

Intel Cloud Orchestration Networking Design and Goals

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7 December, 2016

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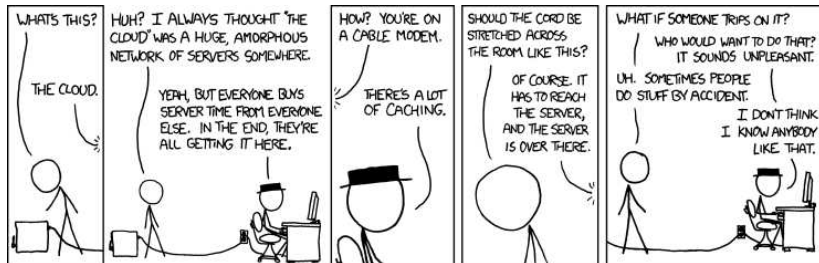
Our team is implementing a software defined network based on Open vSwitch for a cloud orchestration technology called Ciao.

Our client is Rob Nesius, Engineering Manager at Intel Corporation.

Scope

What is a cloud?

Figure 1: The Cloud - Randall Munroe [1]



"A huge, amorphous network of servers somewhere"

Scope

The network connecting the nodes must be controlled. In our case, this is achieved by the Cloud Integrated Advanced Orchestrator, or Ciao.

Ciao provides an easy to deploy, secure, scalable cloud orchestration system which handles virtual machines, containers, and bare metal apps agnostically as generic workloads [2].

Scope

The servers, or nodes, in these clouds need to talk to each other, hence the need for a network solution.

Ciao uses a software defined network to allow different compute nodes to communicate with each other.

Software defined networking is a software abstraction of physical networking solutions, allowing for “a more scalable and centralized network control architecture” [3].

Project Goals

Goal One

Switch Ciao Generic Routing Encapsulation (GRE) tunnel implementation to use Open vSwitch-created GRE tunnels.

Generic Routing Encapsulation (GRE) GRE encapsulates an arbitrary network layer protocol so it can be sent over arbitrary network layer protocol [4].

Open vSwitch (OVS) Open vSwitch is a “multilayer virtual switch. . . designed to enable massive network automation through programmatic extension” [5].

Project Goals

Goal Two

Switch the tunneling protocol implementation to best-performing network virtualization technology based on our performance measurement of each on data center network cards.

Project Goals

Goal Three (optional)

Replace the Linux bridge implementation with OVS switch instances.

Project Design

Open vSwitch uses a database to manage configuration while running. The configuration can be updated on the fly by accessing its management protocol using the Open vSwitch Database Management Protocol, defined in RFC 7047[6]

Libovsdb

Libovsdb is an open source library that provides a Go programming language wrapper around the OVS Database Management Protocol. Here is an example:[7]

Listing 1: Example insert operation using libovsdb

```
// simple insert operation
insertOp := libovsdb.Operation{
    Op:    "insert",
    Table: "Bridge",
    Row:    bridge,
    UUIDName: namedUUID,
}
```

nvGRE and VxLAN

Two alternative tunneling protocols to replace GRE, the current protocol used by Ciao.

nvGRE: Network virtualization standard created in tandem by HP, Dell, and Intel VxLAN: Network virtualization standard created in tandem by Cisco, VMware, Citrix, and Redhat

Overall performance and overhead are similar on paper, will require testing to see which is the best fit for our implementation

Stumbling Blocks I

The one major problem we had during the fall quarter was getting the Intel NUCs connected to the campus network. We required network access to install Clear Linux on the NUCs, to access them remotely via SSH, and to perform actions that require internet access such as accessing the Ciao git repository hosted on GitHub. Intel wants us to store the NUCs in a secure location. Kevin McGrath let us use his lab which has restricted access.

We set the NUCs up in Kevin's lab on campus, and had to work with Todd Shecter, the head of the OSU EECS IT department to get permission to connect them to the campus network, and register them so they would be able to connect to the campus network. This took three weeks between technical issues and communication delays because most of our communication was done by email.

Stumbling Blocks II

- ▶ We first emailed Todd with an explanation of our project and requested network access. He requested a meeting to better understand what we were doing.
- ▶ After explaining our project to Todd in person, he gave us permission to connect the NUCs to the campus network, and said he would help.
- ▶ To connect the NUCs to the network Todd required the MAC address of each device.
- ▶ None of the NUCs had an OS on them, and the MAC address was not listed on the case, or in the BIOS. We had to boot each NUC from a USB flash drive to get the MAC address.
- ▶ We provided Todd with the MAC addresses of each NUC so they could be connected to the campus network.
- ▶ We waited for Todd to register the NUCS on the campus network.

Stumbling Blocks III

- ▶ After Todd registered the NUCs they were not being assigned an IP address by the campus network.
- ▶ As a workaround so we could install Clear Linux we bridged the network connection from Garrett's laptop to the NUCs.
- ▶ We emailed Todd explaining the IP address issue, and he had us go through several troubleshooting steps, none of which worked.
- ▶ Todd had us connect one of the NUCs to a different switch in the lab which resolved the issue.
- ▶ We were going to move the NUCs over to the other switch, but it took a couple of days before we had time to do this, and during that time the campus network started assigning IP addresses to the NUCs.

References

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