

Grid Storage

Next Generation Fixed Content Storage for the Healthcare Enterprise

by

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Presentation Overview

- Introduction
- Medical imaging facts
- Traditional Approaches
- Grid Storage Solution
- Clinical Deployment
- Concluding Remarks

Bycast Business Overview

Grid Based Solutions for Storage and Transmission of Fixed Content Data

Enterprise and Multi-Site Fixed Content Storage Grids

Images, Studies and Files...

- A study/exam is not a single image or file
- Study consists of one or many individual components
- Components are inter-related and are required together

Study = Complex Data Object

Metadata

- Pixel information is the data in the image
- Patient demographics, modality, description, etc. are the metadata
- Metadata provides information about the importance of the study

Data + Metadata = Information

Standards

- DICOM is the de-facto standard although implementations vary
- DICOM provides a standard for:
 - Format
 - Communication
 - Comprehensive Metadata

Medical Image Data Explosion

- **Large and Growing Data sets**— Hospital with 100,000 procedures requires 5 - 10 TB, annually. New generation imaging machines produce 10x more data
- **Historical Records**— Past records are required for interpretation
- **Retention and Security (HIPAA)** – Records must be securely maintained and accessible for 5 to 21+ years

**Information and storage management
nightmare**

What comes with Data Growth

Good news

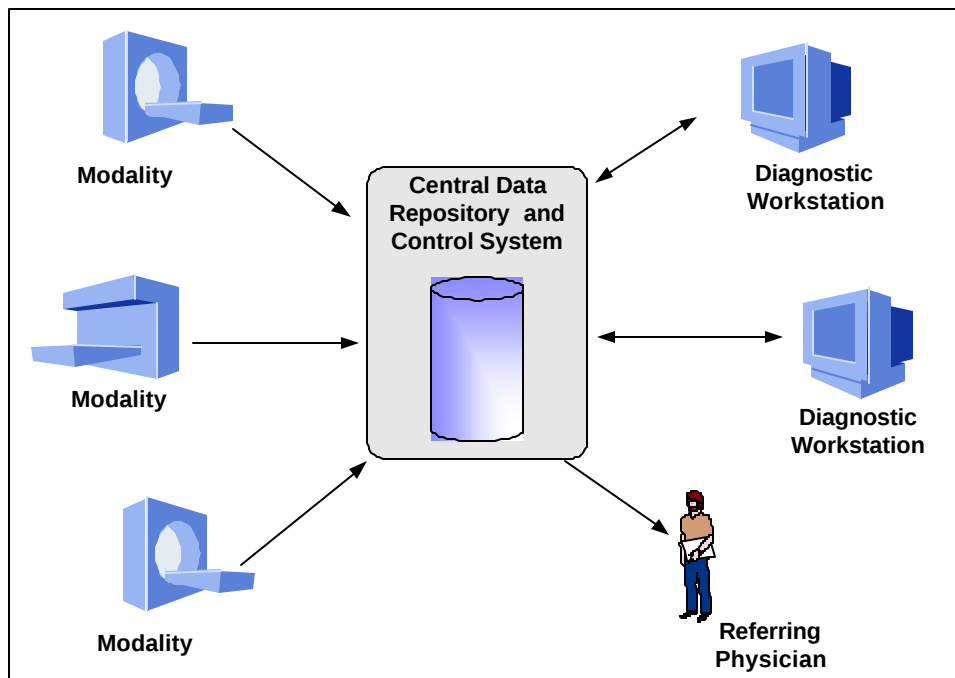
- Increasing storage density and decreasing costs
- Storage hardware is a commodity

Not so good news

Management Nightmare

- Fault tolerance, recovery, 24/7 availability
- User expectations on performance
- Obsolescence and lack of interoperability

Traditional Approach



Challenges

- **Cost**
- **Scalability**
- **Obsolescence**
- **Reliability**

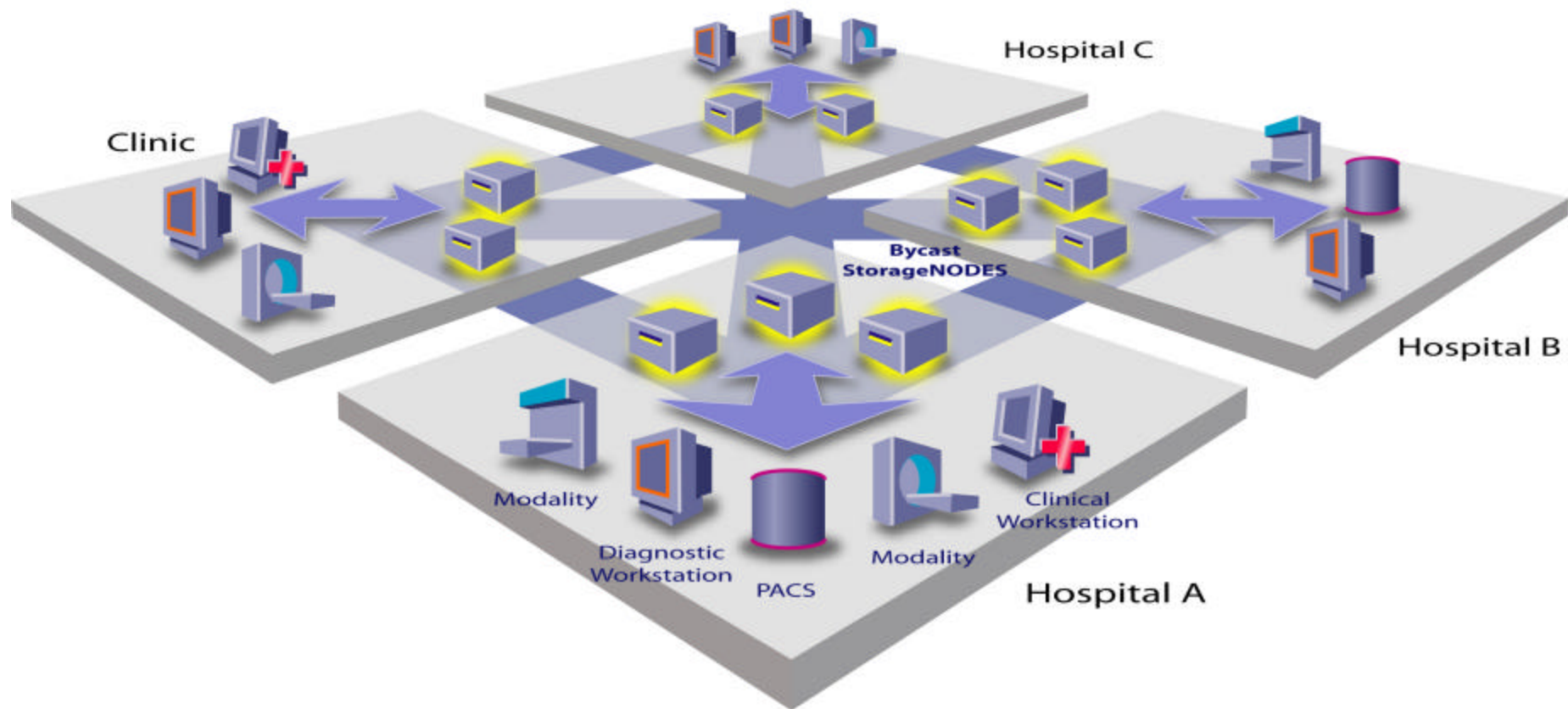
**Lower Performance and Higher Total Costs
of Ownership**

Grid Storage

- Multiple **heterogeneous** distributed elements into a **unified** entity with no single points of failure
- Abstracts content storage, directories, query, security, storage resource management, and reliability

Bycast StorageGRID Software

Bycast StorageGRID MultiSite™



Architectural Highlights

Heterogeneous hardware and grades

- NAS, SAN, RAID and Tape
- Off-the-shelf servers

Content aware

- Managing storage using image metadata

Intelligent

- Manage available storage, bandwidth and CPU to increase performance and availability

Setting a new standard in fixed content storage

Interoperability with Clinical Applications

Leveraging Standards

- File system access (NFS, CIFS)
- DICOM C-Store and Queries
- Support for HTTP

Seamless Integration through open standards

Advantages

- **Intelligent information lifecycle management (iILM)**
- **Built-in business continuity**
- **On demand scalability**
- **Higher performance at lower cost**



**Higher Performance and Costs Less to
Deploy, Manage and Operate**

Privacy and Security

Confidentiality - Stored and transmitted data are encrypted using government approved methods

Integrity - Nodes continuously check data integrity using cryptographic techniques

Audit - Detailed audit trail of all transactions

**Addresses Compliance with HIPAA
guidelines**

Storage Grid Management

- Web based
- Comprehensive management and monitoring
 - DICOM attributes
 - Storage and server resources
 - Network links
- Real-time and historical reporting
- Automated fault detection and alerts



StorageGRID MultiSite

2002-11-20

Last refreshed at 11:56:31

System Status: 

Logout 



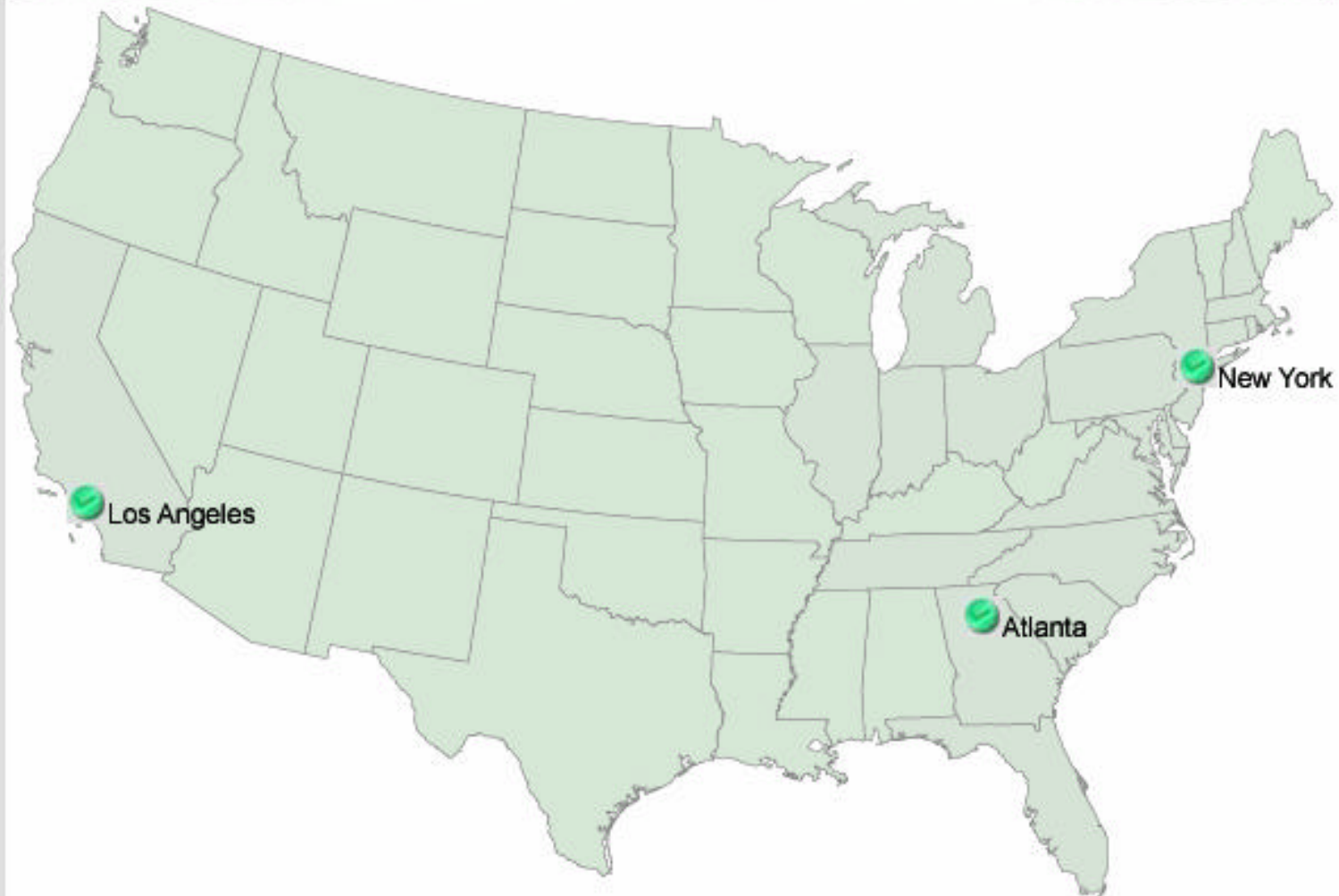
Network Map

-  Los Angeles
-  New York
-  Atlanta

Overview

Main

Configuration

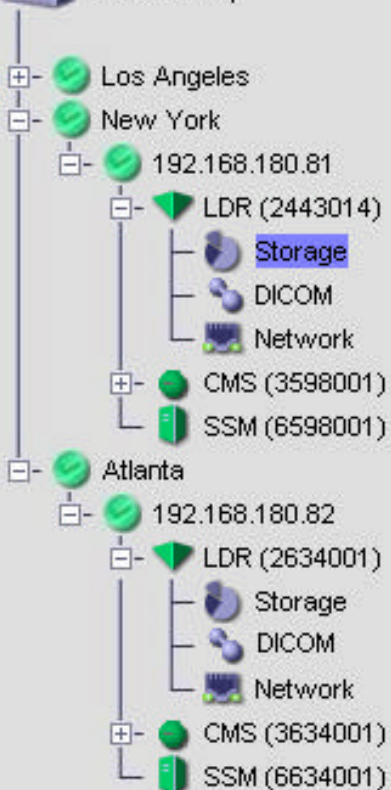


StorageGRID MultiSite

Last Refreshed: 2003-11-25 at 16:48:52

System Status Logout 

Network Map



Overview

Status

Reports

Configuration

Charts

Text

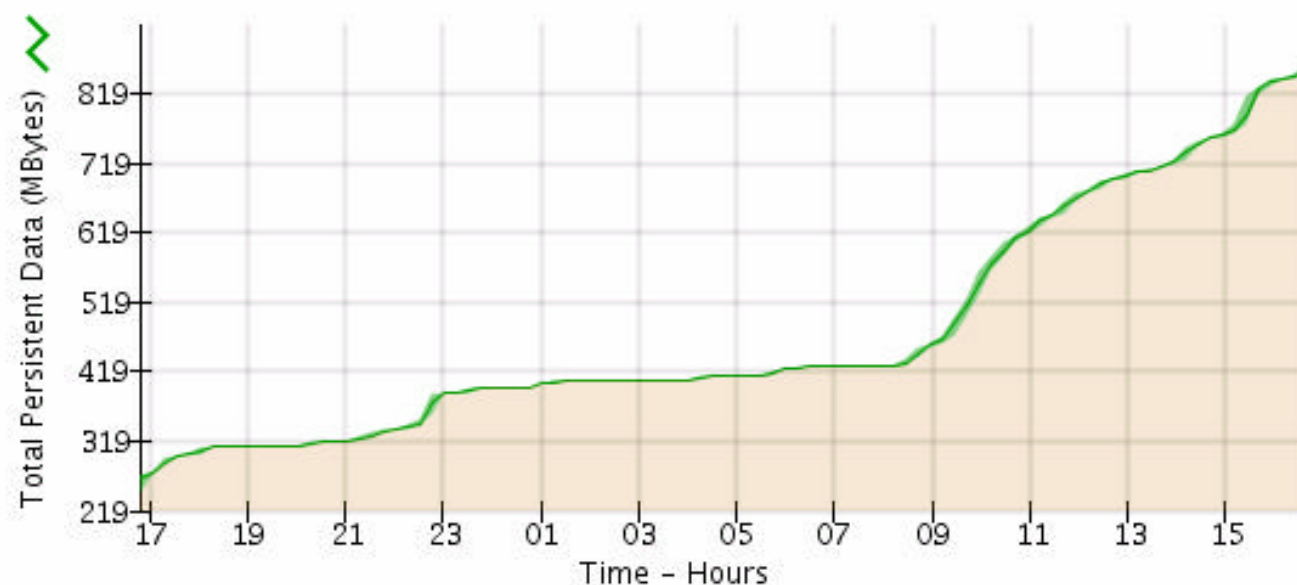


LDR (2443014) - Storage

Last Refreshed: 2003-11-25 at 16:48:52

Total Persistent Data (MBytes) vs Time

2003-11-24 16:48:00 to 2003-11-25 16:48:00

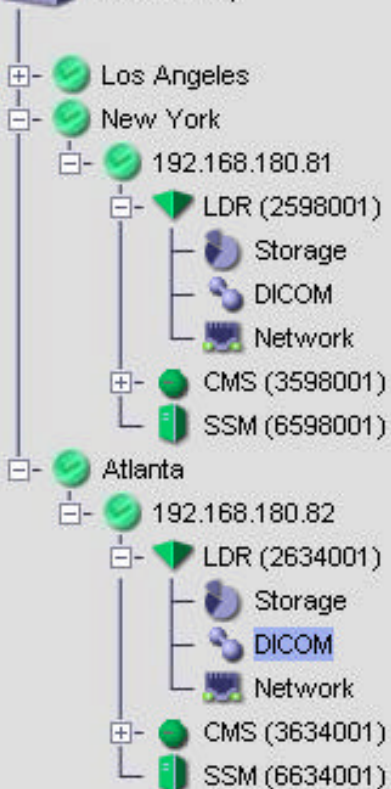


StorageGRID MultiSite

Last Refreshed: 2003-11-25 at 16:43:43

System Status Logout 

Network Map



Overview

Status

Reports

Configuration

Main

DICOM C-ECHO

Inbound C-Echoes (Attempted):	0 C-ECHOes	
Inbound C-Echoes (Successful):	0 C-ECHOes	
Inbound C-Echoes (Failed):	0 C-ECHOes	
Outbound C-Echoes (Attempted):	0 C-ECHOes	
Outbound C-Echoes (Successful):	0 C-ECHOes	
Outbound C-Echoes (Failed):	0 C-ECHOes	

DICOM C-STORE

Inbound C-Stores (Attempted):	0 C-STOREs	
Inbound C-Stores (Successful):	0 C-STOREs	
Inbound C-Stores (Failed):	0 C-STOREs	
Outbound C-Stores (Attempted):	1,388 C-STOREs	
Outbound C-Stores (Successful):	1,388 C-STOREs	
Outbound C-Stores (Failed):	0 C-STOREs	

DICOM C-FIND

Inbound C-Finds (Attempted):	0 C-FINDs	
Inbound C-Finds (Successful):	0 C-FINDs	
Inbound C-Finds (Failed):	0 C-FINDs	

StorageGRID MultiSite

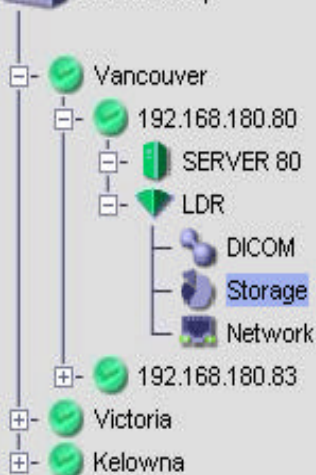
2003-01-09

Last refreshed at 18:44:45

System Status: 

Logout 

Network Map



Overview

Status

Reports

Configuration

Main

Notification

Severity	Id	Active	Node	Attribute	Primary Message	Secondary Message	Value	Value Type	Type	Email
 Unknown	138	☐	2356001	DSER	Storage Status	N/A	0	ENUM	EQ ▾	nms@bycast.com
 Normal	142	☒	2356001	DSER	Storage Status	No Errors	0	ENUM	EQ ▾	nms@bycast.com
 Warning	144	☒	2356001	DSER	Storage Status	Database	1	ENUM	EQ ▾	nms@bycast.com
 Minor	148	☒	2356001	DSER	Storage Status	Verify Faile	2	ENUM	GE ▾	nms@bycast.com
 Major	150	☒	2356001	DSER	Storage Status	Invalid, Cor	4	ENUM	EQ ▾	nms@bycast.com
 Critical	153	☒	2356001	DSER	Storage Status	Max failure	5	ENUM	EQ ▾	nms@bycast.com
 Unknown	193	☐	2356001	SAVP	Available Space	Not Used	0	UF32	EQ ▾	nms@bycast.com
 Normal	194	☐	2356001	SAVP	Available Space	Not Used	0	UF32	EQ ▾	nms@bycast.com
 Warning	195	☒	2356001	SAVP	Available Space	Below 15%	15	UF32	LE ▾	nms@bycast.com
 Minor	196	☒	2356001	SAVP	Available Space	Below 10%	10	UF32	LE ▾	nms@bycast.com
 Major	197	☒	2356001	SAVP	Available Space	Below 5%	5	UF32	LE ▾	nms@bycast.com
 Critical	198	☒	2356001	SAVP	Available Space	Below 1%	1	UF32	LE ▾	nms@bycast.com

Operating Grids



St. Paul's Hospital



BC Cancer Agency
CARE & RESEARCH

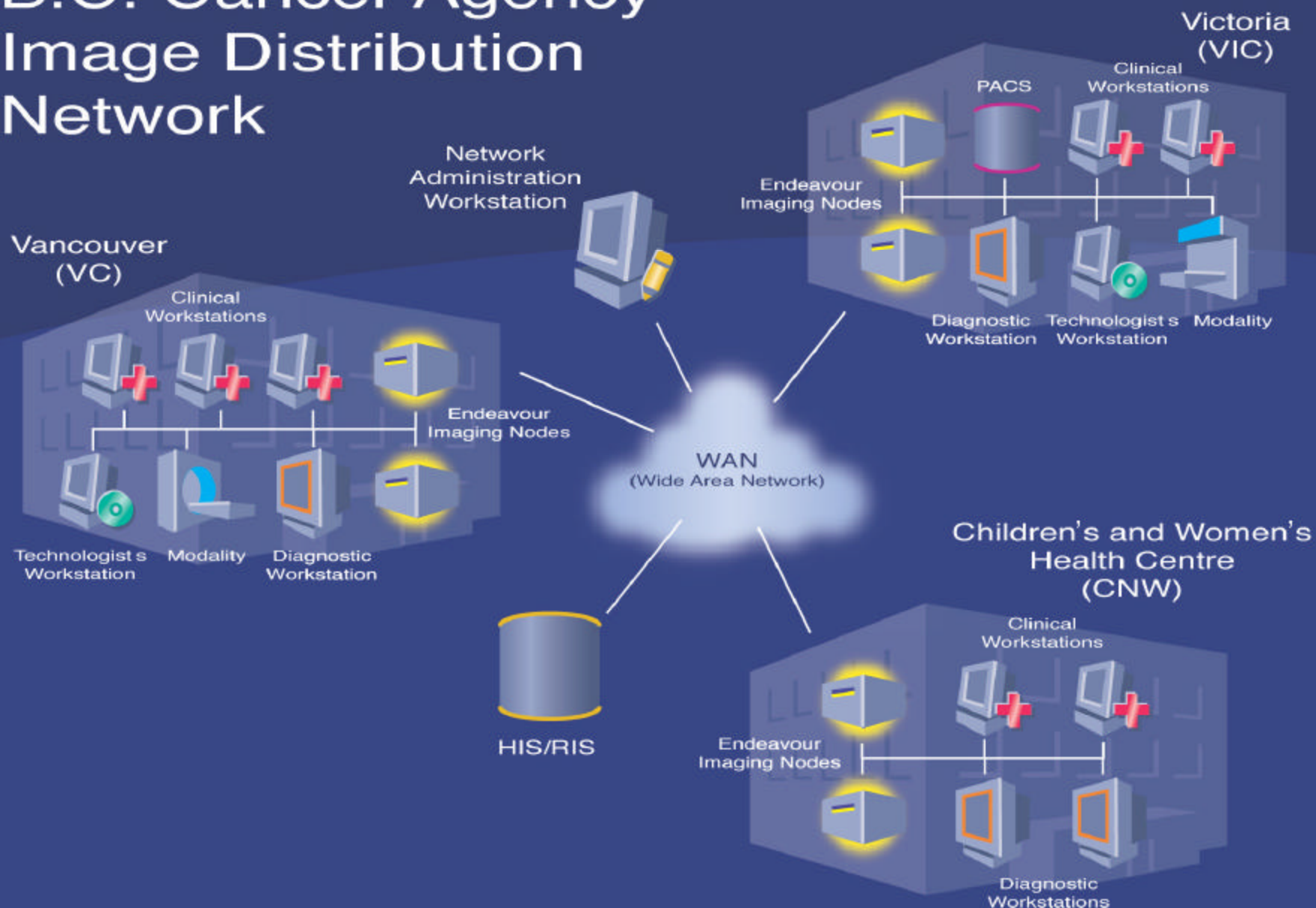


In production with multiple PACS

BC Cancer Agency Case Study

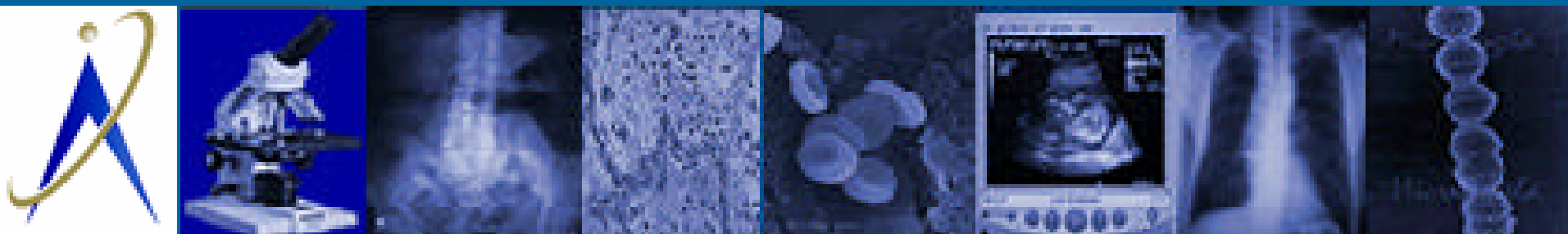
- Delivering cancer care in British Columbia
- Acquiring images internally and from all BC hospitals
- Seamless access across the province
- Existing health information system
- Initial deployment of 4.8 TB expanded to 14 TB
- 200+workstations and 1000 + unique users

B.C. Cancer Agency Image Distribution Network



Conclusion

- A grid based solution tailored to the **unique and specific needs of healthcare**
- Proven solution in a live clinical setting across multiple sites
- Papers published at in SPIE, Medical Imaging 2002



Thank You

Questions and comments via email
mkermani@bycast.com

Corporate Background

- **The Company**
 - Founded in 1999
 - Based in Vancouver, Canada
 - Grids for the storage and distribution of fixed content digital data (images, video, audio)
- **Initial product focus**
 - Medical Image Storage Grids

Bycast StorageGRID

Software on each of the servers (**nodes**) manages limited storage resources and are interconnected over IP network links with **varying bandwidth**

StorageGRID Multisite

Last Refreshed: 2004-01-27 at 18:06:14

System Status Logout 

Network

Services

Reports

Charts

Text

Histograms



Charting and Reports (Text): Study By Type

Results Found

ModalityType *

Start Time



YYYY/MM/DD HH:MM:SS

End Time



YYYY/MM/DD HH:MM:SS

Modality Types

1-27 of 27

Row Number	Modality Type	SOPClass Name
1	1.2.840.10008.1.1	Verification SOP Class
2	1.2.840.10008.5.1.4.1.1.1	Computed Radiography Image Storage
3	1.2.840.10008.5.1.4.1.1.2	CT Image Storage
4	1.2.840.10008.5.1.4.1.1.4	MR Image Storage
5	1.2.840.10008.5.1.4.1.1.20	Nuclear Medicine Image Storage
6	1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image Storage
7	1.2.840.10008.5.1.4.1.1.3.1	Ultrasound MultiFrame Image Storage
8	1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage

Healthcare and Information Technologies

- IT solutions are **simply tools** that must :
 - **Improve care**
 - **Reduce costs**
- “Coolness” doesn’t count
- Benefits must be sustainable
- Must rely on open standards

Barriers to Technology Adoption in Healthcare

- **Non-Technical**
 - Usability
 - Lack of end-user buy-in
- **Technical**
 - Lack of standards & interoperability
 - Reliability
 - Manageability

Some Statistics

- Over 300 million radiology exams annually in North America (Schneider Securities, February 2002)
- Over 90% are still film based (Schneider Securities, February 2002)
- Many imaging modes are inherently digital (CT, PET, MRI, US)
- New generation devices produce many more images per exam

Large Data Sets

Modality	Image Size (KB)	Images Per Study	Study Size (MB)
MRI	~ 250	100 – 1,000	25 – 250
CT	~ 700	100 – 1,200	70 – 900
CR	~ 8,000	2 – 7	16 – 56
Cardiac Biplane	~1,500	400 – 3,600	600 – 5,400

Diagnostic Imaging Facts

- Images are an essential element of the patient record and subject to retention laws
- Imaging exams constitute fixed content data
- Multi-site access is becoming a necessity