Server based computing as an infrastructure of hospital-wide paperless EPR and inter-hospitals system

H. Kodoh, S. Kuwata, K. Teramoto
Division of Medical Informatics,
Tottori University Hospital,
Tottori University Hospital (TUH)

- Founded in 1896
- Number of beds: 697
- Number of outpatients 1,209/day
- Number of Clinics 33
- Location: Yonago, Tottori
- Number of staff
  - Doctor 117,
  - Nurse 505,
  - Medical staff: 93,
  - Administrative staff: 107
  - Total: 822 (2007)
History of ERP in TUH

- Hospital Information System: DAISEN (nickname)
  - **Jan., 2003**- Introduction of the integrated hospital information system and PACS for CT, MRI and pathology
  - **Dec. 2003**- Starting the operation of Electronic Patient Record System
  - **Mar. 2007**- Introduction of Scanning system
    ⇒ Conformable to "Electronic Document Legislation" with electronic signature & electronic timestamp
    ⇒ Achievement of "Paperless Repository of Medical Records"

  - **Jan. 2008**- Renewal of HIS
    ⇒ Introducing **Server-Based Computing and Thin-Clients to overall systems**
    ⇒ Introducing Full PACS to achieve filmless (=film-free) repository of medical images and reports (**Matrix View**)
What's SBC?

- SBC means Server-Based Computing
- Technology that enables servers to handle multiple applications on multiple client PCs and their screen images as "virtual displays"
- Executing application programs on the middleware servers (=SBC servers) to transfer the screen image to its client PC
SBC : Server Based Computing

- Middleware : G0-Global
- 70 Blade server, (HP BL460c Dual Core Intel Xenon5160(3GH, 1333MHz FSB) Memory 6GB, HDD 32GBx2
- over 1,100 clients
Merit of SBC implementation

- Thin Client utilization
  - No user data on PC, because of HDD-free
  - Low risk of virus infection
- Integrated administration of applications on SBC servers
  - No application maintenance on client PCs
- Lessening administrative cost of client PCs
  - Reducing incidence rate of PC hardware problems
  - Utilization of inexpensive PCs (Celeron CPU with 512MB memory would suffice)
Design of Thin-Client PCs 1/3

• Thin Client

Mobile Note PC

Thin client PC

Desktop PC
Design of Thin-Client PCs

• Mobile PCs for nurses in ward

- Thin client on a wagon
- Thin client on the back of display
- Mini keyboard on top
- External Battery (supply power to PC and Display) providing 7 hrs consecutive supply
Design of Thin-Client PCs for diagnosis

- Image of SBC: 8 bit in depth - High-definition image: 10 bit in depth
- => PACS viewer application works on the client

DOM (Disk on Module) Graphic card for high-definition displays

Reuse PC as thin client

Thin client with Multiple Displays
Application of SBC in hospital environment

- Enhancing usability in shared PC use-case
  - Persisting user's screen in pause (session persistence) and resuming it
  - 'User Roaming' providing the same virtual display on different terminal PCs

- Ubiquity – application to 'liaison' of regional medical facilities
  - Secure use of intra-hospital applications from outside
  - No need to install a 'specialized software' to use SBC without SBC software
User Roaming
Newly developed function

• User roaming
  – Login operation by RFID card (non-contacting IC card)

1. Login with IC card
2. SBC desktop appears
3. Start application
4. Login another PC with IC card
5. The screen on the first PC comes to the PC display that the user logged in lately
Specification of Client PCs

• SBC-adaptive PCs • • • 1,100
  • Re-use desktop PCs  270
  • Desktop PCs with Flush ROM  200
  • Small Thin Client PCs  470
  • New desktop PCs  100
  • Unchanged PCs  60
  – Of those, PCs that SBC-incompatible software were installed • • • 60
    • Software incompatible with SBC
      – Departmental System: Laboratory, Diet & Nutrition, Rehabilitation Pharmacy
      – Image Diagnosis and Reporting System (Radiology Department)
  • Major reasons:
    – Vendors refused cooperation
    – image Diagnosis and Reporting System: Possible subtle difference of image viewing between local software and SBC
on SBC infrastructure

EPR & Order Entry System

PACS

• Radiology
  – CR, CT, MRI, Angiography, GI tract (DICOM)
  – Reports: text + key images (XML, PDF)
• Pathology image & reports (JPEG, PDF)
• Ultrasound image & report (DICOM, XML)
• Endoscopy image & report (DICOM, XML, PDF)
• ECG & report (JPEG, XML)
• Physiology function test (XML, PDF)
• Audiometer (TXT, JPEG, PNG)
• Scanning system (JPEG)
• EMR for ophthalmology dept., (XML, PDF)

Document Management system Yaghee

Department information system (ICU, Operation room, , , , )
Components of total integrated PACS

iDIR: integrated Document & Image Reference

Portal PACS (iDIR)
- Matrix View
- List View
- Multi View

Centricity Web
- Matrix View
- List View
- Multi View

Centricity PACS
- HIS/RIS-IF

Scanned Document Server (CDS)
- Worklist View
- E-signature
- Time stamp

Order Mgr/Placer

Image Creator

DICOM image

Non DICOM image/Reports/Scanned document

HIS

Matrix View (Portal PACS)

Order

DICOM image

Header+ images

URL

Oph. EMR

Term Sys.

Doc. P.
CT
Endoscopy report
Spirometer report of CDS
Oshidori-Net: Connecting regional EPR systems to achieve secure mutual reference with thin-client computing technology

- Tottori University Hospital
- Saihaku Municipal Hospital
- Tottori Information Highway (Closed High-Speed WAN)
- Firewall
- Terminal PC
- SBC Server
- Protected/Trusted network
- Electronic Patient Record (EPR) Servers
Image (TUH⇒SMH)

- Double click of icon on desktop
Portal site
List of Registered Patients

<table>
<thead>
<tr>
<th>No.</th>
<th>Surname</th>
<th>Given Name</th>
<th>Gender</th>
<th>Year Month Day</th>
<th>Oshima Hospital</th>
<th>Kita Hospital</th>
<th>Registered Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>男</td>
<td>昭和14</td>
<td></td>
<td></td>
<td>2009/07/10</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>女</td>
<td>大正18</td>
<td></td>
<td></td>
<td>2009/07/13</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和18</td>
<td></td>
<td></td>
<td>2009/07/22</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>女</td>
<td>大正20</td>
<td></td>
<td></td>
<td>2009/07/21</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>女</td>
<td>大正20</td>
<td></td>
<td></td>
<td>2009/07/17</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和22</td>
<td></td>
<td></td>
<td>2009/07/28</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和23</td>
<td></td>
<td></td>
<td>2009/07/29</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和24</td>
<td></td>
<td></td>
<td>2009/07/31</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和25</td>
<td></td>
<td></td>
<td>2009/08/02</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和26</td>
<td></td>
<td></td>
<td>2009/08/06</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>男</td>
<td>昭和27</td>
<td></td>
<td></td>
<td>2009/08/03</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>男</td>
<td>昭和28</td>
<td></td>
<td></td>
<td>2009/08/03</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和28</td>
<td></td>
<td></td>
<td>2009/08/10</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和29</td>
<td></td>
<td></td>
<td>2009/08/10</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和30</td>
<td></td>
<td></td>
<td>2009/08/12</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和31</td>
<td></td>
<td></td>
<td>2009/08/12</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td>女</td>
<td>昭和32</td>
<td></td>
<td></td>
<td>2009/08/18</td>
</tr>
</tbody>
</table>
おしどりネット・登録患者一覧

<table>
<thead>
<tr>
<th>No.</th>
<th>氏名</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HOPE/EGMAIN-FX

FUJITSU

THE POSSIBILITIES ARE INFINITE

システムを起動しています。しばらくお待ち下さい。
Access to SMH

EPR of SMH (Virtual Window on SBC)

EPR of TUH
Situation analysis on May 2010

- **Registered Patient**
  - 111

- **Registered User**
  - TUH 319
  - SMH 51

Introduced patients in 2008
- TUH⇒SMH 119
- SMH⇒TUH 114
Future Plan

• **To increase hospitals**
  – 30 center hopital
  – Referred by clinics
  – Need “Registry server” ---- IHE-ITI XDS
  ⇒ User management
    Patient management
    traceability
Tottori University Hospital

Firewall

Terminal PC

EPR Application

Medical worker

Protected/Trusted network

Electronic Patient Record (EPR) Servers

Tottori Information Highway (Closed High-Speed WAN)

SBC server

Registry Server

Saihaku Municipal Hospital

Firewall

Terminal PC

EPR Application

Medical worker

Protected/Trusted network

Electronic Patient Record (EPR) Servers

SBC server
Thank you for your attention!
Criteria of the selection of SBC software

- Criteria

<table>
<thead>
<tr>
<th>Items</th>
<th>GO-Global</th>
<th>Citrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>use of RFID (non-contact IC card)</td>
<td>OK</td>
<td>NG※</td>
</tr>
<tr>
<td>Multi-platform (Windows・MacOS)</td>
<td>OK</td>
<td>O</td>
</tr>
<tr>
<td>Number of client PC being able to handle</td>
<td>20+</td>
<td>20+</td>
</tr>
<tr>
<td>flexibility on customizing</td>
<td>OK</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

※Evaluated at the time of 2007

TUH has deployed GO-Global
医師のコメント

• 紹介した患者さんの治療経過が詳細にわかるのでとても良い。
• 画像診断などを参照するときもスピードが速く、画像も鮮明に見える。
• 転院してきた患者さんについて、診療情報提供書だけでは把握できない、これまでの医療従事者とのかかわり、コミュニケーションなど詳細な情報が把握できるので、治療にとても役立っている。
Informed consent

Doctor

Consent form

Patient

Informed consent

Health information manager

Storage (Scanning)

Office administrator

Facsimile

System administrator

Health information manager

Storage (Scanning)

Office administrator

System administrator

New registration

Require a consent form of the patient at one hospital

Grant permission to share the patient information with another hospital users (up to 3 years)
データ種別アクセス数（西伯⇒鳥）