HOSPITAL NETWORKS

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The development of Picture Archiving & Communication Systems (PACS) installations in Italy and of their integration with Radiological Information Systems (RIS) and Hospital Information Systems (HIS)
EARLY PACS INSTALLATIONS IN ITALY

- 1987: the development of PACSs in Italy initiated with some delay with respect to other countries in Europe
- In few years Italy became the country in Europe with the greatest number of commercial PACS systems
- 1988: the first system - an AT&T CommView PACS - was installed by Philips at the Local Health Unit of Trieste, in the Istituto di Radiologia of the University of Trieste.
Trieste: the first Italian PACS installation

- main system located in the Radiology Department of the University of Trieste at the Cattinara Hospital
- a second, slave system, installed at the Radiology Service of Maggiore Hospital.
- 1990: the two sub-systems inter-operated correctly by means of a protocol-dedicated 2 Mb/s leased line, by using a proprietary At&T communication protocol
the EC AIM project on PACS Evaluation

- 1989: the EC promoted the AIM Project «Operational Evaluation and Basic Requirements for Prospective Evaluation of PACS Technology»
  - main contractor: [PHILIPS]
  - Italian partners: Research Park of Trieste
                     University of Florence
                     University of L'Aquila
                     Italsiel
growing of commercial PACS installations in Italy

- The AIM project and
- the positive results coming from the evaluation of the first PACS installation of Trieste

stimulated and supported the rapid growth of other seven Philips/AT&T Commview installations in Italy
### PACS installations in Italy during early 1990's

<table>
<thead>
<tr>
<th>CITY</th>
<th>SITE</th>
<th>SUPPLIER</th>
<th>YEAR</th>
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<tbody>
<tr>
<td>Trieste</td>
<td>Cattinara Hospital Univ. of Trieste</td>
<td>Philips/AT&amp;T Commview</td>
<td>1988</td>
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<tr>
<td>Bologna</td>
<td>Maggiore Hospital</td>
<td>Philips/AT&amp;T Commview</td>
<td>1990</td>
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<td>Ferrara</td>
<td>Sant'Anna Hospital</td>
<td>Philips/AT&amp;T Commview</td>
<td>1990</td>
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<tr>
<td>L'Aquila</td>
<td>Collemaggio Hospital Univ. of L'Aquila</td>
<td>not commercial</td>
<td>1990</td>
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<tr>
<td>Trieste</td>
<td>Maggiore Hospital</td>
<td>Philips/AT&amp;T Commview</td>
<td>1990</td>
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<td>Messina</td>
<td>Messina Hospital</td>
<td>Philips/AT&amp;T Commview</td>
<td>1991</td>
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<td>Bari</td>
<td>Mater Dei Clinic</td>
<td>Philips/AT&amp;T Commview</td>
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<td>Milano</td>
<td>S. Paolo Hospital</td>
<td>Philips/AT&amp;T Commview</td>
<td>1992</td>
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<td>Monza</td>
<td>S. Gerardo Hospital</td>
<td>Philips/AT&amp;T Commview</td>
<td>1992</td>
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The non-commercial PACS at L’Aquila

- 1987-1990: a non-commercial PACS/RIS system was developed by the Istituto di Radiologia of the University of L'Aquila.
- 1990: the PACS system was made operative at the Collemaggio Hospital of L'Aquila.
- Differently from the commercial systems, this system used standard protocols at all levels: Ethernet, DECNET, ACR-NEMA.
PACS Commview external communications in Italian installations

- Most of the Commview PACS Italian installations worked (and still work today) essentially inside the protocol-proprietary optical-fiber network in the radiology departments.

- Sometimes they operated also on an external but dedicated Ethernet network, by using:
  - an AT&T Gateway and
  - quite expensive AT&T Results Viewing Stations (RVS).
1992, at Trieste: a joint research program of the Unit of Trieste of the National Group of Bioengineering at the DEEI - Dipartimento di Elettrotecnica, Elettronica ed Informatica of the University of Trieste and the Centro Ricerche e Studi Tecnologie Biomediche e Sanitarie at the Research Park of Trieste

the AT&T Commview Gateway at the Istituto di Radiologia was connected to the Cattinara Hospital optical-fiber network
Trieste: Cattinara Hospital Radiology services with the "Commview PACS"

- ISO/OSI compliant Remote access to PACS
- Development of Open and Versatile Tools for Remote Multi-Platform Workstations
  - 1992: XRIS - X-Window Remote Image Station
  - 1993: ARIS - Autonomous Remote Image Station
  - 1994: SRIS - Integration with Stereotactic Neurosurgery
  - 1995: HRIS - HTML/HTTP browser
WAN-availability in Trieste of Pacs Commview images

- **1990**: The Cattinara Hospital network was connected (with access-lists to assure security and privacy)
  - to the high-speed Metropolitan Area Network of the SIST (Sistema Informatico Scientifico Triestino) and
  - to the SISR (the Regional Health IP WAN of the Regione Friuli Venezia Giulia)

- **1992**: The PACS archive was made available to all the hospitals of Trieste and also to any other site on the network, by means of:
  - Unix- or PC-based remote client stations (XRIS, ARIS)
  - [1995] a WWW gateway and browsers (HRIS)
Trieste & Regione FVG: MAN and WAN Radiology services with the "Commview" PACS

Hospital Network

Cattinara Hospital

Maggiore Hospital

Hospital Network

SIST Metropolitan Area Network

PACS WS

HTML Browser

IRCCS "Burlo Garofolo"

Clients WSs:
- XRIS
- ARIS
- HRIS
- SRIS

County Network Router

SISR County Health Network

County Personal Data Server

Remote Hospital

PACS WS

HTML Browser

Hospital Network
NEW PACS PROJECTS, DEVELOPMENTS AND INSTALLATIONS

- mid 1990’s: with few exceptions, the new projects, developments and installations of PACSs in Italy started in hospital sites and research centers different from those of the first PACS installations.

- This may be partially due to the inherent difficulty for most of the sites to integrate the PACS systems of the first generation with the open and standard environment of our days.
as in most of the world, a transition
- from the concept of the (closed) PACS system just collecting all the images within a radiology department
- to the concepts of
  » open and standard systems
  » integrated health care environments
  » world-wide remote consultation and exchange of images
  » network image processing
  » combined processing and integration of morphological and functional (e.g. EEG maps) images.

there has been also in Italy
The National Project of Telemedicine

- 8 themes
- 1.st theme: create integrated and integrable information systems for the hospital management
- 3.rd theme: develop and build-up a system for acquisition and processing of radiological digital images and a system for the diagnostic support.
- 5.rd theme: develop a telematic system for the management of a cardiology department
National Project of Telemedicine
3° Theme

- **duration:** August 1995 - March 1998

- **1.** st sub-theme: a system for the acquisition, management, archiving and transmission of radiological images

- **2.** st sub-theme:
  > systems for diagnosis support
  > systems for reporting support
development:
by some Italian industries

and by some scientific centers

coordinated by
experimentation:

by five clinic centers:

- Dip. di Fisiopatologia Clinica - Univ. of Florence
- Ist. di Radiologia - Univ. of Pisa
- Ist. di Radiologia - Univ. "La Sapienza" of Rome
- Centro di Medicina Nucleare - CNR of Naples
- Servizio di Radiodiagnostica - Ist. Naz. dei Tumori of Milan
Telemed network

The five clinic centers are connected:

- to the Tuscan MAN
- or
- to the GARR Italian Network
Metropolitan & Regional tele-radiology at the Dipartimento di Radiologia of Pisa

- metropolitan tele-radiology between the hospitals Santa Chiara and Cisanello in Pisa

- regional tele-radiology between the
  - dept. of Cardiology of the Santa Chiara Hospital in Pisa and
  - dept. of Radiology of the Careggi Hospital at Florence

- Geographical communications are made by using the Metropolitan Area Network linking Pisa and Florence
Metropolitan & Regional tele-radiology at Pisa and Florence

- Images are essentially stored on a "modular" PACS simply made by an Ethernet interconnection of the imaging modalities, using DICOM or other proprietary protocols.
The SPERIGEST Project at the IFC-CNR of Pisa

- oct. 1996: the IFC of CNR at Pisa, as Azienda Ospedaliera CREAS-IFC, starts

SPERIGEST

- a "special program" of the Ministry of Health
- with the collaboration of ItalTBS - Research Park of Trieste
- duration: 24 months
- the project utilizes the connection facilities of the Tuscana MAN
The SPERIGEST Project at the IFC-CNR of Pisa

- the aim of the project is an integrated system collecting
  - clinical components
  - administrative components
  - government components
  within a Health local unit.

integrated clinic card:
- data and signals from labs of CREA-IFC
- data and signals from clinics of CREA-IFC
  - clinical chemistry
  - hemodynamics
  - ecography
  - nuclear medicine
  - PET
  - holter
  - ECG
  - ergonometry
  - etc.
The PACS/RIS system at the Dep. of Radiology II of the University "La Sapienza" of Rom

- A PC-based PACS/RIS system with hypermedia capabilities has been recently developed, installed and evaluated.

- The PACS section is being upgraded to a Unix-based system from Imanion.

- The system supports:
  - scheduling
  - recording
  - examination
  - reporting
  - statistics
  - system administration
  - image archiving of secondary caption images from video or scanning.
Center for Biomedical Applications of CRS4 at Cagliari

- development of WWW-Intranet based techniques:
  - **W-MED**: an electronic patient record system that allows to securely view clinical information including:
    - medical images
    - data
    - signals associated

  with individual patients

- **Wolviz**: a medical 3D visualization systems.
Trieste - The DPACS project

- **1996**: following the previous experience, a large project called DPACS (Data and Picture Archiving and Communication System) has been started.

- **Aim of the project**: develop an open system for the archiving and remote consultation of radiological images as well as other data and signals.

- **Final goal**: offer a citizen's virtually integrated clinical card available to all the population of the Provincia of Trieste, through the network at any hospital and private health site.

- **1997**: start of radiology HIS/RIS/PACS service.
The DPACS Project
Data & Picture Archiving and Communication System

- Replacement of current PACS System
- Full HIS-RIS-PACS Integration
- Medical Records Access from any location
  - Intra-Hospital services
  - MAN and WAN interoperability
- Support for DICOM and non-DICOM devices
The DPACS Project
Data & Picture Archiving and Communication System

- Heterogeneous Medical Data Storage
- Three-level Hierarchical Data Storage
- Relational/Distributed Database Engine
- Multi-platform Client-Server architecture
virtual integrated health card and PACS/RIS/HIS integration in FVG and other Italian counties

market study and user-matched integration of radiological PACSs with local and geographical HIS systems

transfer to cardiology of DPACS potentialities and functionalities

• integration of legacy-protocol-oriented administrative services with Intranet client/server systems • high performance health networking

the DPACS project: industrial collaborations

DPACS integration with no-standard environments and DICOM testing

joined R&D and key production

HW support & and wide area telematics experimentation
The DPACS project in the Regione FVG

- The Government of the Regione Friuli Venezia Giulia, has considered strategic that the model of the DPACS project is extended, with suitable adaptations, to the health integration of all the county

- Some experimental integrations have been programmed by the regional committe of health care communication:
  - DPACS (Trieste)
  - PACS/RIS (Aviano, PN)
  - Regional Cardio-Net
  - Telepatology-Net (Udine)
SISR - FVG Regional Health Network WAN Backbone (1996)

end of 1997: upgrade to a private regional Cisco/Stratacom-based ATM backbone
SISR - FVG Regional Health Network
WAN Backbone of Provincia di Pordenone (1996)
Centro Riferimento Oncologico
CRO of Aviano (Pordenone, FVG)

- 1995-1996: A large commercial PACS of the new generation, developed by Philips has been installed at the Department of Radiology of CRO
- The PACS has been integrated with the Insiel RIS
- It is connected to the SISR WAN
- A first experience of radiological regional cooperation/consulting with the DPACS Project at Trieste through the SISR Regional Network is starting
The FVG Health Network: a look to a possible near future

1996: ~200 routers
1997: ~450 routers

1. ALTRO ENTE PUBBLICO
2. COMUNE
3. ENTE PUBBLICO SAN
4. AGENZIA OSPEDALIERA
5. REGIONE F.V.G.
6. Agenzia Regionale Sanità
7. RUPA
8. UNIVERSITA' di TRIESTE
9. MEDICINA+INGCLIN
10. AREA DI RICERCA DI TRIESTE
11. CIVAB-CRSTBS
12. IRCCS
13. BURLO GAROFOL
14. UNIVERSITA' di UDINE
15. MEDICINA

PERMANENT FVG REGIONAL ATM & ATM-like BACKBONE (health virtual circuits)

RETI COMMERCIALI

AMBULATORIO MEDICO CONVENZ.
DPACS <-> SSIC
Italian Agreements

- extensions
- integration
- collaborations

of the DPACS project to other Italian sites can be feasible thanks to the 18 agreements of didactic and research collaboration signed by the SSIC - the post-graduate School of Clinical Engineering of Trieste with hospital, companies and institutions in all Italy:
Formal agreements

- Area di Ricerca di Trieste
- Azienda Ospedaliera «Ospedale Niguarda Ca' Grande», Milano
- Azienda Ospedaliera «S. Maria degli Angeli», Pordenone
- Azienda Ospedaliera di Bologna
- Azienda Ospedaliera di Forlì
- Azienda Ospedaliera di Padova
- Azienda Ospedaliera di Trieste
- Azienda per i Servizi Sanitari n.1 Triestina, Trieste
- Azienda per i Servizi Sanitari n.16 di Modena
- Azienda Sanitaria USL Centro-Sud - Bolzano

- Azienda USL n. 2 di Lucca
- CRSTBS, Trieste
- INSIEL S.p.A., Trieste and Udine
- IRCCS “Casa Sollievo della Sofferenza”, San Giovanni Rotondo (Foggia)
- IRCCS Ospedale Infantile "Burlo Garofolo", Trieste
- IRCCS «San Raffaele», Milano (to be signed)
- Istituto di Fisiologia Clinica del C.N.R., Pisa
- ITALTBS S.p.A., Trieste
- Unità Locale Socio-Sanitaria n. 7, Pieve di Soligo (Treviso)
Other Italian PACS/RIS and teleradiology
new or future installations in depts. of radiology

- Bolzano, Azienda Sanitaria USL Centro-Sud:
  - AGFA Digital Radiology with distributed DICOM WSs
  - Siemens PACS system, intra- & inter-hospitals

- Ravenna+Feanza+Lugo di Romagna (Regione ER), ASS:
  - Imation teleradiology system

- Lodi (Milano), ASS:
  - Imation PACS archive manager integrated with RIS

- Tortona, ASS:
  - Imation PACS archive manager + digitizer

- Rome, University "La Sapienza":
  - Imation PACS archive manager integrated with RIS