

|  |  |
| --- | --- |
| FOLDER 58854  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  P6 system maintains a ZeroMQ server, which listens to incoming protobuf messages. The messages are offered to a collection of message handlers.  One of these handlers is the Exam Card message handler. It carries out the commands given to it by the exam card, e.g., to add contents for a new post-processing step,  or to start executing a post-processing step with a given data content.  The Exam Card message handling can result in progress notifications, which are sent back to the MR software via a ZeroMQ client. |

##### Logging Interface

|  |  |
| --- | --- |
| FOLDER 58669  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Log Routing**  The log entries are routed to an external ZeroMQ server, which provides an extra logging service to P6 system. Each log entry will end up both in the internal P6 log and in the external log. Internal logging is for development and research purposes. |

###### Controller Message Format

|  |  |
| --- | --- |
| FOLDER 58670  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The logs intended for MR scanner and subsequent utility analysis, that is, specific entries filed throught the Logging interface, can be created with explicit function calls and constant message string identifiers.  This is in contrast with development logs that are typically free-format text. |

##### Z-Order Interface

###### Windows Handles

|  |  |
| --- | --- |
| FOLDER 58844  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:39:01 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Z-Ordering of Windows is implemented with native windows handles: the native window handle of a suitable MR user interface window is queried from MR software, and the handle is set as a parent handle for a P6 window. |

##### Menu Interface

###### Menu Item Creation

|  |  |
| --- | --- |
| FOLDER 59035  Rev: 2  **✓** | Model: [] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2021-01-19 11:11:56 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Menu Items**  P6 application needs to be able to add menu items under MR Application menus. There are placeholders for P6 menus present in selected main menu items and P6 plugin populates sub items under them.  Example RT submenus under System menu:    P6 application needs to be capable to react RT menu item clicks in MR user interface. Response of menu item selection can be for example showing UI dialog generated by P6 application. Each RT subitem added contains unique id generated by P6 application. MR application supports P6 submenus under main menu items:   * System * Help   **Interfacing towards MR**  Following sequence diagram describes messaging between MR sw and P6 application, when MR system is started up and user selects RT About menu item in MR application Help menu. MenuItemManager creates all available menu items in response message containing parent type (System, Help) and unique string id for all menu items. |

###### Application Aboutbox

|  |  |
| --- | --- |
| FOLDER 59036  Rev: 1  **✓** | Model: [] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  P6 application needs to be able to display an About Box user interface, which informs the user about the success of the installation (version and software option compatibility) and about the open source licenses that P6 is legally bound to display.  **Interfacing towards MR**  The about box is invoked from MR software, via an menu selection interface: MR user interface queries for about-menu items and user can launch the P6 about box by selecting an item from the dynamically populated menu item list. The about box requires the hosting software to support a Z-order interface, which provides a Windows parent window handle, so that the Z-order of the about box window is maintained by the host application. |

##### Database interface

|  |  |
| --- | --- |
| FOLDER 59309  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Database Access**  MR host background plug-in infra service provides means to access MR database objects and to create new series into database. Series retrieval is used in Examcard post processing step execution to read input data for algorithms and in export manager to read data to be exported. Retrieved series is identified with unique series instance UID and query can be speed up by providing optional patient and study instance UID in request. Series creation is used in Examcard post processing steps to store algorithm output as a new series in MR database. There can be only single series at a time to be written into database. Series creation request needs to be followed by store instances requests. DatabaseAccessManager under Examcards provides locking functionality to protect against concurrent write operations. This class is a single access point for all write operations to MR database.  **Database retrieval**    **Database create and store with progress update**  Sequence of events in post processing step execution. Post processing retrieves algorithm input data, proceeds it to algorithms and stores output series into MR database. Progress reporter is utilized to communicate step progress to MR host post processing service. |

##### ServiceDiscovery Interface

|  |  |
| --- | --- |
| FOLDER 59311  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:07 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  MR host provides discovery service in known local address (local host + predefined port). It is possible to query addresses for other known services. Supported services are:   * AuditLogService * DatabaseService * LogService * PluginService * SoftwareOptionService * ZOrderService   All plug-in ReqClients are using addresses provided by service discovery, except for the progress req client, where the host address is provided within PPStepStartRequest. Progress updates are available for post processing step execution and export jobs. They are triggered with same start request message. |

##### SoftwareOptions Interface

|  |  |
| --- | --- |
| FOLDER 59312  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-03 12:15:07 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  MR Licensing scheme is used for P6, when the plugin is executed on MR console. The licenses are queried from MR using ZeroMQ. To prevent too chatty queries, the license queries are cached in the license store.  On P6 application start, ClientServerManager initializes LicenseStore by requesting required options to be available in cache for quick queries. License checks takes place in post processing step validation where status of required options is checked and in case of disabled option status, user can be informed with descriptive message in validation response. Supported options are:   * Mrcat * AutoContouringProstate * Contour2Plan |

##### Versioning Interface

|  |  |
| --- | --- |
| FOLDER 59329  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:39:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  On P6 application start, ClientServerManager initializes VersionStore by requesting required version information to be available in cache for quick queries. Information is available about:   * MR software version * MR product model * MR system type |

##### Foreground Process Interface

|  |  |
| --- | --- |
| FOLDER 59330  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-03 13:39:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The plugin runs as a background service in order to serve background jobs and DICOM exports. Such a service runs under different user rights and cannot launch user interface components. A separate foreground process is needed during MR application execution to spawn UI components. This process is launched by the MR application:    The UI process kills itself once it detects that its parent process died. |

##### Compatibility Checking

|  |  |
| --- | --- |
| FOLDER 59364  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Joki, Kalle (fir00372) on 2017-03-10 14:13:39 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  **Compatibility Matrix**  In order to be able to use P6 features, the plugin subsystems need to be compatible. The compatibility is checked with the help of a field-upgradable compatibility matrix file, which explicitly lists all allowed version combinations in csv format. Compatibility mismatch prevents execution of post-processing steps and DICOM exports.  **Compatibility knowledge**  The class CompatibilityKnowledge offers two compatibility checks. One is used for checking if the P6 plug-in and the MR software are compatible with each other. The other is used for checking if all three, the P6 plug-in, the MR software, and the TPS software are compatible with each other. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58672  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The MR Communication interface does not include alarms or notifications in itself. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58673  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:46 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is implemented with C# managed language with implicit boundary condition checks and exceptions. |

##### Data and Control Flow Requirements

###### Step Name Validation

|  |  |
| --- | --- |
| FOLDER 59094  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:47 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Incorrect step validation may allow the user to run the whole ExamCard without detecting failures. If treatment technique step is incorrectly shown as valid, user cannot know in advance that the plan generation will fail, and will proceed. The problem would then be detected later. (denial of service) |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58675  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:49 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: The component does not contain data definitions that would affect the output data from the application. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58676  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:50 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The interfaces use ZeroMQ message handling with a simplistic, synchronous REP-REQ pattern. |

##### Fault Condition Handling Requirements

###### Service

|  |  |
| --- | --- |
| FOLDER 58681  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:52 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** A failure in error recovery from a temporary MR scanner plug-in ZeroMQ communication service shortage may hang the messaging between plug-in and MR software preventing normal operation. This will necessitate a computer or services restart and lengthen the procedure. (denial of service) |
| SPEC 58682  Rev: 1  **✓** | SWCMP.MRCommunication.Fault.Service  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:51 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The P6 application shall recover or restart from a temporary shortage of the MR services.  Background:  N/A |

##### Functional and Capability Requirements

|  |  |
| --- | --- |
| FOLDER 58678  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the functional requirements are captured in the subsystem that uses the component. |

##### Installation Requirements

|  |  |
| --- | --- |
| FOLDER 58683  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:54 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the installation is a simple copy-operation. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58686  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:56 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The interface requirements placed on MR are captured in External MR subsystem requirements. |

###### Database Interface

|  |  |
| --- | --- |
| FOLDER 59176  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:56 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Potential Contributions to Hazards:** Data corruption - the MR database interface is not thread-safe by design, and concurrent write operations can lead to corrupt data being saved.  **Sequence of Events, which could lead to a Hazard:** If the exclusive locking mechanism in P6 does not work, the algorithm outputs can target the database at the same time, which leads to undefined behavior for the data being saved.  **Linked to:** SRAS59175 |
| SPEC 59177  Rev: 1  **✓** | SWCMP.MRCommunication.Interfaces.DatabaseLock  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:55 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  MR Communication component shall prevent concurrent DICOM series write operations on the MR database interface.  Background:  N/A |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58687  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:57 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the component is implemented with C#, which provides garbage collection and overflow exceptions. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58688  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:08:58 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: slow operations reduce the thoughput of the application, but there are no time-critical operations that would cause hazards. |

##### Resource Allocation Requirements

###### MR Log

|  |  |
| --- | --- |
| FOLDER 58694  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:09:01 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** The bandwidth resources for downloading MR logs for utility and service analysis back to Philips servers are limited: therefore the amount of data produced by a single examination should have an upper limit. |

###### Internal Log

|  |  |
| --- | --- |
| FOLDER 58698  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:09:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** A too large internal log can consume all disk space on MR scanner and lead to a denial of service. A limit of 512MB has been agreed with MR. Cumulative logs can fill the disk space over long periods of time. |
| SPEC 58699  Rev: 1  **✓** | SWCMP.MRCommunication.Resource.InternalLog  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:09:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The internal log database shall not grow beyond 512MB size limit.  Background:  N/A |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58690  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:09:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the security requirements are captured in the subsystem using the component. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58691  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:09:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the application runs against a verified MR version on the same hardware, so the connectivity is guaranteed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58692  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:09:07 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: This component does not have a user interface. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58693  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-06 10:09:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable: the component is implemented with C#, which guarantees variable initialization. |

### SWCMP.SOUP.AsyncIO

#### Description

|  |  |
| --- | --- |
| FOLDER 58552  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  P6 uses AsyncIO indirectly - the NetMQ uses the low-level socket implementations from the AsyncIO library to implement the 0MQ communication protocol used by P6.  It is handled as a separate SOUP component due to its specific license requirements. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58553  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  AsyncIO  is used as a binary component and does not contain designs for P6. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58555  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58556  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are inherently safe in .NET managed code. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58557  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:07 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58558  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58559  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without event sequence requirements. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58560  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not contain application logic to handle fault conditions. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58562  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:11 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  Because the AsyncIO library is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58563  Rev: 1  **✓** | SWCMP.SOUP.AsyncIO.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:40:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

###### Output

|  |  |
| --- | --- |
| FOLDER 58564  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** A failure in transmitting ZeroMQ message data can result in an invalid value being output to subsequent processing. Such an invalid value can lead to corrupt data being used in the application.  **Sequence of Events:** When P6 software communicates with MR, it uses ZeroMQ messages. AsyncIO is responsible for low-level socket communication. A failure to transmit a message can lead to invalid data being sent to/from MR scanner. |
| SPEC 58565  Rev: 1  **✓** | SWCMP.SOUP.AsyncIO.Functional.Output  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:40:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The AsyncIO library shall output received data without errors in transmission.  Background:  N/A |

##### Installation Requirements

###### License

|  |  |
| --- | --- |
| FOLDER 58575  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. However, the Mozilla Public License, version 2.0 requires that the license and the source code need to be installed with the product and that attribution notice about the tool is displayed in the about-box.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58567  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.  The component is compiled with a fixed API. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58568  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:17 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and memory management is handled by .NET framework. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58569  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The performance requirements are part of the system performance testing, where ZeroMQ-communication consumes a part of the total time budget. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58570  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:19 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The resource requirements of the components are part of the total system resource requirements. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58571  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:20 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The ZeroMQ connectivity is to be used inside the console loopback network only. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58572  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:21 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58573  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:21 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58574  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 09:19:22 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and variable initialization cannot be configured. |

### SWCMP.SOUP.Boost

#### Description

|  |  |
| --- | --- |
| FOLDER 58578  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-16 08:24:26 Meaning: QA Approved - (QA) Signed by: Hulkkonen, Emma (310201279) on 2016-02-16 08:03:46 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Boost is a general purpose source library for the C++ programming language. It is used:     * as a unit test execution tool for native code, * a high-level thread and file system operation abstraction layer, * a command-line parser for development-time execution of code, and * in memory management, with Boost-provided smart pointers implementation. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58579  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:58:51 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:11 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:37:56 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Boost is an auxiliary library component and does not contain designs for therapy applications. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58581  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:58:52 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:13 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:37:57 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are considered in the implementation code, not in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58582  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:58:54 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:14 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:37:58 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are considered in the implementation code, not in this auxiliary component. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58583  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:58:55 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:15 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:37:59 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data and control flow  are considered in the implementation code, not in this auxiliary component. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58584  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:58:57 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:17 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:00 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data definition is considered in the implementation code, not in this auxiliary component. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58585  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:58:58 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:18 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:01 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Event sequence failure cases are considered in the implementation code, not in this auxiliary component - the threading support in Boost only wraps operating system calls, without event sequence implications. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58586  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:00 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:19 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The fault conditions are considered in the implementation code, not in this auxiliary component. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58588  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:02 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:21 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the Boost is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58589  Rev: 1  **✓** | SWCMP.SOUP.Boost.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:01 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:20 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

##### Installation Requirements

###### License

|  |  |
| --- | --- |
| FOLDER 58593  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:06 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:25 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:07 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. However, the Boost license requires that the library can be only installed in binary format without an accompanying boost license file.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |
| SPEC 58594  Rev: 1  **✓** | SWCMP.SOUP.Boost.Installation.License  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:05 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:24 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Boost source or header files shall not be included in the product.  Background:  N/A |

###### License Display

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58595  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:09 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:29 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not contain interfaces to other software items and the interface to the filesystem uses underlying operating system calls. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58596  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:10 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:30 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and memory management is considered in the implementation code. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58597  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:11 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:31 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:11 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The performance is considered in the implementation code, not in this auxiliary component. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58598  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:12 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:33 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The resource allocation is considered in the implementation code, not in this auxiliary component. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58599  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:13 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:34 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:13 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Security is considered in the implementation code, not in this auxiliary component. |

##### Self-Diagnostics Requirements

###### Compilation

|  |  |
| --- | --- |
| FOLDER 58603  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:16 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:36 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:15 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** In C++, the library can be affected by compilation settings. If Boost compilation settings result in incorrect binaries, the usage of the library can lead into corrupt data being used by the application.  **Sequence of Events:** An invalid compiler or linker setting can result in a binary that does not function correctly and may overwrite or read unintended memory, leading to invalid Algorithm component data being sent back to the application. |
| SPEC 58604  Rev: 1  **✓** | SWCMP.SOUP.Boost.SelfDiagnostics.Compilation  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:15 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:35 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Boost self-diagnostic regression test suites shall be executed successfully.  Background:  N/A |

###### Unit Testing

|  |  |
| --- | --- |
| FOLDER 58708  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:18 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:39 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** The C++ code, including Boost implementation itself, is tested with the unit test framework that comes with Boost. A failure to detect a failing unit test can lead to a failing software being delivered with the product.  **Sequence of Events:** If the boost unit test detects a failed assert in the test code, but does not report the failure to the calling program, the assertion on the software does not hold. |
| SPEC 58709  Rev: 1  **✓** | SWCMP.SOUP.Boost.SelfDiagnostics.UnitTesting  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:17 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:38 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  A failed unit test assert in Boost unit test execution shall return a failure code and log the failure.  Background:  N/A |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58601  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:20 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:42 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:38:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality and the command-line option handling is not used in the product. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58602  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 13:59:22 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:53:43 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 13:19:24 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boost is provided as is, and variable initialization of the compilable header files is tested with the application using the library. |

### SWCMP.SOUP.DicomLibrary

#### Description

|  |  |
| --- | --- |
| FOLDER 58356  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:29 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  P6 uses Philips Platform 2.0 DICOM Library for DICOM connectivity. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58357  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:30 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  DicomLibrary  is a precompiled binary component and does not contain designs for P6. It exposes a Microsoft .NET application programming interface to implement DICOM connectivity. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58359  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:31 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58360  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are inherently safe in .NET managed code. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58361  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:33 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58362  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:34 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data. |

##### Event Sequencing Requirements

###### Concurrency

|  |  |
| --- | --- |
| FOLDER 59079  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:36 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Reliability risk: A concurrenct use of .NET library may result in dead-locks or concurrency exceptions from .NET framework. This can lead to intermittent denial of service.  **Sequence of Events:** Concurrent DICOM exports can save time in the total duration of the multinode exports. The multithreading can lead to non-threadsafe .NET collections being used in defective code, resulting in runtime exceptions and program abort. |
| SPEC 59078  Rev: 1  **✓** | SWCMP.SOUP.DicomLibrary.EventSequencing.Concurrency  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:35 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Dicom Library shall support concurrent DICOM object access.  Background:  N/A |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58364  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:38 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not contain application logic to handle fault conditions. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58375  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  Because the DICOM Library framework is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58395  Rev: 1  **✓** | SWCMP.SOUP.DicomLibrary.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:39 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

###### Output

|  |  |
| --- | --- |
| FOLDER 58482  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:41 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  A failure in receiving or transmitting DICOM data (acting in DICOM SCU and SCP roles) can result in an invalid value being output to subsequent processing. Such an invalid value can lead to corrupt data being used in the application.  **Sequence of Events:** MR scanner sends the DICOM images to P6. If the DICOM library does not convert and handle the data correctly, the image data can become corrupt and Algorithm results based on the data will be corrupt. |
| SPEC 58376  Rev: 1  **✓** | SWCMP.SOUP.DicomLibrary.Functional.Output  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:41 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The Dicom Library shall output received data without errors in transmission.  Background:  N/A |

##### Installation Requirements

|  |  |
| --- | --- |
| FOLDER 58366  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:43 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The library is directly copied during deployment without extra installation steps. The licenses do not have extra conditions. |

###### License

|  |  |
| --- | --- |
| FOLDER 59367  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:46:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. The component is the property of Philips. However, the component uses Intel IPP, which requires a license to be displayed.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58367  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.  The component is precompiled with a fixed API. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58368  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and memory management is handled by .NET framework. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58369  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:46 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The performance requirements are part of the system performance testing, where DicomLibrary consumes a part of the total time budget. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58370  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:47 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The resource requirements of the components are part of the total system resource requirements. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58371  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The DICOM connectivity is to be used inside the hospital network only. |

##### Security Requirements v2

|  |  |
| --- | --- |
| FOLDER 59602  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:50 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Unsecure data transfer can lead to confidential patient data loss or corruption.  **Sequence of Events:** Dicom data sent over unsecure connection is sniffed or modified by an unauthorized person. |

###### Data Encryption

|  |  |
| --- | --- |
| SPEC 59603  Rev: 1  **✓** | SWCMP.SOUP.DicomLibrary.DataEncryption  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Taiminen, Toni (320026757) on 2018-12-07 12:10:04 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  DicomLibrary shall supportdata encryption using TLS.    Background:  N/A |

###### NodeAuthentication

|  |  |
| --- | --- |
| SPEC 59604  Rev: 1  **✓** | SWCMP.SOUP.DicomLibrary.NodeAuthentication  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Taiminen, Toni (320026757) on 2018-12-07 12:10:47 Meaning: SME Approved - (Technical)  Approval Status: [Approved]   DicomLibrary shall support node authentication using TLS certificates.  Background:  N/A |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58372  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:49 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58373  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:50 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58374  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-08-29 13:31:51 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and variable initialization cannot be configured. |

### SWCMP.SOUP.DotNet

#### Description

|  |  |
| --- | --- |
| FOLDER 58303  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:58 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  .Net Framework is a software framework from Microsoft. It provides a class library and an application virtual machine with security, memory management, and exception handling services. The framework is provided as a redistributable installation package.  The framework is used by P6 software as a SOUP component that provides a runtime environment for executing the P6 application logic in an application virtual machine. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58308  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:59 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  .Net redistributable is a precompiled binary component and does not contain designs for P6. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58318  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:55 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58316  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:54 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are inherently safe in .NET managed code. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58310  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58321  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:51 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58309  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:50 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without event sequence requirements. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58312  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:48 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not contain application logic to handle fault conditions. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58481  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the .Net framework is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58377  Rev: 1  **✓** | SWCMP.SOUP.DotNet.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

###### Version Check

|  |  |
| --- | --- |
| FOLDER 59181  Rev: 1  **✓** | Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:49:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Because the P6 code is verified with a particular .Net framework runtime, an attempt to run the code on arbitrary version of the runtime can lead to unexpected results and hence corrupt the image or algorithm DICOM output data. Therefore there needs to be means to detect the MR software version to ensure that we are running a verified combination of P6 and MR software, that is, a verified combination of P6 and .Net framework runtime, before allowing the application data to be used. Version compatibility matrix checks handle this concern. |

##### Installation Requirements

|  |  |
| --- | --- |
| FOLDER 58322  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-15 07:45:56 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The installation failure of .NET framework will prevent execution of interpreted .NET code (unrelated execution environments), which is inherently safe. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58317  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:42 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.  The component is precompiled with a fixed API. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58315  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The framework implements its own memory management, with an inherently safe segregation for the interpreted code. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58325  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-15 07:47:32 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The performance requirements are part of the system performance testing, where the component consumes a part of the total time budget. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58311  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-15 07:46:24 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The resource requirements of the components are part of the total system resource requirements. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58319  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:39 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The framework is not connected to the network. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58314  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:38 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58320  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:08:37 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58313  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:49:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  .Net manages the memory and removes most of the memory corruption issues with the inherent design. The remaining logic errors are captured with static code analysis integrated into the build process. |

### SWCMP.SOUP.ITK

#### Description

|  |  |
| --- | --- |
| FOLDER 58608  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:30 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:26 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:44:52 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  ITK is a image analysis source library for the C++ programming language. It is used in implementation of the algorithm component, to extract the body mask with morphological filters. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58609  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:31 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:28 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:44:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  ITK is an auxiliary library component and does not contain designs for therapy applications. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58611  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:34 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are considered in the implementation code, not in this auxiliary component. |

##### Boundary Condition Requirements

###### Filtering

|  |  |
| --- | --- |
| FOLDER 58633  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:35 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:30 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:44:56 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** even though the ITK is a widely used library, it's less often used filtering functions may contains defects with unexpected input values. Such input values can break the filtering functionality and result in corrupt data being used in the application.  **Sequence of Events:** When the body outline is calculated in the Algorithm, a failed filter function may lead to invalid body outline being generated. |
| SPEC 58634  Rev: 1  **✓** | SWCMP.SOUP.ITK.BoundaryConditions.Filtering  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:34 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:29 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:44:55 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The ITK-provided image filters used in body outline extraction shall be tested with invalid setup values to ensure that invalid values result in a detectable failure.  Background:  N/A |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58613  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:34 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data and control flow  are considered in the implementation code, not in this auxiliary component. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58614  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:35 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data definition is considered in the implementation code, not in this auxiliary component. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58615  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:36 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Event sequence failure cases are considered in the implementation code, not in this auxiliary component. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58616  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:36 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The fault conditions are considered in the implementation code, not in this auxiliary component. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58618  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:44 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:37 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:45:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the ITK is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58619  Rev: 1  **✓** | SWCMP.SOUP.ITK.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:43 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:36 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:45:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

##### Installation Requirements

###### License

|  |  |
| --- | --- |
| FOLDER 58621  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:48 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:39 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:45:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. However, the license requires that the library is an accompanied with its license file.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58623  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:50 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:41 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:45:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not contain interfaces to other software items. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58624  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:37 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and memory management is considered in the implementation code. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58625  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:38 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The performance is considered in the implementation code, not in this auxiliary component. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58626  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:39 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The resource allocation is considered in the implementation code, not in this auxiliary component. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58627  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 11:57:39 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Security is considered in the implementation code, not in this auxiliary component. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58628  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:57 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:46 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:45:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58629  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:58 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:47 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:45:15 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58630  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:03:59 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:24:48 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:45:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and variable initialization cannot be configured. |

### SWCMP.SOUP.Newtonsoft.json

#### Description

|  |  |
| --- | --- |
| FOLDER 59767  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:50 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Newtonsoft.json is a .NET implemenation of a JSON file format handler. It is used as a JSON parser in P6. |

#### Design

|  |  |
| --- | --- |
| FOLDER 59768  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:51 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Newtonsoft.json  is a precompiled binary component and does not contain designs for P6. It exposes a Microsoft .NET application programming interface to implement JSON parsing. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 59770  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:52 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 59771  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are considered in the implementation code, not in this auxiliary component. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 59772  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:54 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 59773  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:55 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 59774  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:56 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Event sequence failure cases are considered in the implementation code, not in this auxiliary component. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 59775  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:43:57 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The fault conditions are considered in the implementation code, not in this auxiliary component. |

##### Functional and Capability Requirements

###### Output

|  |  |
| --- | --- |
| SPEC 59806  Rev: 1  **✓** | SWCMP.SOUP.Newtonsoftjson.Functional.Output  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:26 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The Newtonsoft.json library shall parse JSON data correctly in the P6 application domain.  Background: |

###### Capability

|  |  |
| --- | --- |
| SPEC 59805  Rev: 1  **✓** | SWCMP.SOUP.Newtonsoftjson.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:27 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background: |

##### Installation Requirements

###### License

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 59778  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:01 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not contain interfaces to other software items. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 59779  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and memory management is handled by .NET framework. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 59780  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The performance is considered in the implementation code, not in this auxiliary component. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 59781  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:03 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The resource allocation is considered in the implementation code, not in this auxiliary component. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 59782  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The framework is not connected to the network, and is used to parse only input internally generated by P6. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 59783  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 59784  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 59785  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and variable initialization cannot be configured. |

### SWCMP.SOUP.NetMQ

#### Description

|  |  |
| --- | --- |
| FOLDER 58397  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  NetMQ is a pure .Net implementation of ZeroMQ messaging library. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58398  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  NetMQ is a precompiled binary component and does not contain designs for P6. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58400  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58401  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are inherently safe in .NET managed code. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58402  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:11 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58403  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58404  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-15 07:52:40 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without event sequence requirements. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58405  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-10 14:28:49 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The component fault conditions are handled with design: the Infra subsystem provides wrapper classes to limit the communication to known patterns. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58407  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:15 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the NetMQ is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58409  Rev: 1  **✓** | SWCMP.SOUP.NetMQ.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:03:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

###### Output

|  |  |
| --- | --- |
| FOLDER 58421  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** A failure in transmitting ZeroMQ message data can result in an invalid value being output to subsequent processing. Such an invalid value can lead to corrupt data being used in the application.  **Sequence of Events:** When P6 software communicates with MR, it uses ZeroMQ messages. NetMQ is responsible for message communication. A failure to transmit a message can lead to invalid data being sent to/from MR scanner. |
| SPEC 58408  Rev: 1  **✓** | SWCMP.SOUP.NetMQ.Functional.Output  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Vuorinen, Reko (fir00325) on 2017-03-08 14:44:51 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  The NetMQ Library shall output received data without errors in transmission.  Background:  N/A |

##### Installation Requirements

###### License

|  |  |
| --- | --- |
| FOLDER 58483  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:14:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. However, the GNU LESSER GENERAL PUBLIC LICENSE Version 3, 29 June 2007 requires that both source code and the license needs to be installed with the product.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |

###### License Display

|  |  |
| --- | --- |
| FOLDER 59374  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:03:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. However, the license needs to be installed with the product and that attribution notice about the tool needs to be displayed in the about-box.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58412  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:26 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.  The component is compiled with a fixed API. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58413  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:28 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and memory management is handled by .NET framework. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58414  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:29 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The performance requirements are part of the system performance testing, where ZeroMQ-communication consumes a part of the total time budget. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58415  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:35 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The resource requirements of the components are part of the total system resource requirements. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58416  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:32 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The ZeroMQ connectivity is used inside the console loopback network only. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58417  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:31 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58418  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:33 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58419  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-14 18:16:34 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and variable initialization cannot be configured. |

### SWCMP.SOUP.Protobuf

#### Description

|  |  |
| --- | --- |
| FOLDER 58636  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:38 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:43 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:38 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Protobuf is a C++ implementation of Google protobuf protocol. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58637  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:39 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:44 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:39 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Protobuf is an auxiliary library component and does not contain designs for therapy applications. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58639  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:52 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are considered in the implementation code, not in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58640  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are considered in the implementation code, not in this auxiliary component. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58641  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:54 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data and control flow  are considered in the implementation code, not in this auxiliary component. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58642  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:55 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data definition is considered in the implementation code, not in this auxiliary component. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58643  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:55 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Event sequence failure cases are considered in the implementation code, not in this auxiliary component. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58644  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:56 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The fault conditions are considered in the implementation code, not in this auxiliary component. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58646  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:47 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:51 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:46 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the Protobuf is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58647  Rev: 1  **✓** | SWCMP.SOUP.Protobuf.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:46 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:50 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

###### Output

|  |  |
| --- | --- |
| FOLDER 58648  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:49 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:53 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:48 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** A failure in transmitting Protobuf data can result in an invalid value being output to subsequent processing. Such an invalid value can lead to corrupt data being used in the application.  **Sequence of Events:** When P6 software communicates with the Algorithm component, it uses protobuf messages. Protobuf C++ library is responsible for protobuf message handling. A failure to transmit a message can lead to invalid data being sent to/from algorithm. |
| SPEC 58649  Rev: 1  **✓** | SWCMP.SOUP.Protobuf.Functional.Output  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:48 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:52 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:47 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The Protobuf library shall serialize and deserialize data without errors in transmission.  Background:  N/A |

##### Installation Requirements

###### License

|  |  |
| --- | --- |
| FOLDER 58651  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:53 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:55 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:51 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. However, the license requires that the library is an accompanied with its license file.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58653  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:55 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:57 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not contain interfaces to other software items. |

##### Memory Management and Overflow Requirements

###### LargeMessages

|  |  |
| --- | --- |
| FOLDER 58661  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:57 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:59 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:55 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** An attempt to receive a too large message with protobuf should fail - Invalid message can otherwise result in corrupt data being used by the application.  **Sequence of Events:** If Algorithm receives too large a message that does not comply with protobuf protocol specifications, the receiving end may fail to decode the message or tries to interpret the message incorrectly. The corrupt data can then enter the application. |
| SPEC 58662  Rev: 1  **✓** | SWCMP.SOUP.Protobuf.MemoryAndOverflow.LargeMessages  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:06:56 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:28:58 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:54 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  It shall not be possible to receive messages larger than 67108864 bytes.  Background:  N/A |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58655  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:57 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The performance is considered in the implementation code, not in this auxiliary component. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58656  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:58 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The resource allocation is considered in the implementation code, not in this auxiliary component. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58657  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:04:58 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Security is considered in the implementation code, not in this auxiliary component. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58658  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:02 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:29:03 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:51:59 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58659  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:03 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:29:04 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:52:00 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58660  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:04 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 11:29:05 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 10:52:01 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and variable initialization cannot be configured. |

### SWCMP.SOUP.ProtobufNet

#### Description

|  |  |
| --- | --- |
| FOLDER 58486  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:02 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Protobuf.Net is a pure .Net implementation of Google protobuf protocol. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58487  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:04 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  ProtobufNet is an auxiliary library component and does not contain designs for P6. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58489  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:05 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58490  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:06 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are inherently safe in .NET managed code. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58491  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58492  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58493  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without event sequence requirements. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58494  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:11 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not contain application logic to handle fault conditions. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58496  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:15 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the Protobuf.Net is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58497  Rev: 1  **✓** | SWCMP.SOUP.ProtobufNet.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:15:27 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

###### Output

|  |  |
| --- | --- |
| FOLDER 58498  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:17 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** A failure in transmitting Protobuf.Net data can result in an invalid value being output to subsequent processing. Such an invalid value can lead to corrupt data being used in the application.  **Sequence of Events:** When P6 software communicates with the Algorithm component, it uses protobuf messages. Protobuf.Net library is responsible for protobuf message handling. A failure to transmit a message can lead to invalid data being sent to/from algorithm. |
| SPEC 58499  Rev: 1  **✓** | SWCMP.SOUP.ProtobufNet.Functional.Output  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:19 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The Protobuf.Net library shall output received data without errors in transmission.  Background:  N/A |

##### Installation Requirements

###### License

|  |  |
| --- | --- |
| FOLDER 58501  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:24 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:**  The component does not have installation logic and is copied as-is. However, the Apache License, Version 2.0 requires that the license needs to be installed with the product and that attribution notice about the tool is displayed in the about-box.  **Sequence of Events:** Not applicable, the risk analysis relates to a product risk, not to a hazardous situtation. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58503  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:26 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.  The component is compiled with a fixed API. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58504  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:28 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, in binary format, and memory management is handled by .NET framework. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58505  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:15:28 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The performance requirements are part of the system performance testing, where ZeroMQ-communication consumes a part of the total time budget. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58506  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:30 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The resource requirements of the components are part of the total system resource requirements. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58507  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:33 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The protobuf messaging is used inside the console loopback network only. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58508  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:35 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58509  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:37 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58510  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:37:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and variable initialization cannot be configured. |

### SWCMP.SOUP.PythonBundle

#### Design

|  |  |
| --- | --- |
| FOLDER 59741  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Chamorro-Fulla, Marta (320059717) on 2019-09-26 10:09:31 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  PythonBundle is a collection of auxiliary library components and does not contain designs for therapy applications. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 59743  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 59744  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:09 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are considered in the implementation code, not in this auxiliary component. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 59745  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is a collection of auxiliary libraries with a fixed APIs and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 59746  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data. |

##### Event Sequencing Requirements

###### Concurrency

|  |  |
| --- | --- |
| SPEC 59800  Rev: 1  **✓** | SWCMP.SOUP.PythonBundle.EventSequencing.Concurrency.Logging  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:43 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Python Bundle shall provide concurrent logging for Python code using this component.  Background: |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 59748  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The fault conditions are considered in the implementation code, not in this auxiliary component. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| SPEC 59808  Rev: 1  **✓** | SWCMP.SOUP.PythonBundle.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  The anomaly list analysis shall be arranged under each top level library and key dependent library.  Background: |

###### Functional

|  |  |
| --- | --- |
| SPEC 59811  Rev: 1  **✓** | SWCMP.SOUP.PythonBundle.Functional.REST  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:47 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The component shall provide the functionalityfor P6 REST server needs.  Background: |
| SPEC 59812  Rev: 1  **✓** | SWCMP.SOUP.PythonBundle.Functional.DeepLearning  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:47 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The component shall provide the functionalityfor P6 Deep Learning algorithm needs.  Background: |

##### Installation Requirements

###### License

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 59751  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not contain interfaces to other software items. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 59752  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:17 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable:   * Parts of the auxiliary component that are distributed in source code form are is implemented with Python, which provides garbage collection and overflow exceptions. * Parts of the auxiliary component that are distributed in binary form (CUDA and cuDNN) are provided as-is, and handle their own memory management. |

##### Performance Requirements

|  |  |
| --- | --- |
| SPEC 59810  Rev: 1  **✓** | SWCMP.SOUP.PythonBundle.Performance.DeepLearning  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 12:35:53 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The component shall provide the needed performace for P6 Deep Learning algorithm needs.  Background: |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 59754  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The resource allocation is considered in the implementation code, not in this auxiliary component. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 59755  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:19 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The parts of this component that are used in network connectivity is used inside the console loopback network only. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 59756  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:19 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 59757  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:20 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 59758  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Jakonen, Markus (310307712) on 2019-06-03 13:44:20 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and variable initialization cannot be configured. |

### SWCMP.SOUP.RuntimeLibraries

#### Description

|  |  |
| --- | --- |
| FOLDER 58806  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:08 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:51:29 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 11:02:23 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The operating system and runtime libraries provide an execution environment for higher level programming languages. In addition to common utilities, they abstract the underlying hardware platform to a set of generic application programming interfaces. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58807  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:09 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:51:31 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 11:02:23 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The runtime libraries are auxiliary components and do not contain designs for the application. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58809  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:19 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Alarms, warnings, and operator messages are considered in the implementation code, not in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58810  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:20 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Boundary condition violations are considered in the implementation code, not in this auxiliary component. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58811  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:20 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data and control flow  are considered in the implementation code, not in this auxiliary component. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58812  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:21 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Data definition is considered in the implementation code, not in this auxiliary component. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58813  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:22 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Event sequence failure cases are considered in the implementation code, not in this auxiliary component. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58814  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:22 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The fault conditions are considered in the implementation code, not in this auxiliary component. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58816  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:17 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:51:41 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 11:02:29 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the libraries form a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58817  Rev: 1  **✓** | SWCMP.SOUP.RuntimeLibraries.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:16 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:51:40 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 11:02:29 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

###### Environment

|  |  |
| --- | --- |
| FOLDER 58831  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:19 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:51:44 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 11:02:31 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** The combined execution environment formed by the operating system and runtime libraries use low-level application programming interfaces (APIs) with increased likelihood of incorrect API or memory handling usage. This can lead to corrupt data being used by the application.  **Sequence of Events:** When a low-level API call is made, the application can provide an incorrectly sized parameters, which are then overwritten by the call. When the parameters or the memory area near the parameters are used, the data will be corrupt. |
| SPEC 58832  Rev: 1  **✓** | SWCMP.SOUP.RuntimeLibraries.Functional.Environment  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-10 14:07:18 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Joki, Kalle (fir00372) on 2016-02-10 13:51:42 Meaning: SME Approved - (Business)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-10 11:02:30 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The native parts of the application shall be successfully executed with runtime library dynamic code analysis functionality enabled.  Background:  N/A |

##### Installation Requirements

|  |  |
| --- | --- |
| FOLDER 58820  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-11 11:50:33 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-11 11:06:11 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The installation of the operating system and runtime libraries is implicitly correct as the application cannot execute unless correct runtime versions and operating system are available on the hosting computer. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58823  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-11 11:50:34 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-11 11:06:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not contain interfaces to other software items. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58824  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:23 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and memory management is considered in the implementation code. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58825  Rev: 4  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Leminen, Jarkko (310108715) on 2017-03-10 12:19:26 Meaning: SME Approved - (Technical)  Approval Status: [Approved]  Not applicable. The performance is considered in the implementation code, not in this auxiliary component. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58826  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:25 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The resource allocation is considered in the implementation code, not in this auxiliary component. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58827  Rev: 3  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:36:25 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. Security is considered in the implementation code, not in this auxiliary component. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58828  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-11 11:50:39 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-11 11:06:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58829  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-11 11:50:40 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-11 11:06:17 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality that is used in the product. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58830  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-02-11 11:50:41 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Hulkkonen, Emma (310201279) on 2016-02-11 11:06:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and variable initialization cannot be configured. |

### SWCMP.SOUP.WiX

#### Description

|  |  |
| --- | --- |
| FOLDER 58523  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:01 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  WiX is a Windows installer implementation. |

#### Design

|  |  |
| --- | --- |
| FOLDER 58524  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:18 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  WiX is an auxiliary library component and does not contain designs for P6. |

#### Requirements

##### Alarms and Notifications Requirements

|  |  |
| --- | --- |
| FOLDER 58526  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:08 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable.Alarms, warnings, and operator messages are not displayed in this auxiliary component. |

##### Boundary Condition Requirements

|  |  |
| --- | --- |
| FOLDER 58527  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:10 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is used during installation only. |

##### Data and Control Flow Requirements

|  |  |
| --- | --- |
| FOLDER 58528  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:12 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without flow requirements. |

##### Data Definition Requirements

|  |  |
| --- | --- |
| FOLDER 58529  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:14 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not define application data and the installation integrity is tested at runtime. |

##### Event Sequencing Requirements

|  |  |
| --- | --- |
| FOLDER 58530  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:16 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is an auxiliary library with a fixed API and without event sequence requirements. |

##### Fault Condition Handling Requirements

|  |  |
| --- | --- |
| FOLDER 58531  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:41:17 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component does not contain application logic to handle fault conditions. |

##### Functional and Capability Requirements

###### Capability

|  |  |
| --- | --- |
| FOLDER 58533  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:43:35 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  **Risk Analysis:** Because the WiX is a SOUP component, the published anomaly lists need to be evaluated to see if the known or discovered anomalies in the component affect the capabilities of the component.  **Sequence of Events:** Not applicable - the sequence of events depends on the discovered anomalies. |
| SPEC 58534  Rev: 1  **✓** | SWCMP.SOUP.WiX.Functional.Capability  Model: [Any] FS: [Any] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  The functional capabilities of the component shall be ascertained by evaluating the anomaly lists published for the component.  Background:  N/A |

##### Installation Requirements

|  |  |
| --- | --- |
| FOLDER 58537  Rev: 2  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The WIX component is not installed on the target environment.. |

##### Interfaces Requirements

|  |  |
| --- | --- |
| FOLDER 58540  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Hakkinen, Marko (fir00360) on 2016-09-16 06:43:40 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not contain interfaces to other software items. |

##### Memory Management and Overflow Requirements

|  |  |
| --- | --- |
| FOLDER 58541  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:41 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and memory is used only during the installation. |

##### Performance Requirements

|  |  |
| --- | --- |
| FOLDER 58542  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:42 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is used only during the installation. |

##### Resource Allocation Requirements

|  |  |
| --- | --- |
| FOLDER 58543  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:42 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The component is used only during the installation. |

##### Security Requirements

|  |  |
| --- | --- |
| FOLDER 58544  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:43 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The installed files have an integrity check at runtime to detect malicious modifications. |

##### Self-Diagnostics Requirements

|  |  |
| --- | --- |
| FOLDER 58545  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component does not implement features that could be diagnosed. |

##### Usability Requirements

|  |  |
| --- | --- |
| FOLDER 58546  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:44 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. This auxiliary component does not expose user interface functionality. |

##### Variable Initialization Requirements

|  |  |
| --- | --- |
| FOLDER 58547  Rev: 1  **✓** | Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: Ryhanen, Pasi (fir00497) on 2017-03-09 12:37:45 Meaning: SME Approved - (Technical)::Bulk Transitions  Approval Status: [Approved]  Not applicable. The auxiliary component is provided as-is, and variable initialization cannot be configured. |

## Safety Specifications

Not Applicable

## Non-Functional Specifications

Not Applicable

## Compliance Specification

Not Applicable

# Component Traceability

|  |  |
| --- | --- |
| INFO 60552  Rev: 1  **✓** | Component Traceability\_RTgo5.13  Model: [] FS: [] GS: [] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:32 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 12:29:33 Meaning: SME Approved - (Business) Signed by: Kumar, Prasanna (310218471) on 2025-05-23 11:48:58 Meaning: SME Approved - (Technical)  Approval Status: [Approved] |

**Attachment:**

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# Document History

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| INFO 60535  Rev: 1  **✓** | Document History RTgo 5.13  Model: [Ingenia, Ingenia Ambition, Ingenia Elition, Ingenia S] FS: [T15, T30] GS: [All] Options: [] Quality Attributes: [] Type of Test: []  Signatures: Signed by: C, Arun (320177396) on 2025-05-23 14:51:30 Meaning: QA Approved - (QA)::Bulk Transitions Signed by: Jayapalan, Manivannan (320055918) on 2025-05-23 12:28:57 Meaning: SME Approved - (Business) Signed by: Kumar, Prasanna (310218471) on 2025-05-23 11:49:29 Meaning: SME Approved - (Technical)  Approval Status: [Approved]   |  |  |  |  | | --- | --- | --- | --- | | **Revision** | **Date** | **Author** | **Description** | | A | 23-May-2025 | Ashish Kumar P K | Initial version for RTgo5.13, for Voxel. Created based on RTgo5.12 Component Specification: RTgo(D001191761), with new requirements for Pelvis Autocontouring(60520, 60523, 60542, 60525, 60524, 60550, 60519, 60521, 60522). | |

