

Proposal: Cross Network Secure Service Networking

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Abstract—Cross network secure service networking is starting to be a more common requirement these days where certain services must be accessible but proper security controls must also be implemented to prevent unauthorized access. Traditionally this can be accomplished by means of a virtual private network (VPN), but this does not always work with services or applications that can't run the required VPN software. Cross network secure service networking allows for services to communicate with each other across networks by establishing an encrypted and authenticated overlay network that allows for secure communication at the service level. This proposal will compare existing frameworks, and propose a new framework that offers security as the preliminary design consideration.

I. INTRODUCTION

Cross network secure service networking is starting to be a more common requirement these days where certain services must be accessible but proper security controls must also be implemented to prevent unauthorized access.

VPN are present in a modern connected world. One instance is in corporate environments which allows secure access to protected services from untrusted environments, such as the public internet. Secure access to corporate services can be accomplished by means of a client to site or a site to site virtual private network (VPN). Generally with a site to site VPN, the tunnel are usually established by dedicated hardware. With a client to site VPN, the tunnel is usually established by software on a client device [1] [3].

Overlay networks are common in modern data centres where they allow abstraction of certain network functions that can run on top of physical networks [5]. A common network overlay is Virtual eXtensible Local Area Network (VXLAN) [6]. This framework allows data centres to offer tenants with their own isolated network domains without deploying additional infrastructure. Network encryption is available for VXLAN by means of IPSec.

Cross network secure service networking allows for services to communicate with each other across networks by establishing an encrypted and authenticated overlay network that

allows for secure communication at the service level. Cross network secure service networking can also be leveraged by legacy applications that don't offer in transit data encryption by means of a bastion host [4] that can function as a proxy which would take in unencrypted data then pipe it to a service or client over an encrypted tunnel. A common example of such a device are terminal servers [2] that connect to supervisory control and data acquisition (SCADA) and legacy equipment that only have serial connection or telnet, and offer the user a secure session by means of a SSH session or VPN.

Multiple commercial offerings exist for software applications, notably Consul and Google Compute Engine (GCE) Identity-Aware Proxy (IAP). They offer software that enables cross network secure service networking. Consul can run on almost any operating system, while IAP is Google Cloud specific where it allows a identity aware proxy that allows secure access to non public services.

Consul is software that is majorly used for discovery and configuration for a range of applications and services, it provides an up to date outlook on services in an infrastructure. Consul was mainly built to manage services in a distributed system. One of the main challenges faced by many large scale industries, is the heightened use of distributed systems and service discovery has come as a blessing to the challenges faced by the use of distributed systems. Consul is made user-friendly with the use of a flexible and powerful interface. Consul requires a data plane and it runs with a built-in proxy. All the services discovered by consul in an infrastructure is stored in a single registry so that the services can find each other by storing the information of IP addresses or other location information, this makes consul a centralized service registry. Clients can find services that are registered with consul with the help of DNS or HTTP interfaces which leads to an easy procedure to discover resources [7].

Identity-Aware Proxy (IAP), is a service from Google which provides a central authorization layer for applications accessed by HTTPS [8]. IAP works by only granting users or so-

called members access when they possess the correct role. This allows for access control policies to be specific to resources and applications [8]. IAP works by intercepting web requests, authenticating the user making the request, and only granting access when the user is in fact authorized. This technique of implementing authentication and authorization remotely removes the need for a VPN [9]. Google's goal with IAP is to create a method that users may connect to untrusted networks and access services without needing a VPN [10] this directly mitigates the issues surrounding VPN usage, such as reduced speed. As well, users of VPNs must either have full access or no access to the network, and service granularity is extremely limited. IAP solves this by providing authentication on an application by application basis.

As the previously mentioned Consul runs in software while Google IAP runs only within Google Cloud. Consul is not designed to operate with physical equipment.

In this project we will be experimenting with available products along with a custom solution that we will design that will meet our requirements. We will be using Docker Engine with Docker Compose scripts to experiment with the software along with creating a consistent setup for a more accurate comparison.

II. PROBLEM STATEMENT

The issue you have with overlay networks is that it must be implemented at the network level, it is not implemented at the service level. This is where cross network secure service networking comes into play. This proposal will compare existing frameworks, and propose a new framework that offers security as the preliminary design consideration.

III. WORK PLAN

A. Proposal Phase

In this phase, we are researching possible topics, reading papers, and formulating a proposal for our research topic. Due date: October 5th 2020

B. Research Phase

In this phase, we are researching the approved topic by reading papers and starting to plan our experimenting phase. We are also researching what we should be using to perform our experimenting phase along with what metrics should be measured to indicate a successful experiment.

C. Experimenting Phase

In this phase, we are experimenting with the products we found during our research and attempting to generate metrics.

D. Reporting Phase

In this phase, we are analyzing, exploiting, and reporting on the data from the previous phase.

E. Presentation Phase

In this phase, we are preparing the the reported data in a presentable format.

IV. FINAL OUTCOME

We hope to have a framework that offers security as the preliminary design consideration along with support for "drop in" solution legacy applications.

V. OTHER DETAILS

A. Metrics

- Latency
- Throughput
- # Encrypted packets
- # Of clear text packets
- Resource utilization of host
- Other?

B. Licensing

All software used is free to use, open source, or licensed under GPL/GNU.

C. Software that will be used

- Kibana
- Elasticsearch
- Docker Engine
- Docker Compose
- Libvirt - QEMU/KVM
- Shadowsocks
- STunnel
- Wireguard
- Consul
- Wireshark
- Other?

D. Setup

We have planned to have a lab environment that is consistent and easy to use. We will be using Docker Engine with Docker Compose scripts to allow for a easy lab setup. A Github repository will be provided with all our research and scripts.

We have two options where we will try to run our lab environment. The first option is on our own laptops, which is the preferred option. With the few containers that we are expected to have running at once, we should have no issues. The second option is in Georges' home lab, which has a lot more computing power.

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