A First Look at Problems in the Cloud

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Cloud Computing

• New delivery and consumption model for IT
  – No set up cost for users and on-demand usage
  – Several service models emerging:
    Infrastructure, Platform, Software.

• Infrastructure-as-a-Service
  – Easily acquire and release virtual servers, storage, bandwidth
  – Provider manages the virtual infrastructure resources
  – User manages the application and OS

• New model = new challenges for service management
  – Virtualized and abstracted resources
  – Limited visibility into the infrastructure layer

What is required to support problem determination in the cloud environment
Problems in the Cloud

• **Our objective**: develop an understanding of the nature of problems experienced by customers of an IaaS cloud

  • Understand the types of problems arising in deployment and operation
    – How do these change over time (longitudinal study)

  • How users go about solving their problems today
    – Which problems require more help from cloud providers
    – Which problems are persistently difficult to solve

• Develop a preliminary characterization of the forum-based cloud support model
  – See paper for details

*Identify useful mechanisms and best practices for efficient problem resolution in the cloud*
Data-driven Approach

• Study actual user problems and experiences
  – Based on open support forum of a large IaaS Cloud provider

• 3 years of message threads
  – August 2006 through December 2009
  – 9,575 reported problems (threads)
    • Too many for manual classification
    – Each thread consists of a number of related forum postings
      • Free text problem symptoms and suggested solutions
      • Timestamps and user id
      • Need to impose structure for automated grouping

• Text analytics to classify reported problems
  – IR techniques to group problems into clusters
  – 91% of threads mapped to 27 clusters
  – Grouped in 5 classes
Observed problem taxonomy

- **Image Maintenance**
  - Image bundling
  - Storage and image migration
  - Update/install kernel in img
  - API errors (java exceptions)
  - SSH key-pair
  - Misc bundling

- **Connectivity**
  - General reachability
  - Firewall
  - Connecting to applications

- **Performance**
  - Instance not responding
  - Instance stuck in terminating
  - Storage performance
  - Connection performance

- **Virtual Infrastructure**
  - Attach/detach virtual storage
  - Virtual load balancer
  - DNS and virtual IP

- **Application**
  - Email server setup
  - Windows licensing
  - LAMP setup
  - Linux
Observed problem taxonomy

<table>
<thead>
<tr>
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- Roughly even split across classes
  - Fewer application problems fewer (typically out of scope for IaaS)
Size of the Different Classes

- Roughly even split across 1st 4 classes
- Fewer application problems fewer (typically out of scope for IaaS)
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Evolution of Problem Classes

- Image maintenance shrinks: release of new tools
  - Improves on existing techniques
  - E.g. 1st Quarter 2007: image manipulation feature
- Virtualization grows: release of new features
  - Users unfamiliar with new feature
  - E.g. 3rd Quarter 2008: virtual storage
- Connectivity remains stable
- Users consult operators for difficult problems
- Operators involvement needed for 20-65% of the threads
- Performance & virtual infrastructure requires the most help
  - Performance: virtualization abstracts away details needed to debug
  - Virtual Infrastructure: user can’t change state of provider’s infrastructure
Evolution of Problem Difficulty

- Over time less help is needed from the operators
  - Forum builds up a DB of solutions
- In a few cases users still need help from the operators
  - Resource abstraction limits user control/visibility
- The virtual infrastructure class is the exception
  - New features are added: users need help understanding them
Observations and Suggestions

• Large fraction of problems solved through self-diagnosis by users

• Limited user visibility causes more operator involvement
  – E.g., Difficult to determine root cause of instance unresponsive
  – Suggestion solution: expose information to the user

• Additional user control for some services could streamline resolution
  – E.g., inspect or change storage volume state
  – Suggestion solution: expose additional control to the user

• New features often introduce new problems
  – Suggestion: Proactive release of companion debugging tools
Some Issues in Enabling Suggested Solutions

• Expose information to the user
  – Protect provider infrastructure details
  – Expose only information relevant to user
  – Reduce collection/storage overhead

• Expose additional user control
  – Multitenancy complications
  – Preventing misuse at the infrastructure level
  – Making the controls scalable
Conclusion

• Empirical study of problems in large provider
  – Classified problem reports into 5 main groups
  – Most persistent problems: virtual infrastructure & performance
  – Problems become less difficult as the forum builds up a database of solutions

• Suggested mechanisms for more effective resolution
  – Expose more information
  – Add user control for infrastructure services
  – Develop specific debug tools for new releases
Thank You

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Questions?
Backup
Class 1: Virtualized Infrastructure

- Virtualized components attached to instance
  - Storage, Load balancers
- Sample problem:
  - Unable to detach storage from an instance because of transient hardware failed during detach operation
Class 2: Image Maintenance

- Pertaining to maintenance of an image
  - Bundling/Storing the image
  - Updating or patching image OS

- Sample thread
  - Image throws exceptions during boot up because the image was not built with the appropriate libraries
Class 3: Connectivity

• Connecting to the instance
  – Firewall configuration
  – Connectivity to application

• Sample problem:
  – Unable to connect to instance because kernel ran out of memory and took down the SSH daemon
Class 4: Performance

• General performance of resources in the cloud
  – Performance of instances
  – Performance of virtualization components

• Sample thread
  – User experience poor storage performance because hardware is degraded
Class 5: Application Related

• Related to applications run within the cloud
  – Email server setup/maintenance
  – Setup of LAMP & other issues
  – Windows licensing

• Sample thread
  – How to configure LAMP setup in the presence of dynamic IP addresses