Providers Must Demonstrate Network-Level Value

**Baseline Requirements**

- **Cost**
  - Low unit prices relative to competitors
  - Willingness to further reduce prices in return for steerage
  - Investment in infrastructure that signals ability to control cost trend

- **Access**
  - Geographic coverage that aligns with purchaser of interest
  - Ability to meet convenience demands of consumers (after-hours, weekend access; virtual care; etc.)

**Elements of an Attractive Network**

- **Clinical Quality**
  - Better outcomes than competitors
  - Adherence to evidence-based clinical practices

- **Service Experience**
  - High patient satisfaction ratings
  - Strong brand reputation

**Differentiators**

Source: Health Care Advisory Board interviews and analysis.
BIG DATA

VOLUME
DATA SIZE

VELOCITY
SPEED OF CHANGE

VARIETY
DIFFERENT FORMS OF DATA SOURCES

VERACITY
UNCERTAINTY OF DATA
Is “Cloud” the big savior?
PERSONAL LIFE: EMBRACING THE CLOUD

- Thoughts in the cloud (e.g. Facebook)
- Music in the cloud (e.g. Amazon)
- Documents in the cloud (e.g. Office 365)
- Entire Operating System in the cloud (e.g. Google Chrome OS)
Merrill Lynch Estimates "Cloud Computing" To Be $100 Billion Market

Cloud market to hit 240 billion by 2020

Public Cloud Services Spending to Grow Rapidly, Gartner and IDC Say

Spending in 2016 will hit $204 billion, according to Gartner analysts, while IDC says it will reach more than $141 billion by 2019.

The Cloud Wars: 100+ billion at stake
by Kash Rangan, Alan Cooke, Justin Post, Nat Schindler

The Wall Street Journal | On Technology
Seeking Safety in Clouds
SO, WHAT IS CLOUD COMPUTING?

National Institute of Standards and Technology (NIST) definition:

“A model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort”
Software as a service
Running specific applications through a cloud

Platform as a service
Suite of applications, programming languages, and user tools

Infrastructure as a service
Relying on remote data storage networks

On-demand Service
Ubiquitous network access
Location-independent resource pooling
Rapid elasticity
Measured service
# CLOUD CHARACTERISTICS

<table>
<thead>
<tr>
<th>Common Characteristics</th>
<th>Essential Characteristics</th>
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<tbody>
<tr>
<td>• Massive Scale</td>
<td>• On Demand Self-Service</td>
</tr>
<tr>
<td>• Resilient Computing</td>
<td>• Broad Network Access</td>
</tr>
<tr>
<td>• Homogeneity</td>
<td>• Rapid Elasticity</td>
</tr>
<tr>
<td>• Geographic Distribution</td>
<td>• Resource Pooling</td>
</tr>
<tr>
<td>• Virtualization</td>
<td>• Measured Service</td>
</tr>
<tr>
<td>• Service Orientation</td>
<td></td>
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<tr>
<td>• Low Cost Software</td>
<td></td>
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<tr>
<td>• Advanced Security</td>
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</table>
GO HYBRID?

Public Cloud
- Elasticity
- Utility Pricing
- Leverage Expertise

Private Cloud
- Total Control
- Regulation
- Flexibility

Community Cloud
- Meets shared concerns

Hybrid Cloud
CLOUD CASE STUDY: IMAGING
BIG ISSUES FACING IMAGING INFORMATICS

- Imaging Overload
- Pay for Performance
- Clinical Validation
- System Integration
- Reforming the Imaging Report
- Image Sharing
GROWING ROLE OF IMAGING IN HEALTH IT

Growing diversity of modalities

Increased utilization of imaging annotations & feature extractions to support care/research

Inclusion of images in regional, state, and national clinical data exchanges

Increased utilization of OE and DS algorithms to guide provider ordering behavior

Expansion of imaging to support advances in molecular medicine-based research

Integrated approach to managing imaging across the “ologies”
There are a number of different departments that have specific needs for static and cine image storage and retrieval that are somewhat synergistic yet not addressed sufficiently by current methodologies.
**CLOUD BASED ENTERPRISE STORAGE**

**Traditional Image Storage**

- **“Siloed” Traditional architecture:**
  - Difficult & expensive to administer
  - Low utilization of hardware & storage
  - Vulnerable to failure and downtime
  - Bandwidth inefficient
  - Block level replication

**Cloud Based Image Storage**

- **“Virtualized” Grid infrastructure:**
  - Smaller, shared & more cost effective storage environment
  - Adaptive, self healing & self managing
  - High availability & speed
  - Enables infrastructure to be managed independent of the application
  - Single point of access: EMR, HIE, Portals
  - Eliminates redundancy
  - Tighter ILM enforcement
SCHEMA OF VNA WITH CLOUD – HIE INTEGRATED/IMAGE SHARING ENABLED
**Key Capabilities**

- **As easy as a social network:** Confer on patient cases, send messages, invite users, join networks.
- **Secure communications:** enabled with SSL, Secure DICOM encryption. ATNA compliant, audit trails.
- **Vendor agnostic:** Upload from a CD, file folder or any DICOM-based device.
- **Easy normalize and download option:** Edit and send incoming studies to your local DICOM devices.
- **Built-in intelligence:** Analytics dashboard to help visualize exchange trends, clinical reasons & specialty mix.
IMAGE EXCHANGE

**Age of patient empowerment**
- Increasingly tech savvy patients
- Easy gathering of images from multiple providers
- PHRs, Kiosks, Second opinions

**Telehealth**
- Broader market growth
- Collaboration

**Easy access via the cloud = happier referral base**
- Create ‘stickiness’ with key physicians
- Ease inbound referral process for outside facilities

**Elegant point-to-point transfer of studies**
- e.g. for trauma transfers
ADVANCED VISUALIZATION IN THE CLOUD

Advanced Visualization

Leverage cloud compute power to enable access to non-diagnostic 3D views & Image post-processing

1. Data sent to Cloud
2. Images processed in Cloud
3. View & manipulate images on browser devices

Cloud + AV Algorithms

- Anywhere access to 3D views (Rads, Specialists, Device Manufacturers)
- Navigate findings, and rotate 3D segmentation

Algorithm Framework

Enable research institutions and 3rd party providers to run and share prototype algorithms

- Publish and share algorithms
- Analyze results (automatic & assessments)
- Batch processing of algorithms on large volume sets

Algorithm Developer

Algorithm Tester

Increased scalability, mobility and flexibility to drive improved clinical & productivity outcomes
CLOUD ECONOMICS 101

“Statically provisioned” data center

“Virtual” data center in the cloud

Unused resources

Dr. Jie Liu, Microsoft Research
CLOUD-ONOMICS

- Lower initial investment
- Reduced total cost of ownership (TCO)
- Faster deployment
- Simplified management
- Virtualization
- Seamless scalability
- Minimize capital expenditures
- Economies of scale
PERFORMANCE

Imaging is increasingly dealing with:

- large imaging data sets,
- complex algorithms,
- pre- and post-processing requirements, and
- an increasingly distributed environment.

Cloud deployments afford flexibility to IT departments

- Administrators can better anticipate fluctuations in user load
- No need to scramble to secure additional hardware and software
- Robust reliability, with edge architecture and core nodes

Better performance for clinical users
WORKFLOW

Tech->Resident->Attending Radiologist->Surgeon

Seamless access to current images, prior studies and reports

Appropriate viewer for referring clinician (e.g. PCP vs Vascular Surgeon)

Streamlined image enablement of the EMR

Easier patient access to images and reports
HEALTHCARE IS EVOLVING TO A COLLABORATIVE CARE MODEL

Current Hospital-centric Model
- Hospital centric
- Episodic
- Departments
- Proprietary
- Data silos
- Fee-for-Service

Collaborative Care Model
- Care Pathways
- Patient Centric
- Open
- Solutions
- Interoperable
- Patient data consolidation
- Outcome Driven

Patients
Janus (Latin: Ianus)
(using lessons accumulated in the past to see into the future)
WORKFLOW – POWERED BY CLOUD

Collaboration in the Cloud

Incidental Findings
- Follow-Up for Incidental Findings
- Patient Portal Notifications
- DOX Radiologist Decision Support

Monitoring & Tracking
- Lesion Tracking & Notification
- Most Likely Diagnosis Based on Imaging Parameters
- Cohort-Based Projected Outcomes

Collaborative Diagnosis
- Video Conferencing
- Presentation Tools in Viewer

Treatment & Follow-Up
- Follow-Up Notification for Path & Surgery Reporting
- Rad-Path Correlation
- Prioritized Asynchronous Messaging

Contribution to Cohort Knowledge Base
- MDT Conferencing Tools
- Cohort-Specific Data Repository
- Follow-up & Surveillance Notifications for Patient
James is in an accident and goes to the ER. James is fine, but when the trauma rad reads his CT, he finds a liver lesion.

James sees his PCP and a GI specialist, who order labs and recommend more imaging. The AI rad who reads James’ CT is concerned about the lesion and recommends monitoring.

**Incidental Findings**
- Follow-Up for Incidental Findings
- Patient Portal Notifications
- DDX Radiologist Decision Support

**Monitoring & Tracking**
- Lesion Tracking & Notification
- Most Likely Diagnosis Based on Imaging Parameters
- Cohort-Based Projected Outcomes
Collaborative Diagnosis

- Video Conferencing
- Presentation Tools In Viewer

Treatment & Follow-Up

- Follow-Up Notification for Path & Surgery Reporting
- Rad-Path Correlation
- Prioritized Asynchronous Messaging
The radiologist, pathologist, and surgeon present James’ case at Liver Board for resident education.

Contribution to Cohort Knowledge Base

- MDT Conferencing Tools
- Cohort-Specific Data Repository
- Follow-up & Surveillance Notifications for Patient

The data about James’ case is added to the patient cohort knowledge base at his institution.
CLOUD COMPUTING: CONCERNS

Security
- Ensuring only authorized access (Identity Management)
- Ensuring integrity and availability
- Preventing data breach

Data Governance
- Data location constraints
- Regulatory protection of privacy & confidentiality
- Clarity about data ownership & control

Business Environment
- Ensuring interoperability
- Ensuring portability (& avoiding vendor lock-in)
- Insufficient reliability (& commitments to SLAs)
Amazon Cloud Outage Hits Netflix, Foursquare

In the same week that a lightning strike in Dublin knocked out service for some European users of Amazon and Microsoft’s cloud services, Amazon also suffered a stateside cloud outage that affected popular services like Foursquare, Reddit, and Netflix.

According to Amazon’s service dashboard, the company’s Elastic Computer Cloud (EC2) and Relational Database Service (RDS) experienced a service disruption in Northern Virginia yesterday around 10pm Eastern time. Service for both services was restored just after 11pm, but not before impacting some of its high-profile users.

Down Goes The Internet... Again. Amazon EC2 Outage Takes Down Foursquare, Instagram, Quora, Reddit, Etc
92%

The universe of threats may seem limitless, but 92% of the 100,000 incidents we’ve analyzed from the last 10 years can be described by just nine basic patterns.

Conducted by Verizon with contributions from 50 organizations from around the world.
Can the cloud be *more* secure than on-premises?
IT EXECS EAGER TO REALIZE CLOUD BENEFITS

But only if they can be sure that security will be as good or better

70% of CIOs will embrace a cloud-first strategy in 2016

(IDC CIO Agenda webinar)

94% experienced security benefits they didn’t previously have on-premise

62% said privacy protection increased as a result of moving to the cloud

Barriers to Cloud Adoption study, ComScore, September 2013
## CONCLUSION

<table>
<thead>
<tr>
<th>Reduce costs</th>
<th>by eliminating server sprawl and consolidating on highly scalable private clouds.</th>
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<tbody>
<tr>
<td>Maximize business agility</td>
<td>with simplified management and reduced time to market.</td>
</tr>
<tr>
<td>Increase performance</td>
<td>with fully integrated hardware and software for all business applications.</td>
</tr>
<tr>
<td>Mitigate risk</td>
<td>by minimizing downtime and protecting your enterprise technology stack.</td>
</tr>
<tr>
<td>Enable business growth</td>
<td>with unmatched reliability, availability and serviceability, and built-in virtualization.</td>
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</tbody>
</table>
Connect
Collaborate
Compute