What is Cloud Computing?

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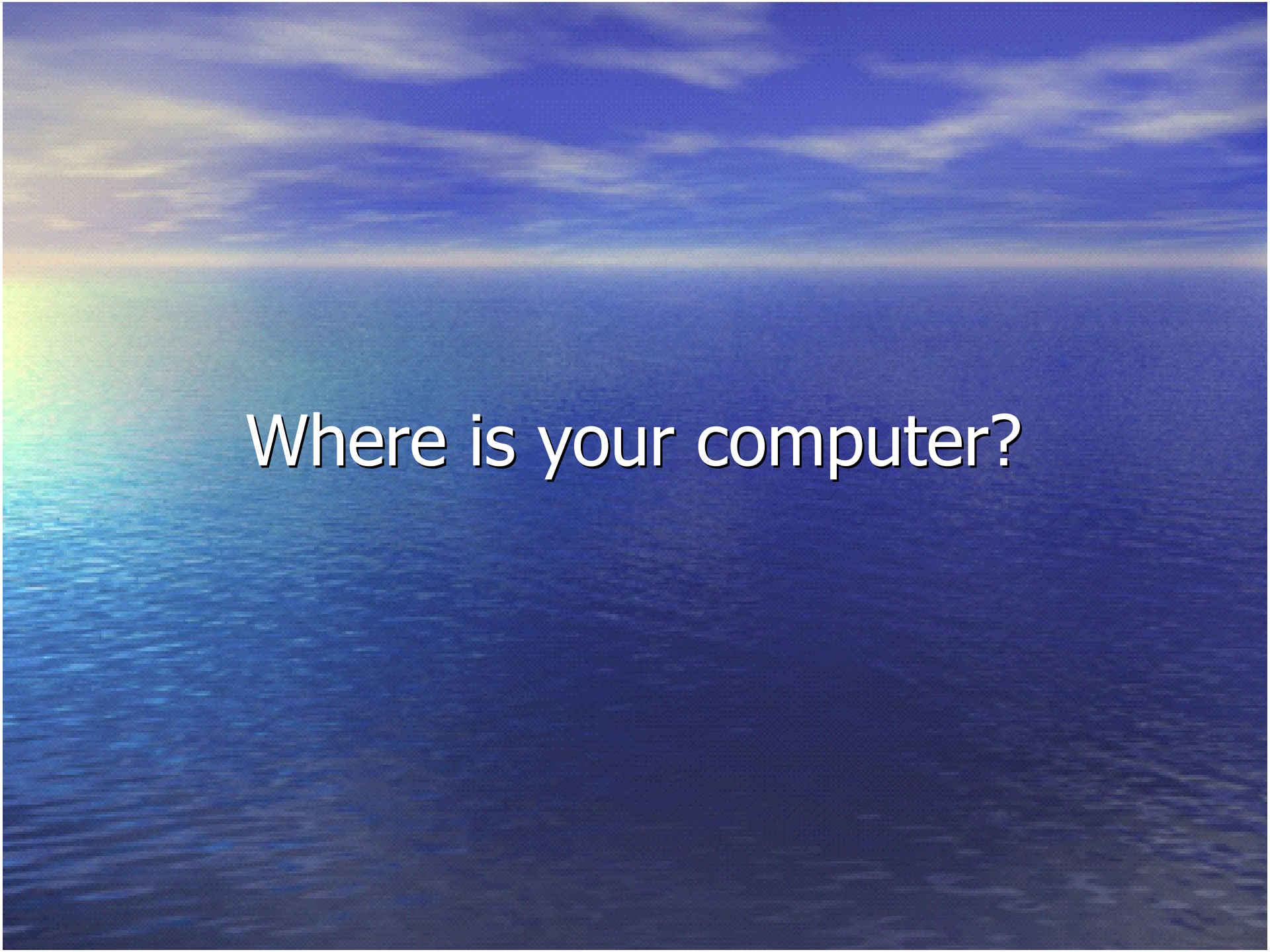
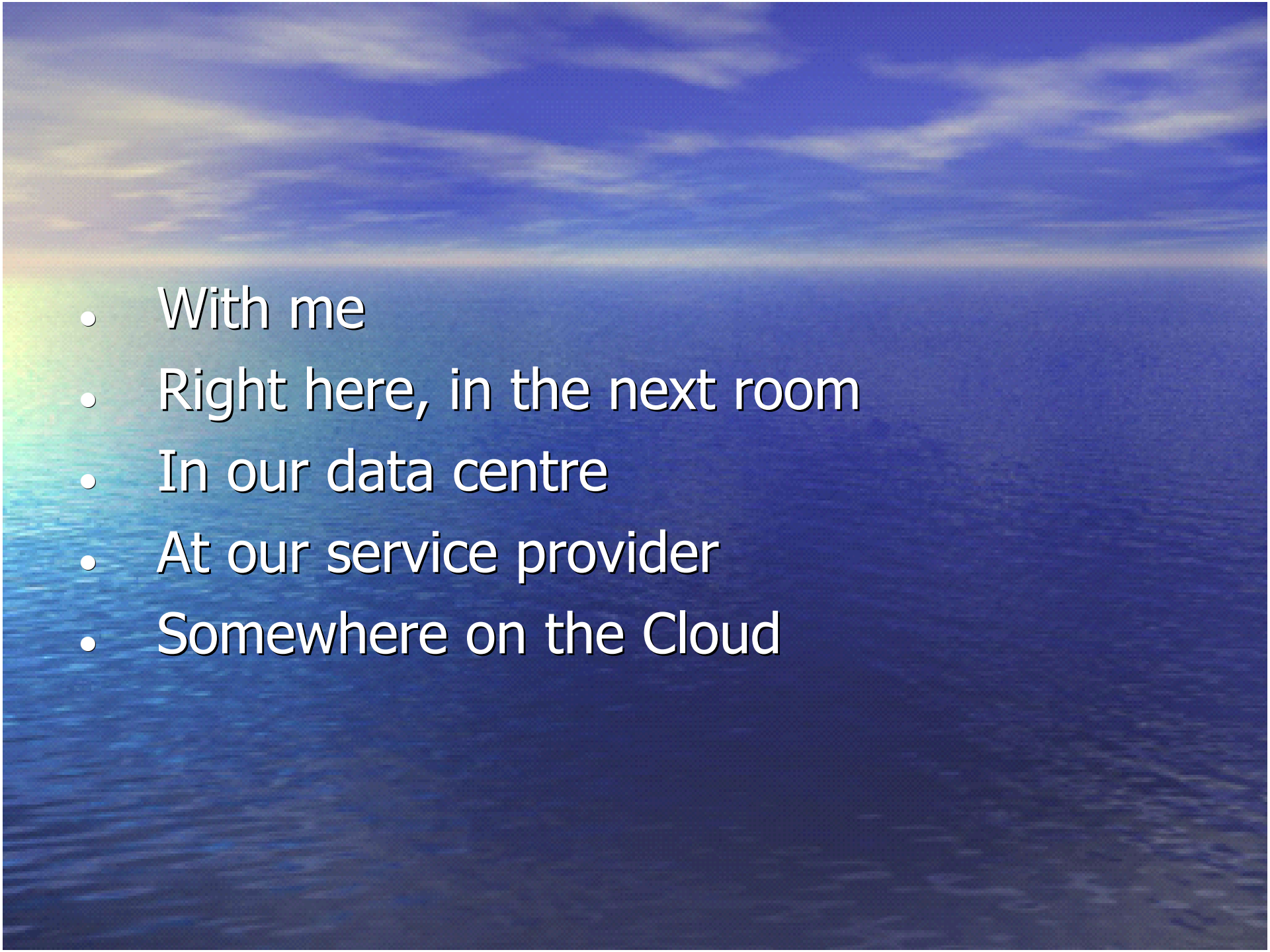
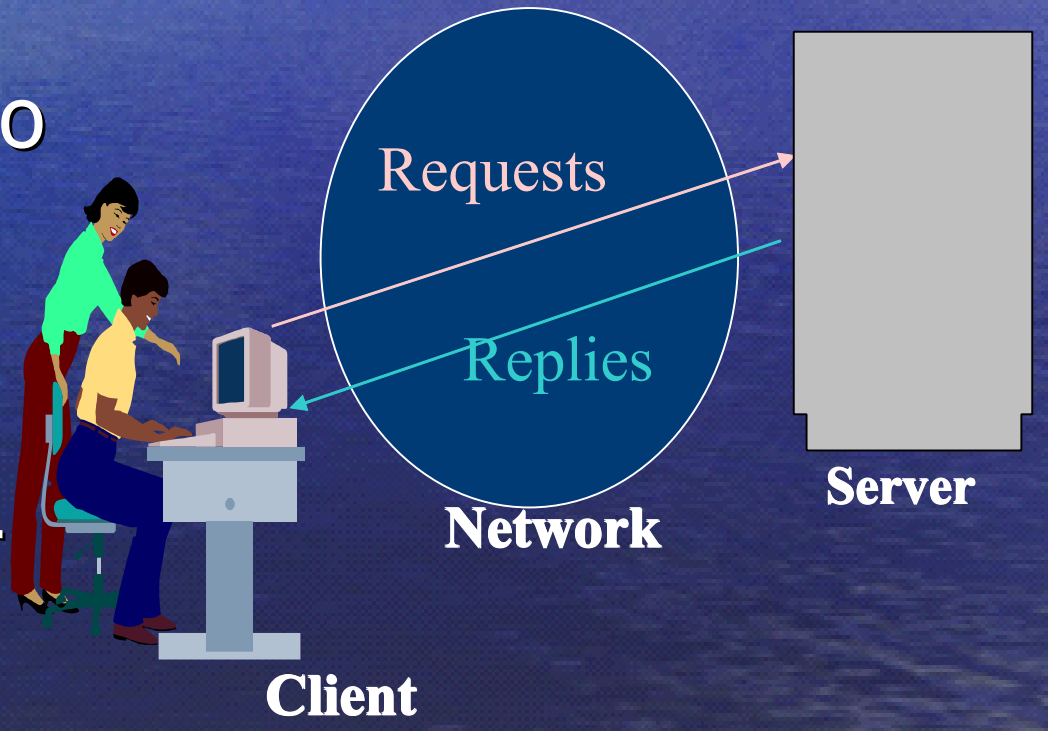

Where is your computer?


With me
Right here, in the next room
In our data centre
At our service provider
Somewhere on the Cloud

Client-Server Computing

- People use a *client* computer (or phone, etc.) to do their work
- Most of the computation is done on a server
- Server is some-where on the network



Cloud Computing

A style of computing in which resources are provided as a service over the Internet or in private network

- dynamically scalable and
- often virtualized

How Cloud Computing Works

- Various providers let you use their services
- Set up an account, perhaps just with a credit card
- Set up virtual servers or applications
- Will run on a large server farm somewhere
- Can increase capacity on a few minutes' notice
- Can shut down when you don't need it
- They send you a bill for what you use

Origin of the term "Cloud Computing"

- "Comes from the early days of the Internet where we drew the network as a cloud… we didn't care where the messages went… the cloud hid it from us"
  - Kevin Marks, Google

Development of Cloud Computing

- First cloud

  networking (TCP/IP abstraction)

- Second cloud

  documents (WWW data abstraction)

- Current cloud

  servers, applications, data, and heterogeneous platforms

Cloud Characteristics

- On-demand self-service
- High speed network access
- Resource pooling
- Location independence
- Rapid elasticity
- Measured service

Additional Characteristics

- Cloud computing often leverages
  - Massive and rapid scalability
  - Homogeneity
  - Virtualization
  - Resilient computing
  - Low cost software
  - Geographic distribution
  - Advanced security technologies

Technologies behind Cloud Computing

- Better wide-area networks
  - Cheap
  - High speed
  - Reliable
- Virtualisation
  - resources which are not really there
- Cheap, powerful hardware
  - but software still expensive

Technologies (cont.)

- High setup and maintenance costs
  - difficult to find technical people
- Unlicensed software use common
  - how can we ensure people pay for our services?

Virtualisaton

- Creating something out of nothing
  - well not really nothing
  - Providing something using something else
- Virtual servers
  - multiple servers created from a single physical server
- Virtual LANs
- Virtual Discs, etc.

Why use Cloud Computing?

- Reduces capital expenditures on infrastructure
- Reduces operational expenditures on infrastructure maintenance
- Reduces the need for skilled manpower
- Can be used from anywhere
  - office, home, or while travelling
  - all you need is a web browser and an Internet connection

Why Cloud (cont.)

- Don’t need to keep hardware for short-term high-usage periods
  - such as end-of-month
- Don't need to keep back-up servers or data

Case 1 – Cost Control

- Many systems have variable demands
  - Batch processing (e.g. New York Times)
  - Web sites with peaks (e.g. Forbes)
  - Startups with unknown demand (e.g. the Cash for Clunkers program)
- Reduce risk
- No need to buy hardware until you need it

Case 2 - Business Agility

- More than scalability - ***elasticity***!
- Ely Lilly in rapidly changing health care business
  - Used to take 3 - 4 months to give a department a server cluster, then they would hoard it!
  - Using EC2, about 5 minutes!
  - And they give it back when they are done!
- Scaling back is as important as scaling up

Case 3 - Stick to Our Business

- Most companies don't WANT to do system administration
- Forbes says:

  We are is a publishing company, not a software company
- But beware:
  - Do you really save much on sys admin?
  - You don't have the hardware, but you still need to manage the OS!

Types of Cloud Computing

- Software as a Service SaaS
- Platform as a Service PaaS
- Infrastructure as a Service IaaS

Software as a Service (SaaS)

- Applications running on a cloud
- Accessed via a web browser interface.

e.g.

Hotmail

Salesforce.com

Google Docs

SaaS (cont.)

- Instead of buying software, you rent it by the hour
  - or get it "free"
- Can be accessed from anywhere
- Using "any" device
  - No maintenance
  - No upgrading
  - No hassle
- Like a taxi service

Platform as a Service (PaaS)

- Provides a combination of services do develop/customise your applications
- Supports the application development life-cycle
- e.g. Google's App Engine, Microsoft Azure.
- Applications developed by subscriber
- Programming (.Net, Java, Python) tools supplied by service provider

PaaS (cont.)

- Provider responsible for the network, severs, operating system, storage etc
- More flexible than SaaS
- More support than IaaS

Infrastructure as a Service (IaaS)

- Provides basic infrastructure such as servers, storage, networking, etc.

e.g.

Tier 3

Amazon EC2

- Client should install OS, applications, etc.
- Templates available

Cloud Deployment Models

- Private cloud

  enterprise owned or leased
- Community cloud

  shared infrastructure for specific community
- Public cloud

  Sold to the public, mega-scale infrastructure
- Hybrid cloud

  composition of two or more clouds

Challenges and Concerns

- Security

  the elephant in the cloud
- Possibility of failure
- Legal and Compliance
- Auditing
- Lack of Standards
- Lock-in

  can I move to a different provider?

Challenges and Concerns (cont.)

- Hard to Integrate with in-house IT
- Continuity of Data Access

  what if provider goes out of business?

Cloud Security

- Clouds are massively complex systems
- Create many security related issues
- Clouds typically have a single security architecture

  but have many customers with different demands
- We may not understand security model
- Can't verify if system is secure

More on Security

- Trusting vendor's security model
- Where is the data stored?
- Who is securing it
- Administrator accountability
- Loss of physical control
- Data retention / backup standards
- Redundancy / Disaster Recovery

Choosing a Cloud Provider

- What is your objective and requirements?
- How critical is your application?
- Reputation and expertise of provider
- Performance
- Availability of support

Conclusion

- Cloud is on its way
- Can provide more features at lower cost
- Many issues to be addressed

- Don't get caught to the rain!

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