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FacultySummit 2011

Cartagena, Colombia | May 18-20 | In partnership with COLCIENCIAS

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Scientific computing using Windows Azure

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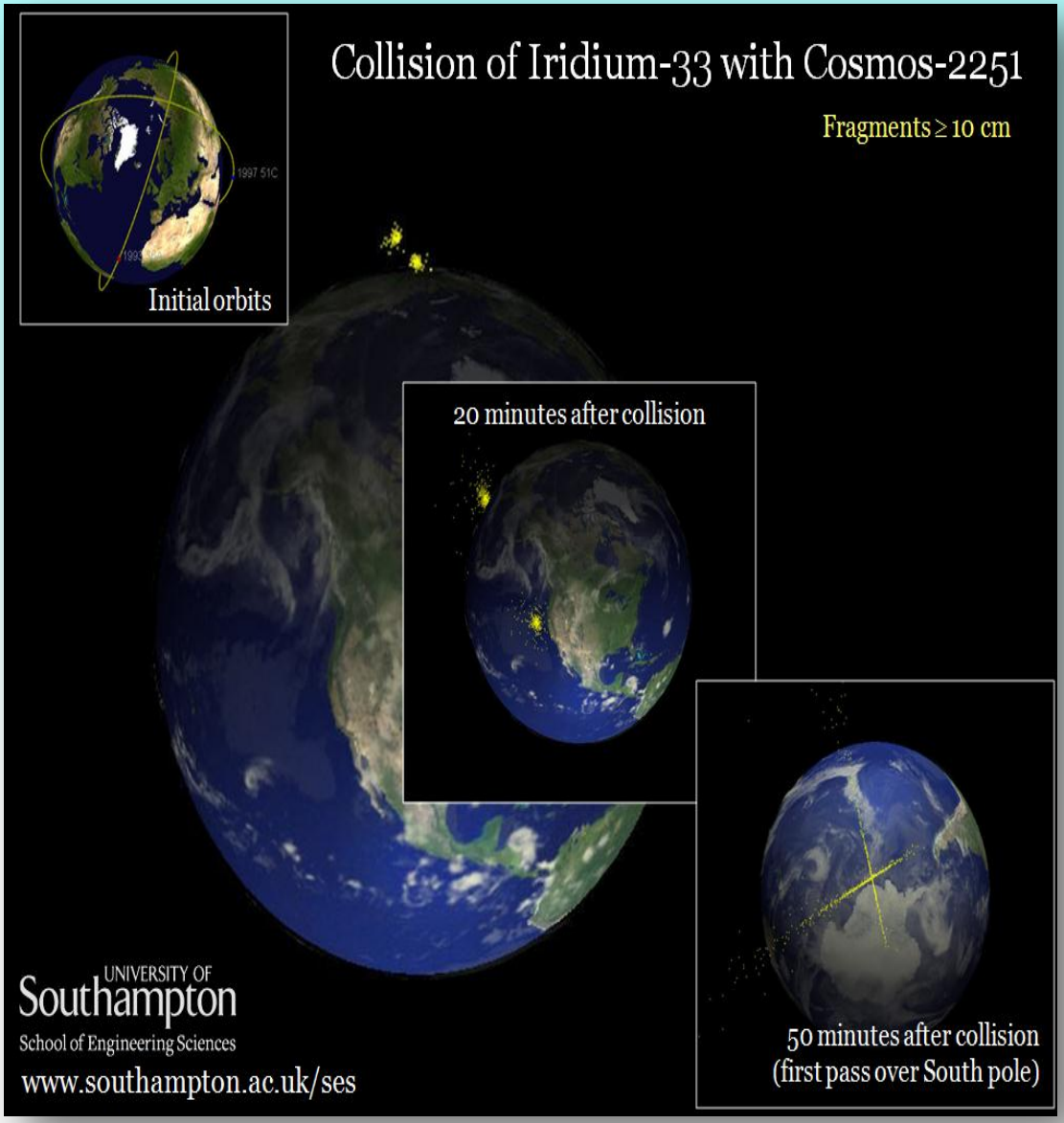
Introduction

- Space Situational Awareness
- How are we using the cloud?
  - Cloud computing scenarios
  - Clouds in Space architecture
- Data visualisation
- Atmospheric Science Through Robotic Aircraft (ASTRA)
- Q&A

Space situational awareness

- Knowledge of space vehicle environment important
- Space debris increasingly problematic, e.g. Cosmos 2251 & Iridium-33 collision in February 2009
- Near-earth objects (Apophis 2029-miss, 2036-hit)
- Observation, data management, modelling, and operational tools. Global problem requires global IT infrastructure
- Southampton Space Situational Awareness Azure System
  - Processing and visualisation of tracked space objects, conjunction/impact analysis
  - Decision support system for space debris and NEO impacts
  - Debris removal

Iridium 33 and Cosmos 2251



Space debris

~20,000 objects (currently tracked)

~19,000 objects with a diameter over 10cm (not tracked)

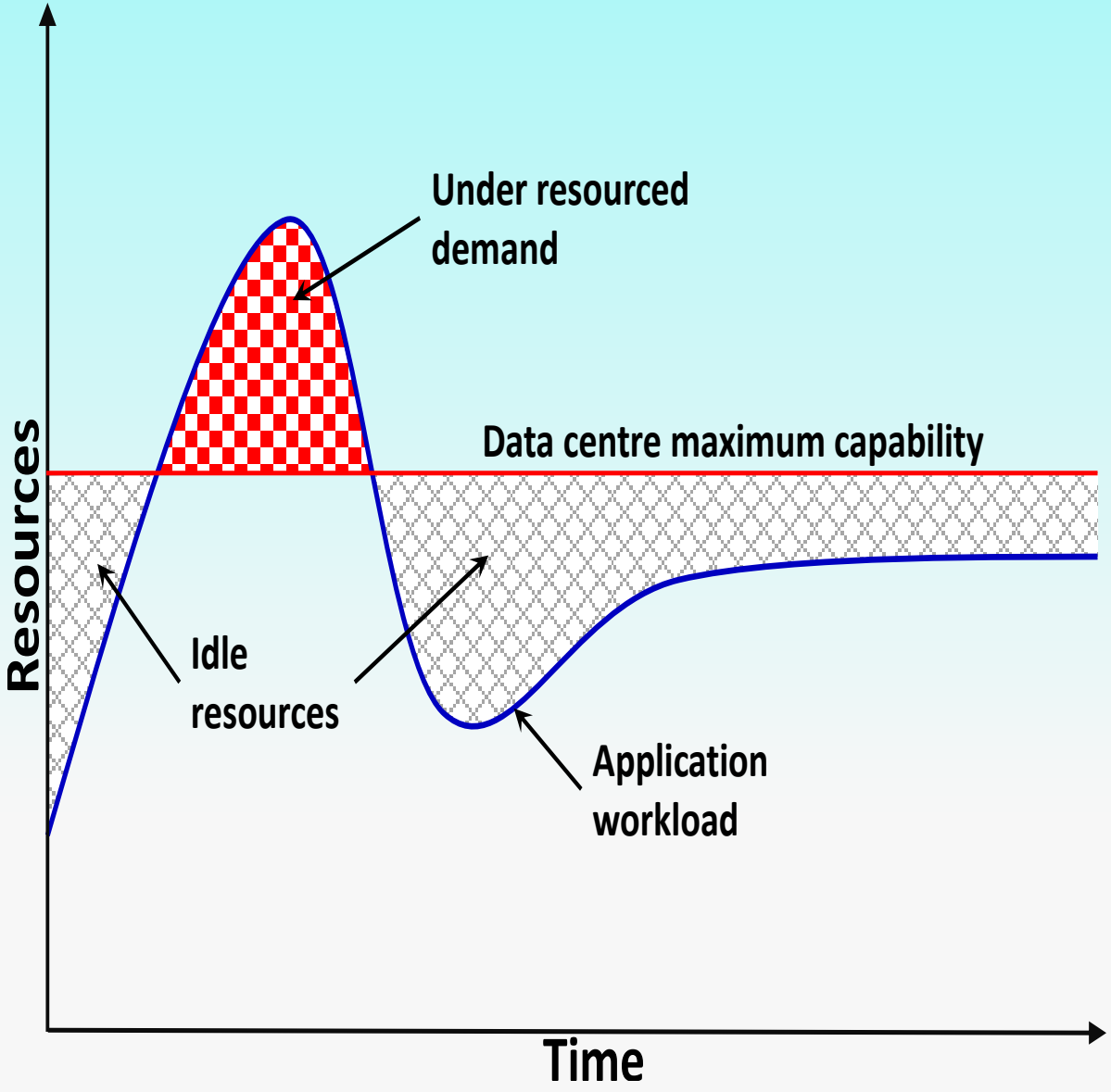
~500,000 objects over 1cm (not tracked)

*Images from www.bbc.co.uk

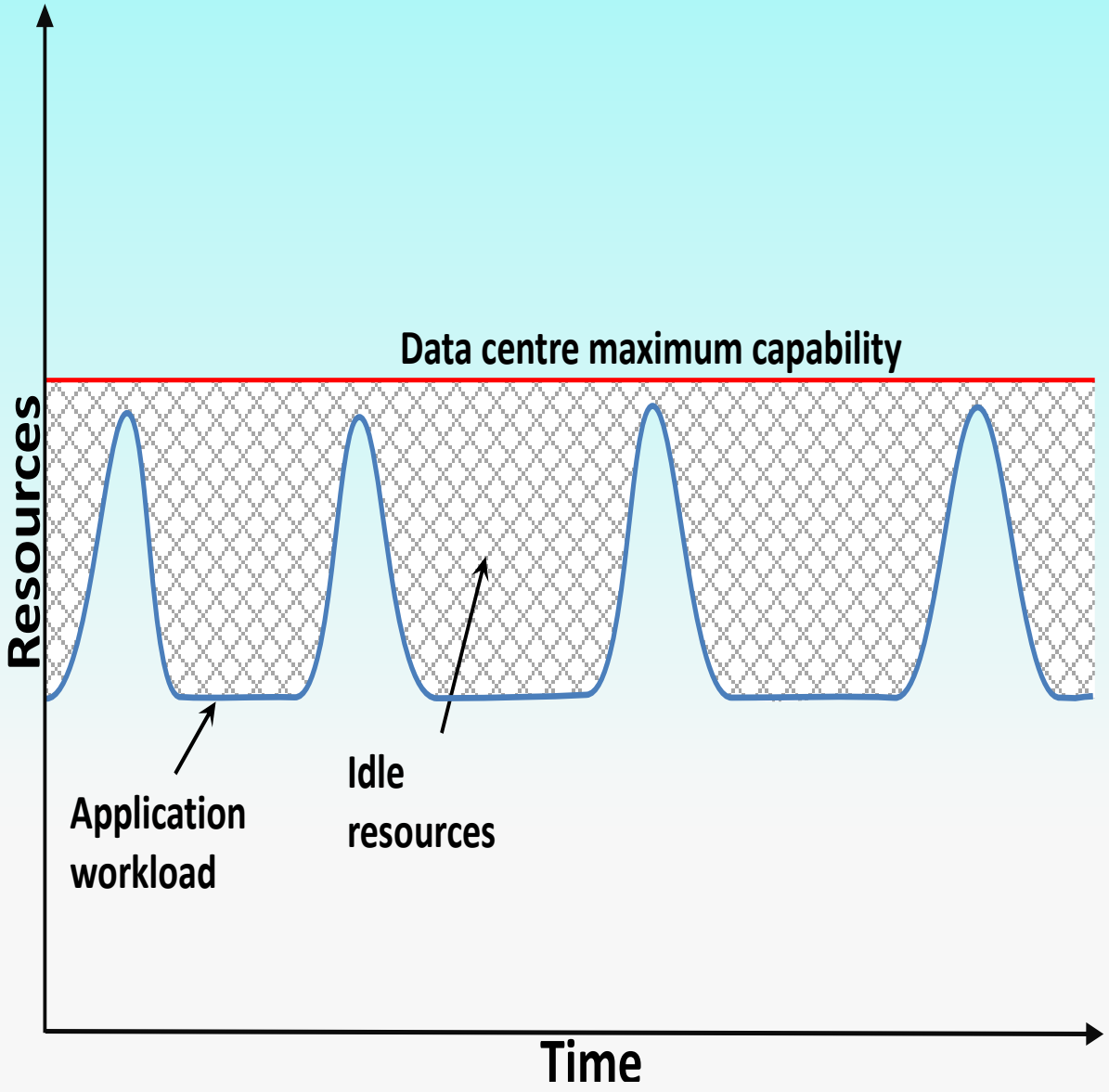
What is Cloud computing?

- Pay-per-use
- Quick provisioning
- Unlimited resources ($)
- Compare with a datacentre or outsourcing
  - Bulk hardware purchase
  - Bulk admin
  - High utilisation
- No capital cost / lead time
- “Architect well and trade time for cost”

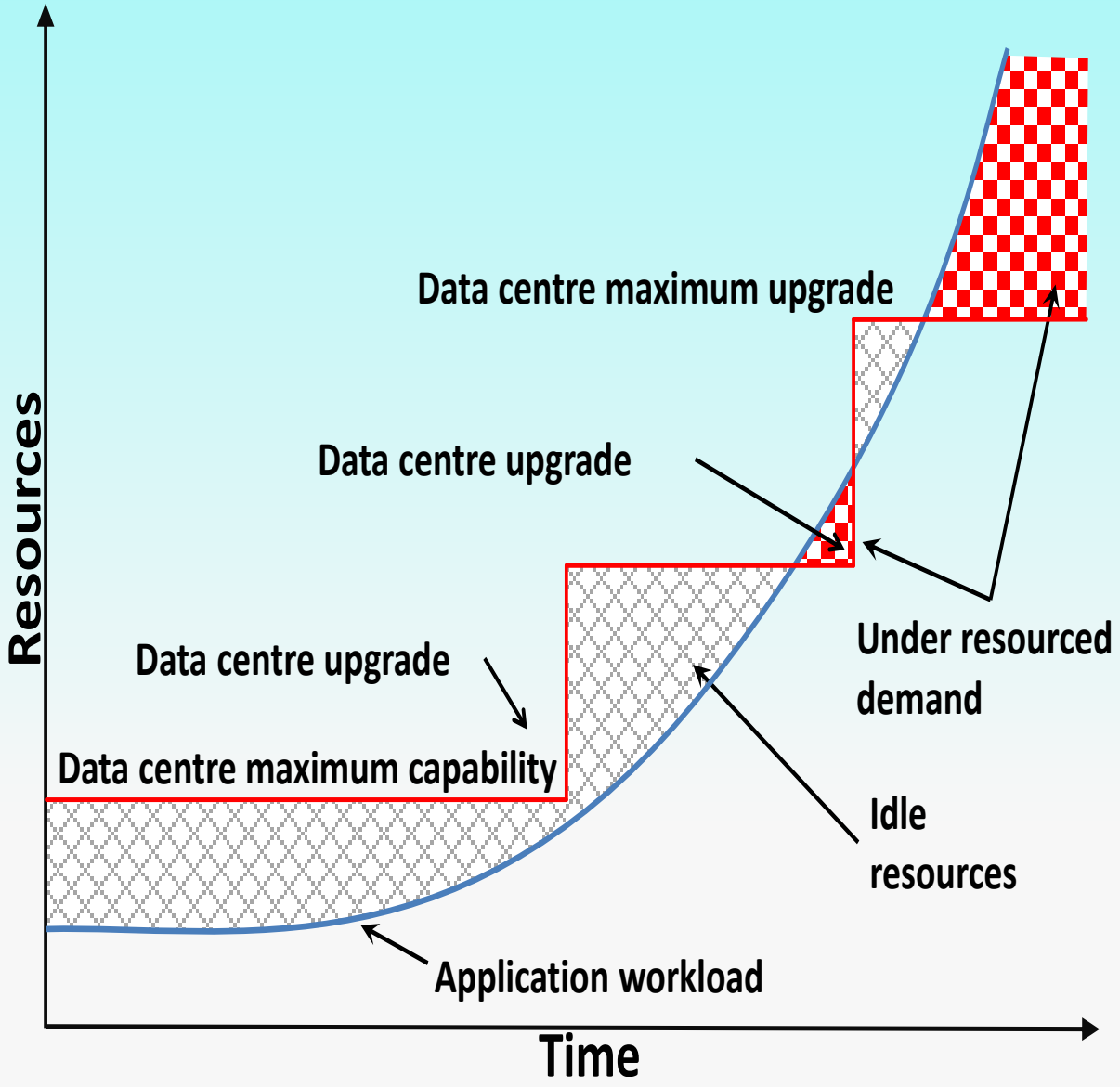
Hype curve


Under resourced demand
Data centre maximum capability
Resources
Idle resources
Application workload
Time

Burst capability (predictable and unpredictable)



(Super) - scalability



Data and algorithms

- Data dissemination
  - Co-locate data and processing power
  - Easier costing model for shared datasets.
  - DataMarket section of the Windows Azure Marketplace
- Algorithm development / validation
  - In general a serial task
  - Many require a large test dataset (large computation)
  - ‘Rent’ an appropriate machine for development tasks

Cloud computing

- Infrastructure as a Service (IaaS)
  - Cloud IaaS sells/rents out infrastructure such as servers, virtual machines and networking and is an alternative to physically owning infrastructure.
  - For example renting a virtual machine on Amazon EC2
- Platform as a Service (PaaS)
  - Often build upon IaaS, cloud PaaS offerings include an Operating System and perhaps a software stack (.Net, Java).
  - For example Microsoft Windows Azure Workers
- Software as a Service (SaaS)
  - SaaS offers an end user application and can be built upon IaaS and PaaS.
  - For example SalesForce CRM

Windows Azure

- Azure Compute
  - Windows 2008 R2 (64 bit)
    - VM Role (build locally)
  - Scale out (more hardware)
  - Scale up (faster hardware)
- Azure Storage
  - Blob
  - Table
  - Queue
  - SQL Azure

    Consider database sharding over scale-up

Compute Instance Size	CPU	Memory	Instance Storage	I/O Performance
Extra Small	1.0 GHz	768 MB	20 GB	Low
Small	1.6 GHz	1.75 GB	225 GB	Moderate
Medium	2 x 1.6 GHz	3.5 GB	490 GB	High
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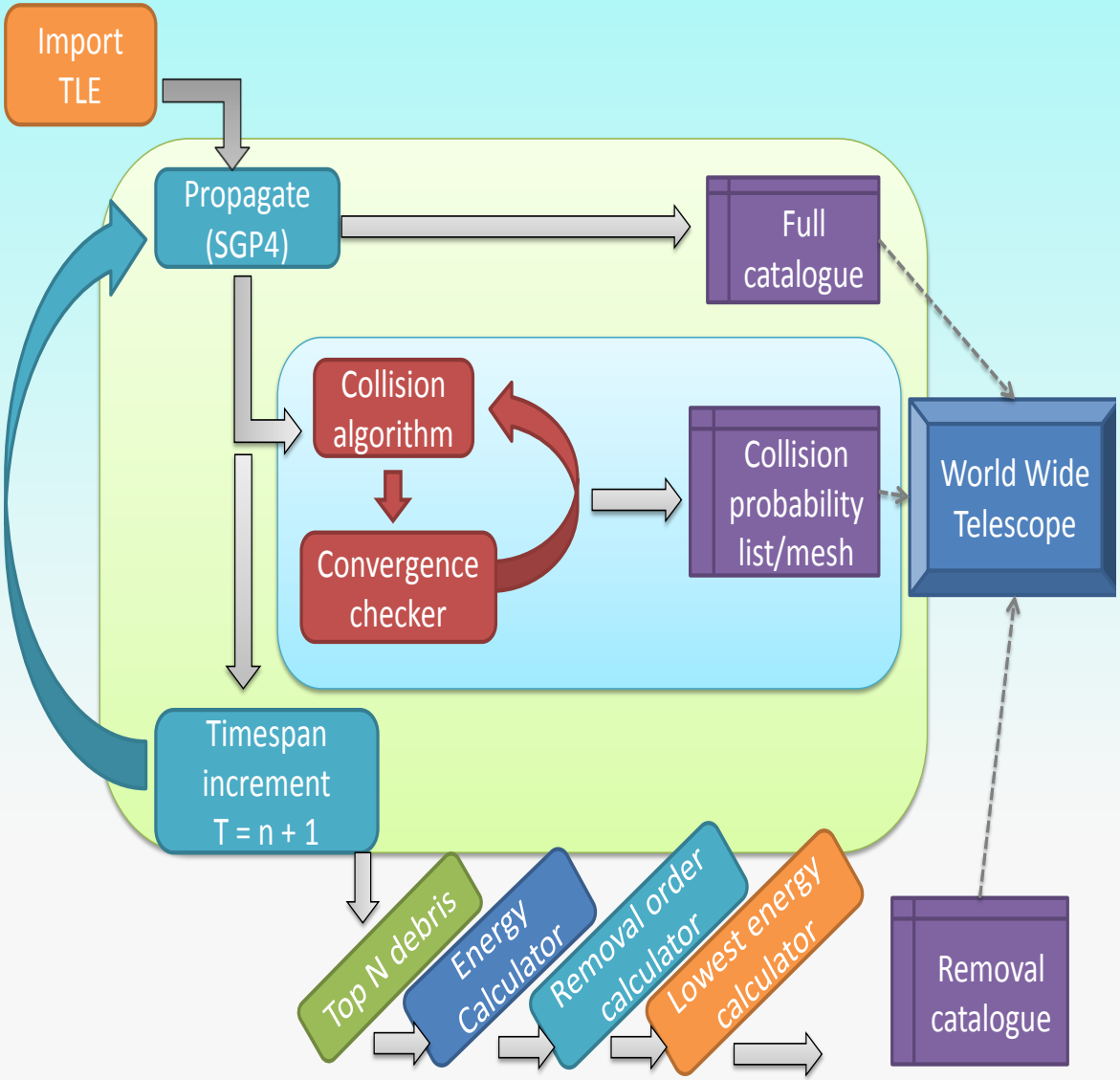
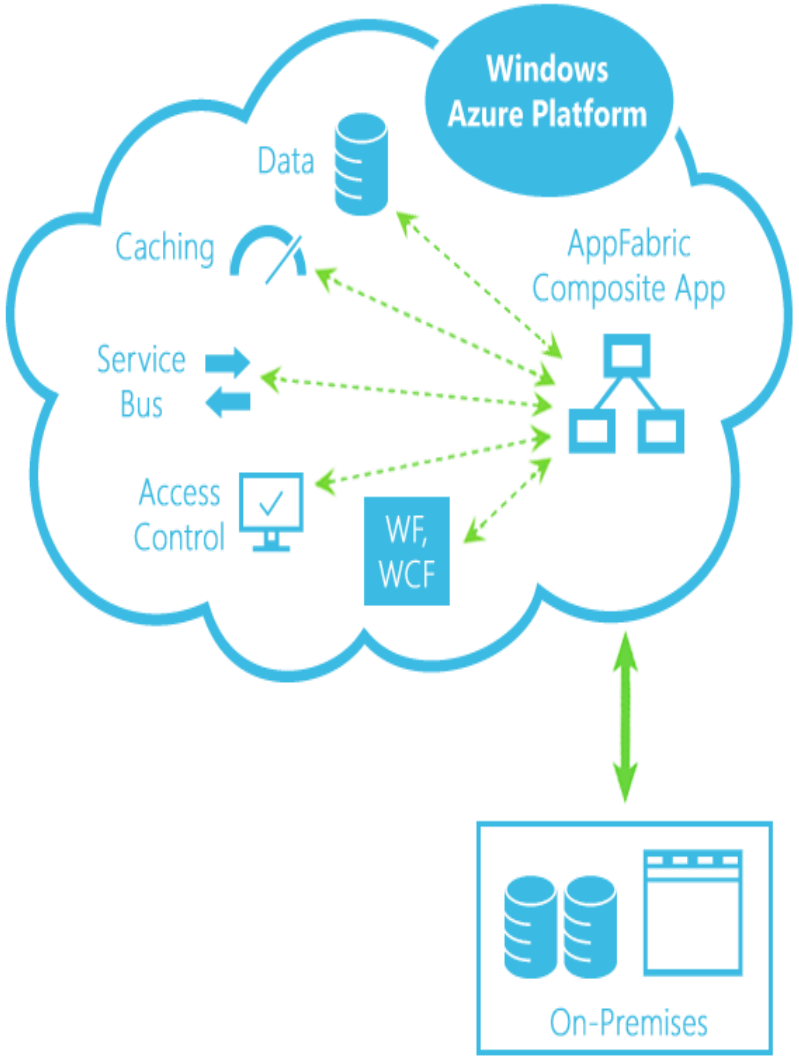
Images: www.microsoft.com/windowsazure

Clouds in space



Windows Azure

- **Compute**
- **Storage**
- Virtual Network
- Content Delivery Network
- AppFabric
  - Service Bus
  - Access control
  - Caching
  - Workflow
- Marketplace
- Appliance
- ….and more!



Images: www.microsoft.com/windowsazure

General considerations for Cloud compute

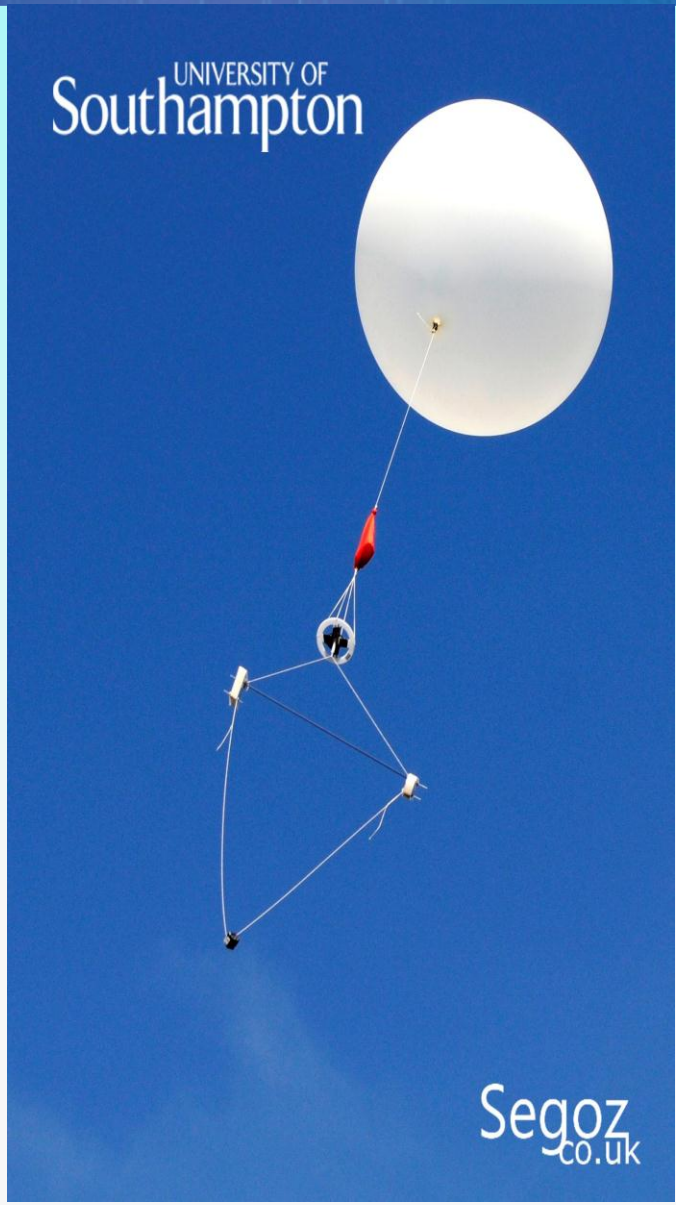
- Data storage policy (data export / local storage laws)
- There is a public network in-between (security/availability)
- SLA compensation policy
- Clouds are multi-tenanted (Security, Security, Security)
- Pricing (PAYG, Spot pricing, CPU units, offers…..) beware of direct comparisons
- Vendor roadmap (Lock-in)
- Use a flexible architecture (Pricing models change)
- Licensing (for example per core application licenses)

(Many issues are answered by current outsourcing scenarios)

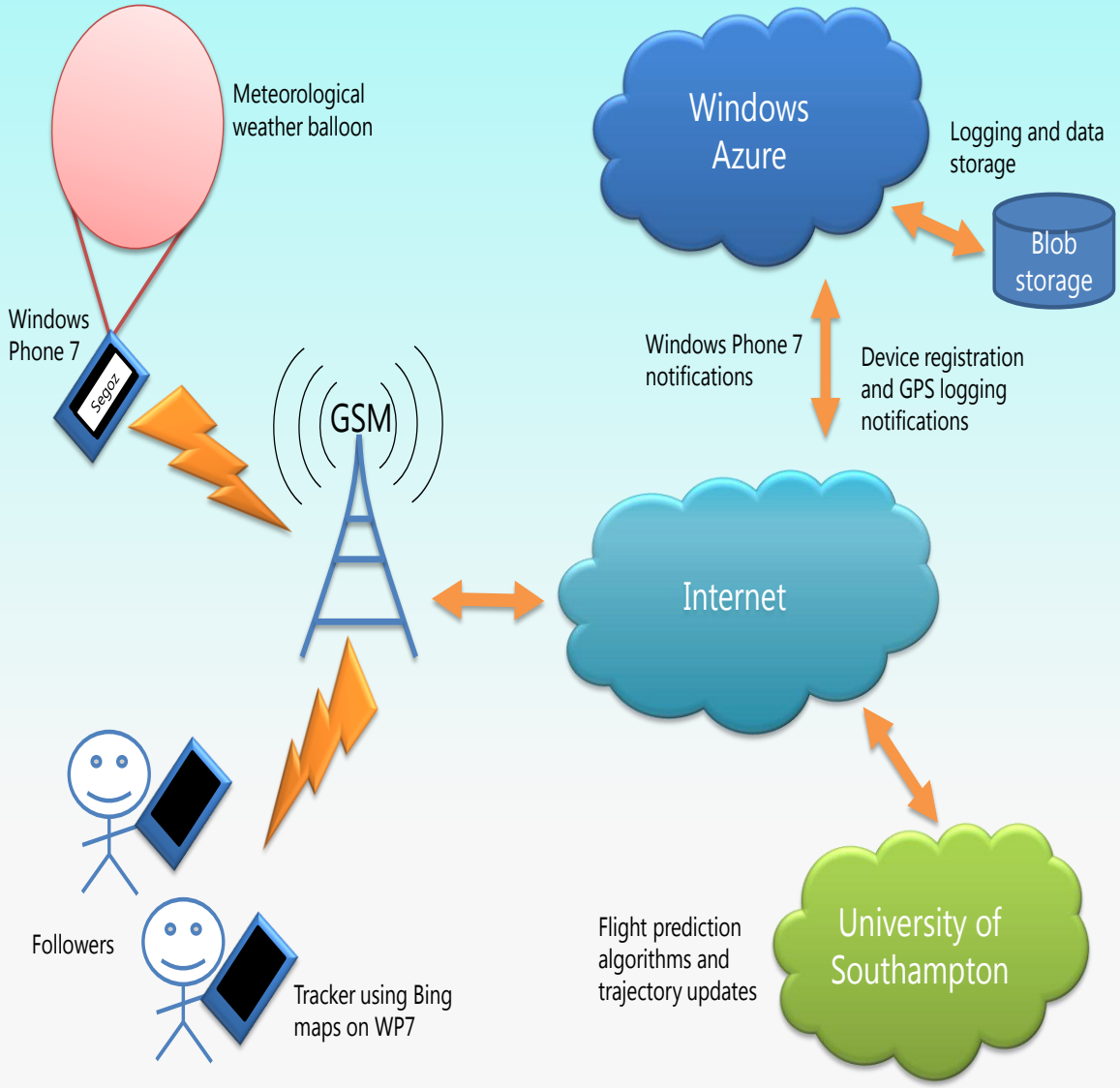
World Wide Telescope (WWT)

Atmospheric Science Through Robotic Aircraft

- Monitoring the atmosphere
  - Weather, pollution
  - Volcanic ash…
- Low cost metrological balloons
  - High altitude
- Instrument retrieval using WP7 + GPS
- Predicting the landing location with Azure

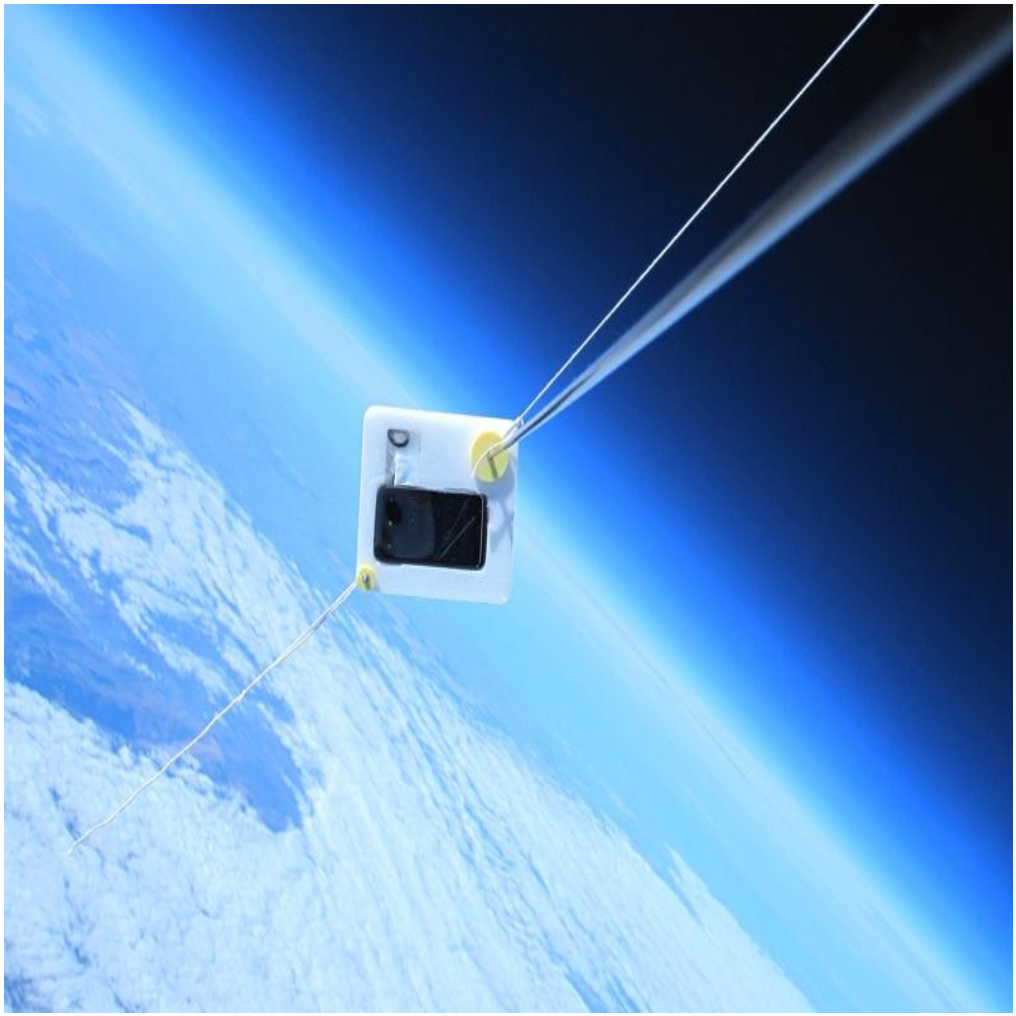


ASTRA architecture



ASTRA flights using WP7 and Windows Azure

- ASTRA 7
  - 18,237 meters (59,832 feet)
  - Top speed 145 km/h (90mph)
  - 1hr 16’
- ASTRA 8
  - 21,600 meters (71,000 feet)
  - Top speed 82 km/h (51mph)
  - 2hr 30’



Summary

- Cloud advantages
  - Burst capability (predictable and unpredictable)
  - Super-scalability
  - Algorithm development
  - Data dissemination
  - 'Augmented processing'

} Clouds in Space

} ASTRA

Cloud computing is opening up new opportunities for science

Further information

- Clouds in space

  G. Aloisio and S. Fiore, editors. Grid and Cloud Database Management, chapter Scientific computation and data management using Microsoft Azure. Springer.

  http://cmg.soton.ac.uk/research/projects/cloud-computing-for-planetary-defense/ (Previous version)

  http://cloudresearch.jiscinvolve.org/wp/category/projects/clouds-in-space/ (Blog)
- Atmospheric Science Through Robotic Aircraft (ASTRA)

  http://www.soton.ac.uk/~astra/ (Main page)

  http://segoz.co.uk/Stratosphericflight.aspx (WP7 application)

  http://www.soton.ac.uk/~astra/diary.html

  http://www.microsoft.com/showcase/en/us/details/da17789f-7914-4131-b7cb-91937be3d20a (Video)

Further information

- Azure
  http://www.microsoft.com/windowsazure/ (Main page)
  http://www.microsoft.com/windowsazure/getstarted/ (Start here)
  http://www.microsoft.com/windowsazure/features/ (Features starting point)
  http://social.msdn.microsoft.com/Forums/en-US/category/windowsazureplatform (Support forum)
  http://www.microsoft.com/windowsazure/whitepapers/ (Extra reading)
- Azure tools ($)
  http://www.cerebrata.com/products/cloudstoragestudio/ (Data access)
  http://www.red-gate.com/search?fi=1&s=azure (SQL Azure backup & admin)

Further information

- WP7

  http://watoolkitwp7.codeplex.com/ (Azure + WP7)
- WWT

  http://www.worldwidetelescope.org/ (Main page)
  http://www.worldwidetelescope.org/help/SupportHelp.aspx?Page=UserGuide (User guide)
  http://www.worldwidetelescope.org/Authoring/Authoring.aspx?Page=DevelopersProgram (Developer)
  http://www.worldwidetelescope.org/Docs/WorldWideTelescope_lcapi.html (API)
  http://www.worldwidetelescope.org/ExcelPlugin.aspx (Excel plugin)

Q & A

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