Re-use in Workstation Products

By

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EasyVision family of products

Examination rooms

R/F  Vascular

print  store

phase 1: 1992

Export

Examination rooms

MR  CT

MPR  MPR  print  store

phase 2: 1994

Export

Print

View

Clinical focus

Phase 3: 1995

Research

Archive
Product types:

- Modality productivity enhancers:
  + Easyvision R/F
  + Easyvision RAD
  + Easyvision CT/MR
  
  street price ca 50 k$, high added clinical value; sales directly related to modality sales

- Clinical Focus:
  + Neurovision
  + Image Guided Surgery
  
  street price ca 100 k$, very high added clinical value; sales limited to specialist areas

- “PACS” workstations
  + Teleradiology Workstation
  + Critical Care Workstation
  + Multi modality review station
  
  street price ca 25 k$, low added value, low margin; sales potentially very high
september 1991
September 1992

R/F application

<table>
<thead>
<tr>
<th>Print</th>
<th>Store</th>
<th>View</th>
<th>Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>spool</td>
<td>HCU</td>
<td>store</td>
<td>image</td>
</tr>
<tr>
<td>gfx</td>
<td>UI</td>
<td>DB</td>
<td>PMS net in</td>
</tr>
<tr>
<td>DOR</td>
<td>NIX</td>
<td>SunOS</td>
<td></td>
</tr>
<tr>
<td>RC</td>
<td>HC</td>
<td></td>
<td>PMS net out</td>
</tr>
<tr>
<td>driver</td>
<td>driver</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RC interf | HC interf | DOR | Standard IPX workstation |

Desk, cabinet, cables, etc.

Dev. tools

Service mode

SW keys

Config

Install

Start up

RC

3M

DSI
## june 1994

<table>
<thead>
<tr>
<th>EasyVision CT/MR</th>
<th>EasyVision R/F</th>
<th>EV RAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>specialized appl. (dental, etc.)</td>
<td>specialized appl.</td>
<td></td>
</tr>
<tr>
<td>MR</td>
<td>CT</td>
<td>RF</td>
</tr>
<tr>
<td>Compose</td>
<td>Print</td>
<td>Store</td>
</tr>
<tr>
<td>spool</td>
<td>HCU</td>
<td>store</td>
</tr>
</tbody>
</table>

### CDSSpack

- RC dial
driver
- HC
driver
- DOR
driver
- NIX
- Solaris

### Hardware

- RC
dials
- 3M
- new
HCU
- Desk, cabinet, cables, etc.
- MR | CT | DSI | DCAS | PCR

### Software

- SW
dials
- config
- install
- remote
access
- customization
- service
mode
- SW
keys
- PMS net in
- PMS net out
june 1994
### 1995/1996

<table>
<thead>
<tr>
<th>Back-ends</th>
<th>IGS</th>
<th>EV mmrs</th>
<th>EV RAD</th>
<th>EV ct/mr</th>
<th>EV R/F</th>
</tr>
</thead>
<tbody>
<tr>
<td>specialized appl. (dental, bolus chase, cardiac, etc.)</td>
<td>interfacing RIS, etc.</td>
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<tr>
<td>dev. tools</td>
<td>MR</td>
<td>CT</td>
<td>RF</td>
<td>Vascular</td>
<td>Cardio</td>
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<tr>
<td>remote access customization</td>
<td>Compose</td>
<td>Print</td>
<td>Store</td>
<td>MPR</td>
<td>View</td>
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<tr>
<td>service mode</td>
<td>spool</td>
<td>HCU</td>
<td>store</td>
<td>image</td>
<td>gfx</td>
</tr>
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<td>SW keys</td>
<td>PMS net in</td>
<td>PMS net out</td>
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<tr>
<td>config</td>
<td>CDSpack</td>
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</tr>
<tr>
<td>install</td>
<td>RC driver</td>
<td>HC driver</td>
<td>DOR driver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start up</td>
<td>NIX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC dials interf</td>
<td>Solaris</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOR</td>
<td>HP-UX?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RC dials</td>
<td>Standard SS5or SS6 workstation or HP 712++</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>new HCU</td>
<td>Desk, cabinet, cables, etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd monitor video in video out accelerator dig. film</td>
<td>MR</td>
<td>CT</td>
<td>DSI</td>
<td>DCAS</td>
<td>PCR</td>
</tr>
</tbody>
</table>
Process structure

- UI process
- DB
- Import
- Export
- Optical store
- Print
- Compute

Job queueing and status persistent via database
How to extend

New modality:

- Data model (storage and access structure)
- Import mapping and conversion
- Configuration definitions
- presentation:
  - data base
  - image selection
  - image annotation (monitor & film)
  - info/text page

New clinical application:

- facility (User Interface)
- protocol print
How to extend, other vendors

New modality vendor (via DICOM):

• Customization data element semantics
• Validation

New “PACS” vendor (via DICOM):

• Customization data element semantics
• Customization export:
  + matrix size
  + nr of bits
  + processing
  + graphics representation
• Validation
**Distributed applications**

USER

DSI

Client

images

Bolus chase request

Print or export by ref.

overview image(s)

Easyvision R/F

Server

processed images to PACS

film sheets

Philips Medical Systems

Common Digital Systems, Gerrit Muller
Distributed applications

USER

Easyvision Rnn.m

digitized audio

Speech recognition

MS word file

electronic report

RIS/HIS
Distributed MR&CDS applications

USER

MR scanner based f.i. on IAP

Client

images

Fancy function request

Print or export by ref.

overview image(s)

Easyvision CT/MR

Server

processed images to PACS

film sheets

PMSnet on DICOM
PMSnet, DICOM

PMSnet, DICOM =

network + protocol + data dictionary + services + model

Services are:

• world wide standardized (store, query, etc.) multi-vendor

• PMS standardized (print, file, export) multi-modality

• Bi lateral agreed (CT: print via port number and fixed data elements)

• Unilateral supported (for instance: Muller! -> print)
Services in PMSnet/DICOM

Uni- and Bi-lateral services:

• simple
• fulfill many demands
• low implementation effort
• low functionality

Standardized services:

• allow for full model:
  - Film low
  - Print Job Muller finished
  - Feedback on film output

• client side needs more code to benefit from full model.
PMSnet on DICOM =

DICOM +

PMS services +

detailed data dictionary +

detailed model
Status CDS:

- Transition from sequential development to parallel development
- Technology Improvement Plan: start phase 2

Interfacing, further manageability

- Software Process Improvement:
  - Strive for improved manageability, maintain innovation rate
    (requirement management, planning, etc.)
  - SW development environment
    (DDTS, Clearcase?)
  - Quantification (Metrics)
    (QAC?, project TU Delft)
  - Documentation
Major phases

• Phase 1 (modularization):
  + Cleanup most obvious modules
  + First division in separate packages
  + Equalization of internal data model and PMS
    Data Dictionary
  + PMSnet, PMSdor, complete new
  + analysis (modularity, notifications, properties)

• Phase 2 (Interfacing):
  + Further modularity restructuring
  + Prototyping interface
  + Advanced development interface
  + Prepare external interface
  + Explore real time extensions (e.g. Threads)
Major phases 2

- Phase 3 (Internal benefit, standardization)
  + Explore C++
  + Explore X
  + Implement 1D viewing
  + Use external interface

- Phase 4 (external benefit)
  + Decide on C++, X use
  + Use platform by non CDS clients
Status june 1994

• Modularity
  + CDS pack independent of rest SW
  + SW archive divided in “groups”, dependencies are analyzed and reduced

• Property management
  + file structure streamlined

• SPI support library
  + Implementation finished
  + Increased performance and functionality
  + Much less code
  + Configuration simpler

• PMSdor, PMSnet redesigned

• Solaris 2

• HP: viewing ported, plan for product porting
• Cardio graphics:
  + additional functionality
  + “cold” graphics removed

• Data representation:
  + XDR based self describing object format

• Data base:
  + improved performance
  + support for spooled services

• Process structure:
  + import and export servers-> network server
  + spoolers and UNIX command server removed

• Memory usage:
  + ASW: 20% reduction (UNIX 20% increase)

• Documentation:
  + System level OK