Why workstation product group?

- Integration of functionality in hospital
  + Multi modality
  + Multi vendor
  + Multi application
  + Distributed application

- Balance of functionality inside and outside examination room

- Distributed applications, networking:
  + scalability
  + graceful degradation
  + customization
Product = tuned platform + specific SW

- Platform consolidation of application knowledge
- Re-use in look-alike products
- Exploitation of technological and organizational experience
What is the platform?

- All SW and HW shared by multiple products
- Managed centrally by CDS
- Own lifecycle
- Continuous change and expansion:
  - External changes (workstations, disks, optical media, framebuffers, keyboards, system software)
  - New functionality; Move from specific to re-useable
  - Internal rework (PR’s, CR’s)
Scope of the platform

- Functional:
  - Image and graphics
    processing, analysis, display, manipulation
  - Films and monitors
    device handling, layout and presentation
    management, image quality
  - Patient and image data
    storage, communication, data management
  - Distributed application
    client-server architecture, system clusters,
    PMSnet, customization
Scope of the platform 2

- **Support:**

  + **Hardware**
    
    workstation, optical media, hardcopy units incl interface, standard video in and out, remote control, desk, spinning wheels...

  + **System software**
    
    operating system, drivers, networking, system start up and shutdown

  + **Installation, configuration and service diagnostic SW**

  + **Elementary software support**
    
    collections, strings, symboltables, notifications, properties, error handling, etc.

  + **Libraries**
    
    user interface, screen management, printing, database, PMSdor and PMSnet formatting and protocols, graphics, image processing, etc.
How is the platform used?

- Property interface
  + configure common application
- API (Application Programmers Interface)
Lifecycle and archive structure.

- Intern CDS-Best: snapshots (feedback)
- non CDS products: releases (own lifecycle)
- Old interfaces: allow in principle for transition period of 1 year (after phase 3: introduction of external interface)
Schedule

• 5 manyear/year; 1phase per year

• half year focus on infrastructure

• half year focus on functional extensions

• risks:
  + cannibalization of resources
  + subcritical resources, inadequate quality
  + interference between product and tech. imp.
  + fast technological changes
  + fast applicational changes
  + lack of experience in large scale re-use
  + education/training
Analysis of CDS software october 92

Current advantages:

- Functionality Easyvision, new and complete
- Experience in:
  - complete product lifecycle
  - interoperability of modalities and cultures
  - resource use
  - installation and configuration
  - system engineering and integration
- Flexibility by means of notifications and properties
- Standard workstations and UNIX
- PMSnet, PMSdor
- Pixel manipulation library
- Powerful toolbox
- New technology (OO, networking)
Analysis of CDS software october 92

Requires improvement:

- Interface management (definition, scope)
- Property and notification management
- Data management, relation with data dictionary
- Programming tools and environment (Obj-C)
- Modularity, dependencies
- Geographical separation PMSnet, PMSdor, hardcopy driver development
- First generation tools (e.g. Grey level tool)
- Balancing resource usage
- “Real time” control of UNIX
- Process recovery
- Size of programming staff
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
Current status june ’93

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

• Property management
  + file structure streamlined

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

• PMSdor, PMSnet redesign and coding planned

• Solaris 2: masterplan

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

• Data model:
  + 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)
Learning curve
june 1991, R0.2:

- toolbox: viewing, user interface, database
- application: test vehicle, viewing only, no modality knowledge, hardcopy in preparation
- system: tuned OS

sept 1992, R1.0:

- toolbox: + spooler/server + hardcopy + DOR support
- application: R/F based view/print/store/link
- system: installation, configuration, start up, tuned OS, sw keys, service mode

may 1993, R1.2:

- application: + limited vascular + ACR/NEMA picture export
June 1994, Easyslice R1.1, Easyvision R2.1:

- toolbox: major cleanup, modularization, performance improvement

- application: MR and CT, Bolus chase, stenotic sizing in vascular (first application package), Cardiac extended communication, user interface tuned to application (facilities)

- system: Solaris 2, new HW, some cost price reductions

**Next learning directions:**


- application: PCR, digitized film, US(?), more application packages, interface to other hospital functions (RIS, IMAC, ...)

- system: dedicated products (print only, view only, etc), other HW platform(?)
september 1991

View, test vehicle only

image
gfx
UI
DB

SunOS, SunView

Standard Sun workstation
september 1992

R/F application

<table>
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<tr>
<th>Print</th>
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<th>View</th>
<th>Cluster</th>
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<td>PMS net out</td>
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SunOS

standard IPX workstation

Desk, cabinet, cables, ...

DSI

Dev. tools

Service mode

SW keys

Config

Install

Start up

RC

3M

R/F application

PMS

net

in

PMS

net

out

Print Store View Cluster

september 1992
### june 1994

<table>
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<tr>
<th>EasySlice</th>
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**CDSpack**

- RC dials
- HC driver
- DOR driver

Solaris

- Standard IPX or LX+ workstation
- Desk, cabinet, cables, ...

**Tools**

- dev. tools
- remote access
- customization
- service mode
- SW keys
- config
- install
- Start up

**3M**

**New HCU**

**MR**

**CT**

**DSI**

**DCAS**

**PCR**
june 1994

EasySlice | EasyVision | EV
specialized appl. (dental, ..) | specialized appl. |
MR | CT | RF | Vascular | Cardio | PCR
Compose | Print | Store | MPR | View | Export | Cluster
spool | HCU | store | image | gfx | UI | DB | PMS net in | PMS net out
CDSpack
RC driver | HC driver | DOR driver
Solaris
Service mode
SW keys
config
install
Start up
Desk, cabinet, cables, ...
3M
MR | CT | DSI | DCAS | PCR
new HCU
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new HCU
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<td>Standard LX+ or LX+++ workstation or HP 715++</td>
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Start up

MR CT DSI DCAS PCR

new HCU 3M

2nd monitor video in video out accelerator dig. film

dev. tools
remote access customization
service mode
SW keys
config
install