

the Openstack-Openstack federation model. AWS STS returning temporary credentials is similar to obtaining Resource Acquisition Token (RAT).

The access rules supported by Amazon are very similar to but different from Keystone policies (described in IV.A). Access rules here refer to a JSON document that specifies the access rights for federating users. It contains the following fields – Action, Resource, Effect and Principal [13]. Effect specifies whether to allow or deny an Action on a Resource by a Principal. The Principal is generally a user. These access rules are used along with the API calls to enforce access control. This is similar to the model used for Openstack - Openstack federation. Action can be mapped on to a Privilege, Resource is analogous to Object, Effect is analogous to Rule and Principal maps to Subject.

Since OpenStack is written in Python, we are using the Python SDK for Amazon called boto. This has modules for various services provided by Amazon like EC2 and S3. There is similarly also a module for AWS STS which provides the necessary APIs namely `get_federation_token`, `assume_role` and `assume_role_with_saml`.⁴ Similar to the policy engine of Openstack.s

6. Conclusion

We have proposed a secure infrastructure which allows secure sharing of resources between Openstack and Openstack and also between Openstack and Amazon. This showcases the generality of the proposed scheme. In addition, our architecture also has the desired property of having the control of resources in the remote cloud. The federation design also ensures that controlling access to the remote cloud is easy and secure.

7. References

- [1] Moreno-Vozmediano, Rafael, Rubén Montero, and Ignacio Llorente. "IaaS cloud architecture: from virtualized data centers to federated cloud infrastructures." *IEEE Computer* (2012): 1-1. (Access date: 10 July 2013)
- [2] Celesti, Antonio, Francesco Tusa, Massimo Villari, and Antonio Puliafito. "Security and cloud computing: Intercloud identity management infrastructure." In *Enabling Technologies: Infrastructures for Collaborative Enterprises (WETICE)*, 2010 19th IEEE International Workshop on, pp. 263-265. IEEE, 2010. (Access date: 21 June 2013)
- [3] "API Endpoint", <http://docs.openstack.org/developer/nova/devref/api.html> retrieved on (Access date: 31 August 2013).
- [4] Calero, Jose M. Alcaraz, Nigel Edwards, Johannes Kirschnick, Lawrence Wilcock, and Mike Wray. "Toward a multi-tenancy sauthorization system for cloud services." *Security & Privacy*, IEEE 8, no. 6 (2010): 48-55. (Access date: 15 June 2013).
- [5] Chadwick, David W., and Matteo Casenove. "Security APIs for My private cloud-granting access to anyone, from anywhere at any time." In *Cloud Computing Technology and Science (CloudCom)*, 2011 IEEE Third International Conference on, pp. 792-798. IEEE, 2011. (Access date: 25 August 2013)
- [6] J. D. Amit Sangroya, Saurabh Kumar and V. Varma, "Towards analyzing data security risks in cloud computing environments," in *Proceeding at International Conference on Information Systems, Technology, and Management (ICISTM 2010)*, 2010, p. 255265 (Access date: 3 September 2013).
- [7] Luokai Hu et al., "Towards an Approach of Semantic Access Control for Cloud Computing," *Proc. 1st Int'l Conf. Cloud Computing*, LNCS 5931, Springer-Verlag, 2009, pp. 145–156. (Access date: 5 August 2013)
- [8] D. Nurmi et al., "The Eucalyptus Open-Source Cloud-Computing Sys- tem, Proc. 9th IEEE/ACM Int'l Symp. Cluster Computing and the Grid, IEEE CS Press, 2009, pp. 124–131 (Access date: 8 May 2013)
- [9] Openstack Keystone workflow and Token scoping from https://www.ibm.com/developerworks/community/blogs/e93514d3-c4f0-4aa0-8844-497f370090f5/entry/openstack_keystone_workflow_token_scoping?lang=enS(Accessdate:15May2013)
- [10] GetFederationToken API http://docs.aws.amazon.com/STS/latest/APIReference/API_GetFederati onToken.html (Access date: 1st March, 2014).
- [11] Assume Role API, http://docs.aws.amazon.com/STS/latest/APIReference/API_AssumeRole.html (Access date: 1st March, 2014).
- [12] Assume Role With SAML API http://docs.aws.amazon.com/STS/latest/APIReference/API_AssumeRole WithSAML.html (Access date: 1st March, 2014)
- [13] Policy document specification <http://docs.aws.amazon.com/IAM/latest/UserGuide/>