Cloud Computing in Healthcare
Possibilities & Challenges

James Kavanagh
eHealth Architect, Microsoft Australia
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“... we’ve redefined cloud computing to include everything that we already do. I can’t think of anything that isn’t cloud computing.”

Larry Ellison, Oracle CEO

“... Today’s IT departments will come to be viewed as an evolutionary dead-end – a temporary aberration necessitated by client-server computing but wiped out by The Cloud, which is emerging as the dominant mode for corporate computing”

Nicholas Carr, Author of “Does IT Matter?” and “The Big Switch”

“a computing paradigm where the boundaries of computing will be determined by economic rationale rather than technical limits.”

Prof. Ramnath K. Chellappa (Emory University)

“Just an old idea whose time has (finally) come”

Berkeley University, “Above the Clouds”
Characteristics of Cloud Computing

- The illusion of infinite computing resources available on demand, thereby eliminating the need for Cloud Computing users to plan far ahead for provisioning.
- The elimination of an up-front commitment by Cloud users, allowing organisations to start small and increase hardware resources only when there is an increase in their needs.
- The ability to pay for use of computing resources on a short-term basis as needed (e.g., processors by the hour and storage by the day) and release them as needed, thereby rewarding conservation by letting machines and storage go when they are no longer useful.

Client Software
- E.g.: Windows, Linux, Browser, Mobile Phone

Software as a Service (SaaS)
- E.g.: Live Messenger, HealthVault, SalesForce.com, Google, Bing

Platform as a Service (PaaS)
- E.g.: Microsoft Azure, Google AppEngine

Infrastructure as a Service (IaaS)
- E.g.: Live SkyDrive, IronMountain, Amazon EC2 and S3
What if we apply elastic computing to healthcare?

Automatic and semiautomatic analysis of n-dimensional medical images, aiming to improve measurement of anomalies, detecting possible tumours and increasing the efficiency and accuracy of radiologists and clinicians.

Tumour Growth Model
- Early tumour masses are often approximately spherical and grow as spheres. Mathematical models treat this case.
- They can sprout additional spheres (this corresponds, biologically, to clonal expansion)
- Heterogeneous tumours with multiple clonal centres may demonstrate variations in response to therapy (i.e. resistant clones)
- Can we relate morphological changes, determined from images, to underlying cancer growth processes?

Sir Michael Brady FRS FREng FIET FBCS FMedSci
Professor of Information Engineering
Oxford Cancer Imaging Centre
University of Oxford
Cloud Computing enabling eHealth

Capabilities Required:
- Identification & Authorisation
- Document & Message Exchange
- Storage & Computing
- Real-time communication
- Health Records

Existing Cloud Services:
- OpenID, LiveID
- .NET Services, Amazon
- Azure, Google AppEngine, S3
- Live Services, Skype
- HealthVault, Google Health
The Economics of Cloud Computing

Traditional IT Economics:

- Actual Load
- Allocated IT-capacities
- "Under-supply" of capacities
- "Waste" of capacities
- Fixed cost of IT-capacities
- Load Forecast
- Barrier for innovations

TIME

IT CAPACITY
The Economics of Cloud Computing

Cloud View of IT Economics:

- Actual Load vs. Allocated IT capacities
- Reduction of initial investments
- Reduction of "over-supply"
- No "under-supply"
- Possible reduction of IT-capacities in case of reduced load

Time

IT CAPACITY

Load Forecast

Actual Load
An eHealth Example in Australia

Electronic Document Exchange:
- 200 million clinical documents per annum (avg: 7 per second, peak 5x)
- Each document encrypted & uploaded to a repository
- Each document downloaded & decrypted on demand
- Additional processes at low volume
- Each document is average 20kb

Physical Architecture estimate:

Annual Cost Estimate:
- 3 servers: $102,000
- 6 servers: $187,000
- 8 servers: $214,000
- Plus DR: $44,000

TOTAL: $258,000

Note: cost is for hardware, software, bandwidth, storage and operations management only
An eHealth Example in Australia

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An eHealth Example in Australia

Physical Architecture estimate:

- Web Server
- Integration Server
- Database Server

Annual Cost Estimate:
- 3 servers: $102,000
- 6 servers: $187,000
- 8 servers: $214,000
- Plus DR: $44,000

TOTAL: $258,000

Note: cost is for hardware, software, bandwidth, storage and operations management only

Cloud Computing Architecture:

- Compute Time: 15,000 hrs @ $0.12 /hr
  $18,000
- Bandwidth:
  In: 4,000 GB @ $0.10 /GB
  Out: 4,000 GB @ $0.15 /GB
  $1,000
- Auth/Authz and Messages
  Txns: 800 m @ $1.50 /mil
  Auths: 400m @ $1.50 /mil
  $1,800
- Storage:
  SQL: 40GB @ $4,800
  Azure: 4TB @ $1.80/GB pa
  $12,000

TOTAL: $32,800
Construction of extreme scale data centres demonstrated efficiency gains from massive volume
Adoption of Web 2.0 services like Skype, Hotmail, Google and cloud applications like Animoto
Pathfinders like Amazon who demonstrated the business model
Technology innovation in virtualisation and compute algorithms, such as Google’s MapReduce, Open Source Hadoop, Microsoft’s Dryad
Commoditisation of computing, storage and networking infrastructure
Obstacles to Cloud Computing

- Service Availability
- Data Lock-in
- Data Transfer & Performance Bottlenecks
- Scalable Storage
- Software Licensing & Billing
- Data Confidentiality (including Privacy)
Cloud computing is definitely the new black, and it looks like it is going to drag privacy into fashion with it.

Robin McKenzie, Blog Entry, Principal Consultant with Information Integrity Solutions Pty

The location of information in the cloud may have significant effects on the privacy and confidentiality protections of information. Information in the cloud may have more than one legal location at the same time, with differing legal consequences...


... You already have zero privacy – get over it.

Scott McNealy, CEO Sun Microsystems
Dealing with Location Privacy Issues

- North West US
- South West US
- West Europe

- CPU Pool
- Storage Pool
- Networking Pool
- Geo-Location Policy
- Access control
- Connectivity
- Compute
- Storage
- Management
- Affinity Pool
Thank you

To try cloud computing:
www.azure.com
aws.amazon.com
code.google.com/appengine