Synergy2Cloud: Introducing Cross-Sharing of Application Experiences Into the Cloud Management Cycle

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Multi-Tenant Clouds

- Resource contention
- Performance variation
- Failures

Challenging to ensure good application performance
Our Position: Cross-Sharing Experiences

Red would benefit if Green shared info about the failure
Ensuring Performance with Good Decisions

Good **provisioning** decisions

App1: How to best scale next?

Need information to guide provisioning decisions
Ensuring Performance with Good Decisions

Good **runtime** decisions

Detect node failure & restart tasks

Need information to guide runtime decisions
Ensuring Performance with Good Decisions

- Generating an efficient execution plan [NSDI 12]
- Scheduling a known execution plan [SOSP 09]
- Runtime decisions
  - Stragglers [OSDI 08, OSDI 10]
  - Managing traffic [SIGCOMM 2011]
  - Failures [HPDC 12]

All these decisions can benefit from extra information
Obtaining Information Today: Operator

Operator monitoring can be useful but has important shortcomings.
Obtaining Information Today: Apps

Application monitoring also has several limitations:

- Limited view of environment
- Limited to owned resources
- Limited by scale of app

Application monitoring also has several limitations
Commonality among cloud apps

- LARGE SCALE FWK
  - e.g. MapReduce.
  - Many apps built on top

- OS
  - Few OS image types available

- HARDWARE
  - Virtualized. Few instance types available

Unique opportunity in the cloud
Cross-Sharing Application Experiences

I need to scale out fast

Benefiting from information shared by others
Today: Rudimentary Sharing

Too slow. Requires human involvement. Needs to be automatic.
Hurdle to Overcome: Isolation

Isolation impedes sharing and measurement
But Isolation is Important

• More predictable performance
• Improved security

• Today, we are striving to isolate at all levels
  – Network [NSDI 11, CONEXT 10, Xen]
  – Storage [VMWare]
  – CPU [Xen]
  – Caches [CCSW 09]

Is complete isolation the way to go?
Cross-Sharing Application Experiences

Examples

Incentives

Challenges
Cross-Sharing Example: Performance

Shared performance information may help scheduling
Cross-Sharing Example: Scalability

- Red needs to scale fast
- No time for testing
- Which VM type to use?
- Information from green may be useful

Sharing can inform scaling decisions
Cross-Sharing Example: Failures

- Detect compute node failures
- **Green** deployed at larger scale
- **Green** detects failure faster
- **Red** has few vantage points
- **Red** can benefit from **green’s** experience

Some applications are better suited to discover failures
Incentives for the Operator

• 1. App performance = cloud performance
• 2. Apps = huge monitoring platform
• 3. $$$
• 4. If you can’t beat them, join them

Share 3rd party

Use
Incentives for the Applications

• 1. More info => better decisions
• 2. Obtain info quickly – no trial and error needed
• 3. Info about resources that they don’t use
• 4. Some apps better suited than others
Addressing Challenges

- Increasing information expressiveness
- Verifying information authenticity
- Establishing similarity between applications

Synergy between applications and operator
Challenge – Increasing Expressiveness

Another Data Center

Path is congested

Limited infrastructure knowledge
Challenge – Increasing Expressiveness

Empty slots

100% CPU usage

What does 100% CPU mean for me?

Effects of isolation – Info meaningful in context of red only

Operator should provide abstract location information
Challenges - Authenticity

I have 20 instances connecting simultaneously to storage and my throughput is....

- Verify where possible (ownership)
- Cull outliers with statistics
- Filter incoming sources of shared data

Fake Performance Info vs Bad Performance Info
Challenges – Establishing Similarity

- Difficult in the general case
- Not all layers impact every shareable information (compute failures)
- Detect paths in the layers that impact the shared information
- Encode similarity between paths (e.g. hash codes)
Our first step for making cross-sharing a reality
Conclusion

- **Our position:** cross-sharing experiences a promising direction

- **Win-win** for both applications and operator

- Not trivial - several interesting challenges ahead