

Routing Gets Personal: Welcome to /32 to the client

Graduate



Stefan Meyer

Introduction: Regardless of the network architecture or topology in use: Layer 2 networks can be found everywhere. Layer 2 is particularly widespread in the access layer, where L2 switches are used for the most part, as all kinds of end devices are connected to the network, whether by cable or wirelessly. However, the use of large Layer 2 domains also brings disadvantages and limitations to the network, which can lead to minor or major problems depending on the situation.

In order to shrink these Layer 2 domains as much as possible in the network (to point-to-point), a new approach is being taken where each end device is on its own network with a /32 subnet mask. This means that each device is treated as a separate network and is routed to Layer 3 accordingly. This modification could make the entire network infrastructure less prone to faults and more efficient because everything is based on routing. This new approach is referred to in this bachelor's thesis by the term «/32 environment».

Approach / Technology: In a first step, the disadvantages of Layer 2 domains were discussed in more detail to emphasize the motivation behind this new approach for a /32 environment. The focus of this work and the tests are based on a campus network. For this reason, it was analyzed which protocols and services mainly occur in such an environment. Based on these findings, a selection of protocols was chosen that will be tested in detail for their functionality in the /32 test environments. To round off the overview, attention was also drawn to protocols and device groups that would no longer function correctly in an exclusive Layer 3 to the end device approach. With these initial insights, two identical test environments with two different network device manufacturers were set up in the practical part of this work. Arista was used in a virtual test lab, which is based on «containerlab» and works exclusively with Docker containers (Figure 1). Cisco was used in the physical test lab to be able to cover the real-world part. The /32 network was then set up and configured accordingly based on these test lab infrastructures. The problems encountered during this process, as well as solutions and workarounds that were discovered, were recorded in detail and investigated further where necessary. The same approach as for IPv4 with /32 was then followed and tested in an IPv6 environment with a /128.

Result: This work successfully demonstrated that a /32 approach can be implemented successfully and with the expected benefits from a purely technical perspective. Based on the two support matrices (one of those in Figure 2) that were created during the work, two further results came to light. The first one is that, as of today, it is not possible to set up a correctly and dynamically functioning /32 environment network with Arista or Cisco, as both manufacturers have

restrictions or bugs for which no solutions or workarounds are available. The second result confirms that all protocols work correctly in a /32 environment.

Some protocols and devices will still require large Layer 2 networks. However, this work demonstrates that where they aren't necessary, Layer 3 can be expanded up to the end device as long as router vendors provide the necessary features and bug fixes.

Figure 1: Arista virtual test lab
Own presentation

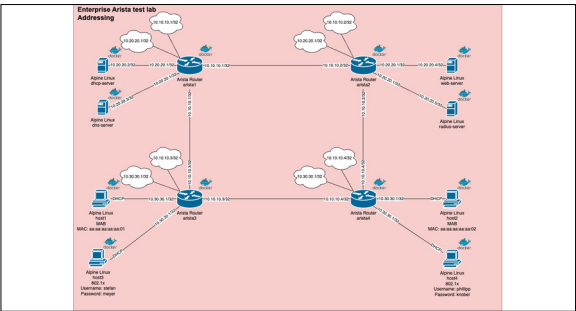


Figure 2: Support matrix /32 environment Arista and Cisco
Green = Works, Orange = Works partially, Red = Does not work
Own presentation

Topic	Arista	Cisco
Set IP address with /32 subnet mask on routed interface		
Routing works with Anycast Gateway		
DHCP Option 82 works as intended		
Automatically set static host route for DHCP host		
More than one DHCP host can be connected to the same router with the same Anycast Gateway		
Routing works with DHCP bindings		
Set interface profile / template with Radius Access-Accept message		
Interface profile / template does support IP related commands		
MAB can be set on routed interface without error message		
MAB configuration works on routed interface		
802.1x configuration behaves normally on routed interface		

Advisors

Urs Baumann, Jan
Untersander

Co-Examiner

Philip Schmid,
Isovalent GmbH,
Zürich, ZH

Subject Area
Network and Cloud
Infrastructure