

RIPE

A large graphic element for the RIPE logo, consisting of two vertical teal bars and two horizontal white bars intersecting to form a cross-like shape.

MANRS Training Lab

Open source tooling to provide hands-on labs



Context

- Developed for MANRS
- But wider applicability kept in mind all the time
- Initial development funded by ISOC (thanks!)
- Released under GPL3 after completion

Design goals

- Lab content goals
 - Allow student to get hands-on experience with different platforms: Cisco, Junos, Mikrotik, etc...
 - Automatic validation of the results
 - Teach student to use IRR

Design goals

- Management goals
 - Allow self-signup by students (optional)
 - Set a time limit for a lab (optional)
 - Allow teacher to extend time limit, pause, restart, export etc.
 - Allow teacher to view what a student is doing and help them

Component choices

- GNS3 for virtual lab
- Django front-end (uWSGI application)
- Web based interface using web sockets
- Redis for live communication channels
- PostgreSQL database for storage

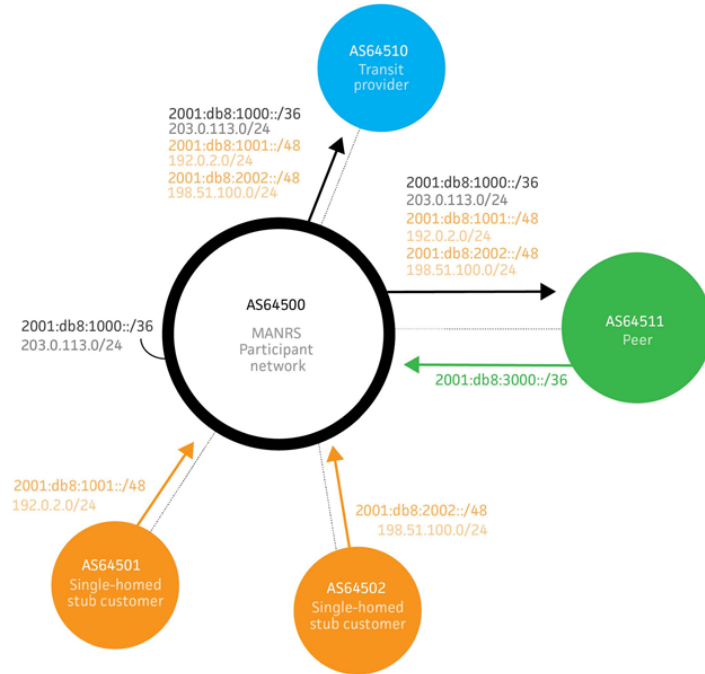
Hardware requirements

- Heavy hardware preferred
 - Every student gets their own clone
 - Every clone needs a few GB of memory and some CPU cycles
 - Juniper vMX needs a little bit more GB and CPU cores

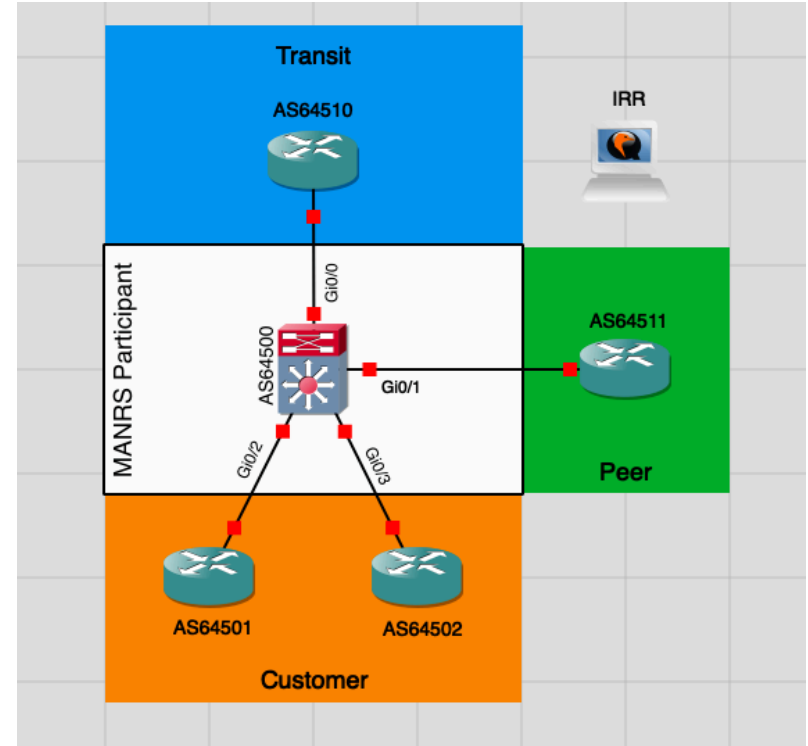
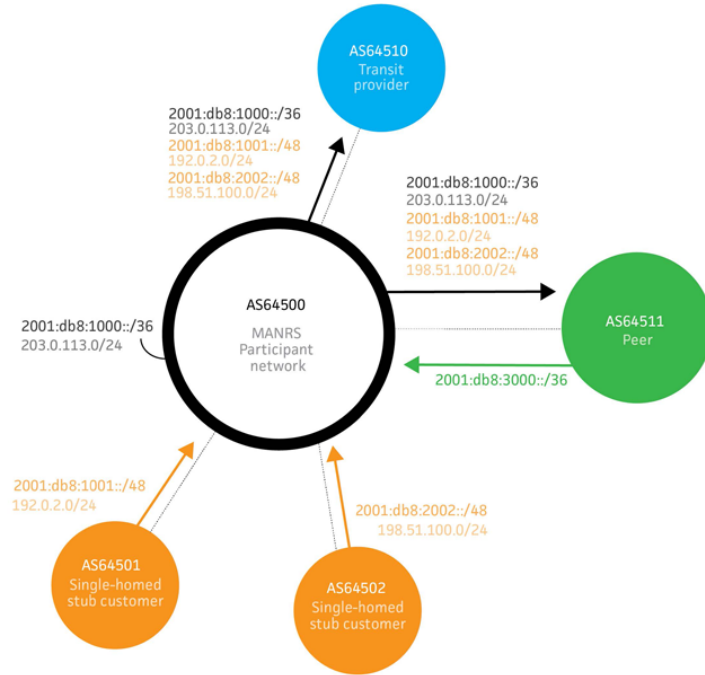
Workflow

- Build a lab template in GNS3
- Link it to the management system
- Configure description, instructions and goals
- Each student gets a clone of the template
 - Either created by teacher or by self-signup

Example: MANRS Lab



Example: MANRS Lab - GNS3 template



Example: MANRS Lab - Linking to training system

MANRS Lab Manager

WELCOME, SANDER / VIEW SITE / CHANGE PASSWORD / LOG OUT

Home > Lab > Exercise templates > Template: MANRS-Cisco-XR

Change exercise template

History

Name:Template: MANRS-Cisco-XR

Project id:70e296d9-8a45-4956-82cb-eb1379367fe4

Exercise instructions:

Use markdown for styling

☐ Allow self-signup
Allow any student to start this exercise without supervision

Default time limit:

in minutes

WORK NODES

MONITOR NODES

IRR NODES


+ Add work, monitor or IRR node

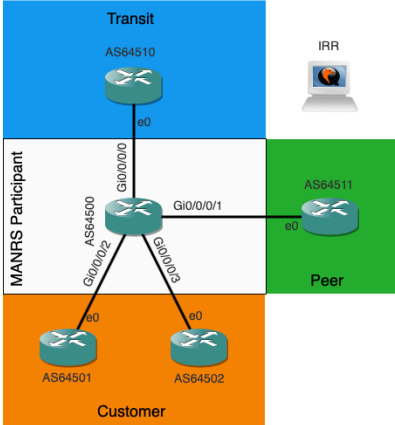
Delete

Save and add another

Save and continue editing

SAVE

 **MANRS**
for Cisco-XR



The diagram illustrates a network topology for a MANRS lab. It features a central 'MANRS Participant' (AS64500) connected to three other regions: 'Transit' (AS64510), 'Peer' (AS64511), and 'Customer' (AS64501, AS64502). The connections are as follows: AS64500 connects to AS64510 via e0 and Gi0/0/0/0; AS64500 connects to AS64511 via e0 and Gi0/0/0/1; AS64500 connects to AS64501 via e0 and Gi0/0/0/2; AS64500 connects to AS64502 via e0 and Gi0/0/0/3. An IRR (Internet Routing Registry) is also shown connected to AS64510.

Example: MANRS Lab - Goal definition

MANRS Lab Manager

WELCOME, **SANDER**. [VIEW SITE](#) / [CHANGE PASSWORD](#) / [LOG OUT](#)

[Home](#) › [Lab](#) › [Monitor templates](#) › MANRS AS64501

Change monitor template

HISTORY

Name:

MANRS AS64501

Instructions:

The customer (AS64501)

=====

Customer 64501 should announce the following prefixes to you:

- `2001:db8:1001::/48`
- `192.0.2.0/24`

For testing purposes you can ping them on addresses `2001:db8:1001::1` and `192.0.2.1`.

Use markdown for styling

MONITOR GOALS

Monitor goal: MANRS AS64501: Received traffic

☐ Delete

Goal type:

Received traffic ▾

Goal content:

SRC=198.51.100.1 DST=192.0.2.1

MONITOR GOALS

Monitor goal: MANRS AS64501: Received traffic

☐ Delete

Goal type:

Received traffic ↕

Goal content:

```
SRC=198.51.100.1 DST=192.0.2.1
SRC=10.0.0.1 DST=192.0.2.1
SRC=2001:0db8:2002:0000:0000:0000:0001 DST=2001:0db8:1001:0000:0000:0000:0001
SRC=2001:0db8:0000:0000:0000:0000:0000:0001 DST=2001:0db8:1001:0000:0000:0000:0001
SRC=2001:0db8:3000:0000:0000:0000:0000:0001 DST=2001:0db8:1001:0000:0000:0000:0001
```

Monitor goal: MANRS AS64501: IPv4 routes

☐ Delete

Goal type:

IPv4 routes ↕

Goal content:

```
BIRD 1.5.0 ready.
10.0.0.0/8 via 203.0.113.252 on eth0 [bgp1 11:48:05] * (100) [AS65001i]
  Type: BGP unicast univ
  BGP.origin: IGP
  BGP.as_path: 64500 64510 65000 65000 65001
  BGP.next_hop: 203.0.113.252
  BGP.local_pref: 100
192.168.0.0/16 via 203.0.113.252 on eth0 [bgp1 11:48:05] * (100) [AS65003i]
  Type: BGP unicast univ
  BGP.origin: IGP
```

Monitor goal: MANRS AS64501: IPv6 routes

☐ Delete

Goal type:

IPv6 routes ↕

Goal content:

```
BIRD 1.5.0 ready.
2001:db8:2002::/48 via 2001:db8:1000:fffe::a on eth0 [bgp1 11:44:26] * (100) [AS64502i]
  Type: BGP unicast univ
  BGP.origin: IGP
  BGP.as_path: 64500 64502
```

Example: MANRS Lab - Student's view

MANRS Lab Manager
Dashboard: MANRS-Cisco for Sander Steffann

Logged in as Sander Steffann (sander@steffann.nl)
[Home](#) | [Admin interface](#) | [Change password](#) | [Log out](#)

Instructions AS64500 AS64501 AS64502 AS64510 AS64511 IRR Online

MANRS for Cisco

Welcome to the MANRS for Cisco lab. This lab consists of a transit, a peer, two customers, and your very own Cisco router in the middle. The goal is to implement MANRS on your router so that the other routers cannot send you hijacked routes or traffic with spoofed source addresses. And they will try!

The layout of this lab is based on the [MANRS Implementation Guide](#). The addresses and prefixes used in this lab correspond to those used in that document.

Background information

At the start of the lab all links are configured and BGP sessions exist for both IPv4 and IPv6. There is no filtering in place. That is your task.

Your router (AS64500)

You have full console access to your router. Configure it so it has MANRS.

You should announce the following prefixes from your own router:

- 2001:db8:1000::/36
- 203.0.113.0/24

The transit (AS64510)

The transit will send you the most routes. But it isn't behaving completely correct. Some of its routes are your own! Make sure you don't accept them, or someone on the internet might hijack you. There is also traffic coming from the transit with source addresses that don't exist in the routing table. Those should also be blocked.

For testing purposes you can ping the transit on addresses 2001:db8::1 and 10.0.0.1.

The peer (AS64511)

The peer will do the same as the transit, except that of course it's only allowed to attract traffic for itself. So make sure that you filter what they announce to you, and also make sure they don't use you as a free transit!

The peer should announce the following prefixes to you:

- 2001:db8:3000::/36


For testing purposes you can ping the peer on address 2001:db8:3000::1.

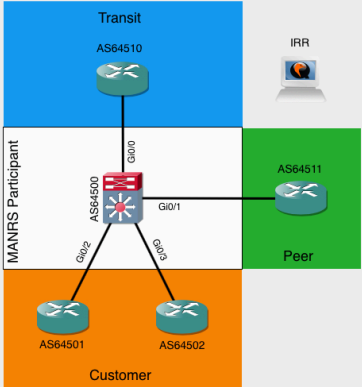
The customers (AS64501 and AS64502)

You have two customers in this lab. Both of them have IPv4 and IPv6 address space. AS64501 has address space from your aggregated block, AS64502 has provider independent space. But beware: there is also some hijacking going on! Make sure both of your customers behave and don't interfere with each other or the rest of the internet.

Customer 64501 should announce the following prefixes to you:

- 2001:db8:1001::/48
- 192.0.2.0/24

**MANRS**
for Cisco



```
graph TD
    AS64510[AS64510 Transit] ---|G0/0| AS64500[AS64500 MANRS Participant]
    AS64511[AS64511 Peer] ---|G10/1| AS64500
    AS64501[AS64501 Customer] ---|G0/2| AS64500
    AS64502[AS64502 Customer] ---|G0/3| AS64500
```



Example: MANRS Lab - Student's view

MANRS Lab Manager

Dashboard: MANRS-Cisco for Sander Steffann

Logged in as Sander Steffann (sander@steffann.nl)
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Instructions AS64500 **AS64501** AS64502 AS64510 AS64511 IRR Online

Your router (AS64500)

The goal of this lab is to teach your router MANRS.

You should announce the following prefixes from your own router:

- 2001:db8:1000::/36
- 203.0.113.0/24

Username: manrs
Password: manrs

```
If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco IOSv (revision 1.0) with 460017K/62464K bytes of memory.Installed ima
ge archive

Processor board ID 90L71H708Z9TK9AWM2HLG
4 Gigabit Ethernet interfaces
DRAM configuration is 72 bits wide with parity disabled.
256K bytes of non-volatile configuration memory.
2097152K bytes of ATA System CompactFlash 0 (Read/Write)
0K bytes of ATA CompactFlash 1 (Read/Write)
1024K bytes of ATA CompactFlash 2 (Read/Write)
0K bytes of ATA CompactFlash 3 (Read/Write)

% Warning: use /31 mask on non point-to-point interface cautiously
% Warning: use /31 mask on non point-to-point interface cautiously
% Warning: use /31 mask on non point-to-point interface cautiously
% Warning: use /31 mask on non point-to-point interface cautiously

Press RETURN to get started!

Log in with username 'manrs' and password 'manrs':
User Access Verification
Username:
```

For emergencies: [reboot device](#)

MANRS for Cisco

```
graph TD
    AS64510[AS64510 Transit] --- G0/0[AS64500]
    AS64511[AS64511 Peer] --- G0/1[AS64500]
    AS64501[AS64501 Customer] --- G0/2[AS64500]
    AS64502[AS64502 Customer] --- G0/3[AS64500]
    AS64510 --- IRR[IRR]
```

Example: MANRS Lab - Student's view

MANRS Lab Manager

Dashboard: MANRS-Cisco for Sander Steffann

Logged in as Sander Steffann (sander@steffann.nl)
[Home](#) | [Admin interface](#) | [Change password](#) | [Log out](#)

Instructions AS64500 **AS64501** AS64502 AS64510 AS64511 IRR Online

The customer (AS64501)

Customer 64501 should announce the following prefixes to you:

- 2001:db8:1001::/48
- 192.0.2.0/24

For testing purposes you can ping them on addresses 2001:db8:1001::1 and 192.0.2.1.

Looking glass from this router's viewpoint

Received traffic (last change at 3:36:18)

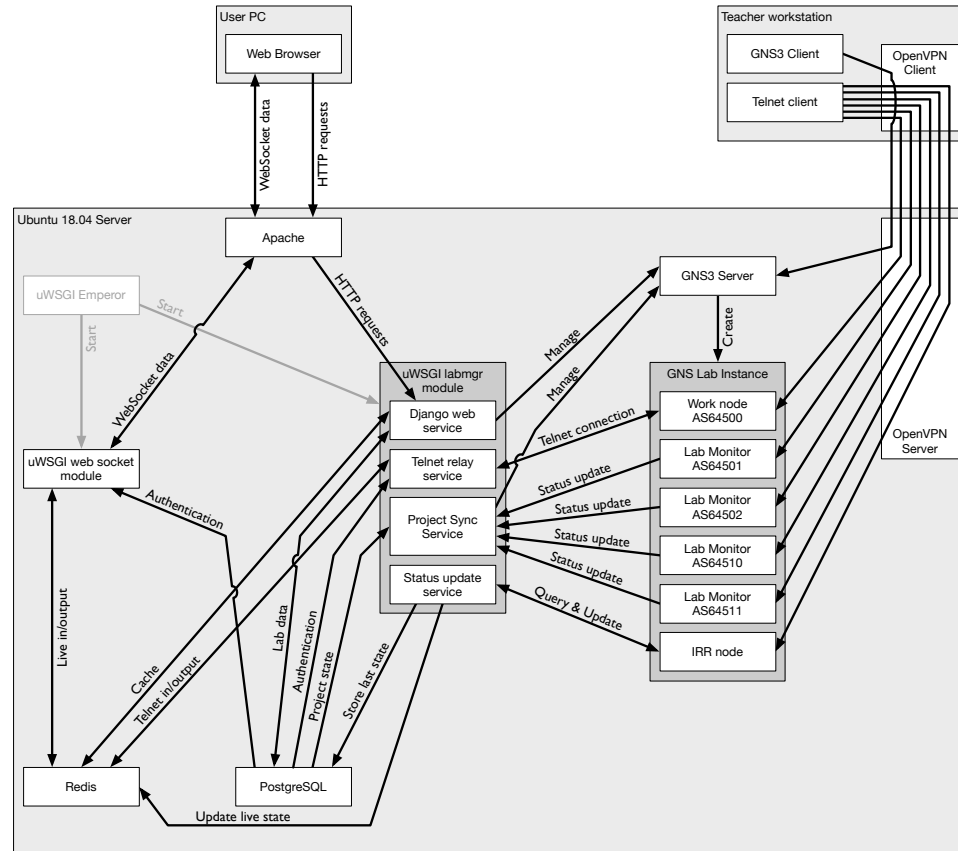
Expected	Currently seen
10.0.0.1 to 192.0.2.1	10.0.0.1 to 192.0.2.1
These packets shouldn't be received	192.0.2.3 to 192.0.2.1
These packets shouldn't be received	192.88.99.2 to 192.0.2.1
These packets shouldn't be received	192.88.99.10 to 192.0.2.1
198.51.100.1 to 192.0.2.1	198.51.100.1 to 192.0.2.1
These packets shouldn't be received	198.51.100.3 to 192.0.2.1
2001:db8::1 to 2001:db8:1001::1	2001:db8::1 to 2001:db8:1001::1
These packets shouldn't be received	2001:db8:1000::3 to 2001:db8:1001::1
These packets shouldn't be received	2001:db8:1001::3 to 2001:db8:1001::1
2001:db8:2002::1 to 2001:db8:1001::1	2001:db8:2002::1 to 2001:db8:1001::1
2001:db8:3000::1 to 2001:db8:1001::1	These packets are missing
These packets shouldn't be received	3ffe::2 to 2001:db8:1001::1
These packets shouldn't be received	3ffe::10 to 2001:db8:1001::1

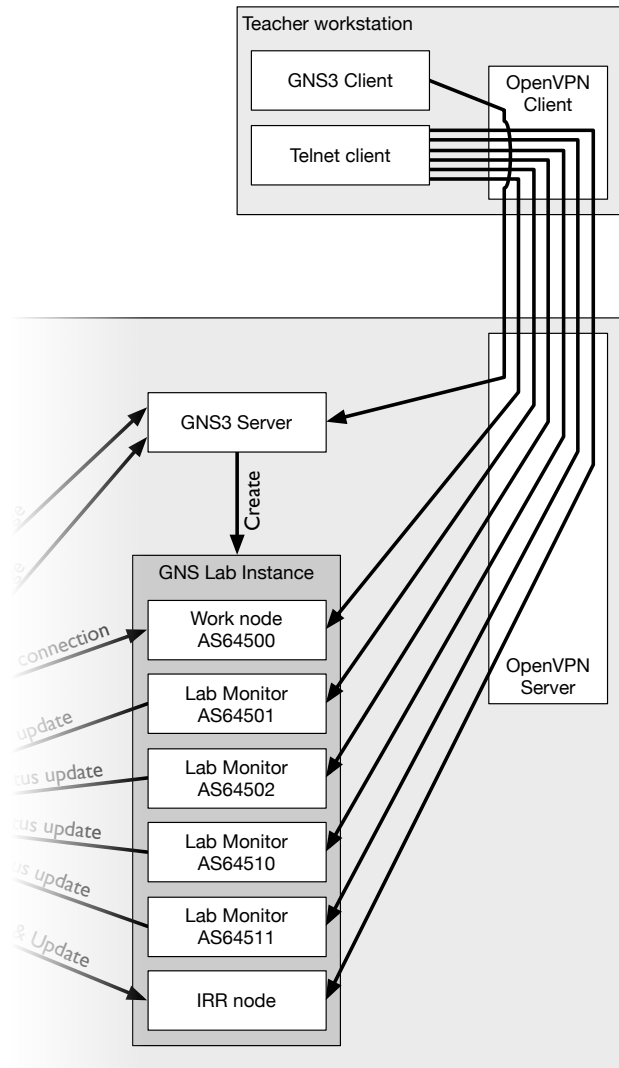
IPv4 routes (last change at 3:38:29)

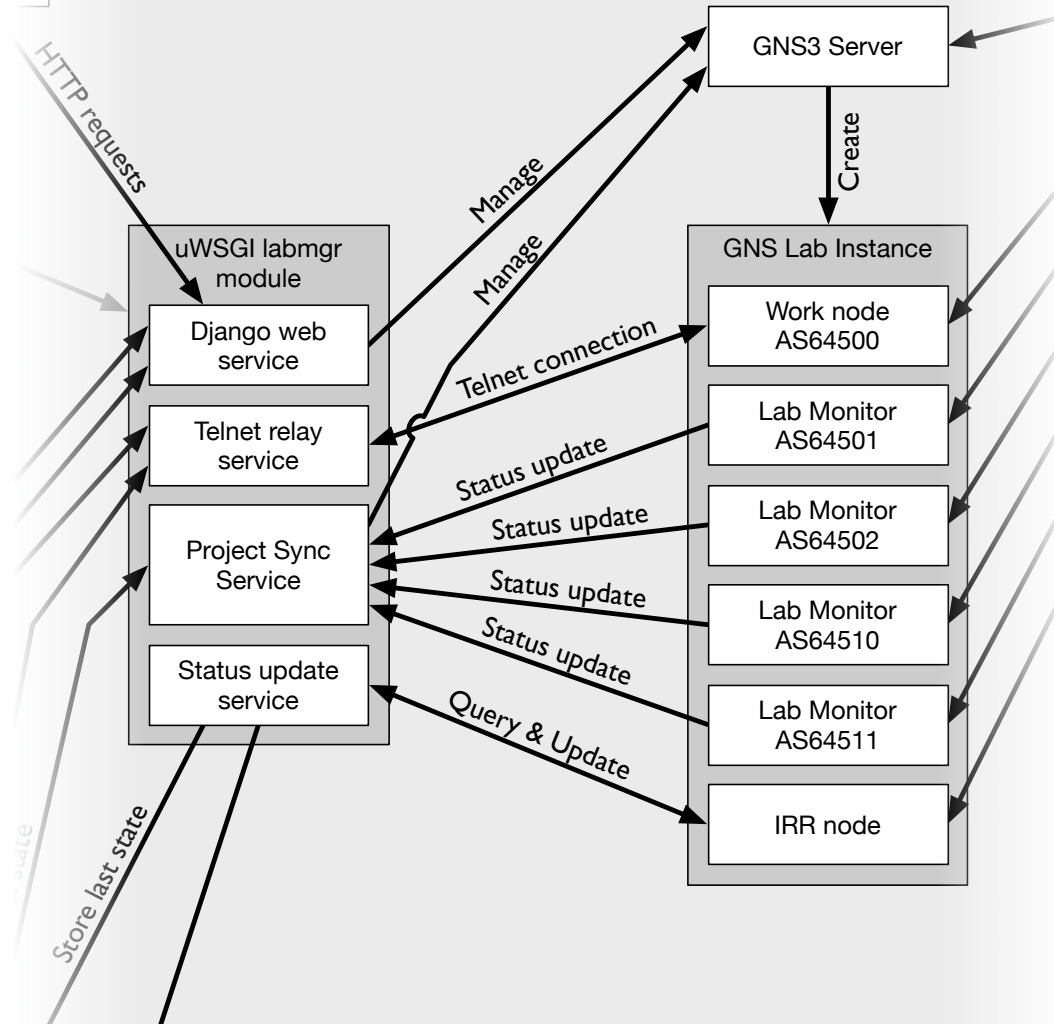
Expected	Currently seen
10.0.0.0/8	10.0.0.0/8
AS-Path: 64500 64510 65000 65000 65001	AS-Path: 64500 64510 65000 65000 65001
172.16.0.0/12	172.16.0.0/12

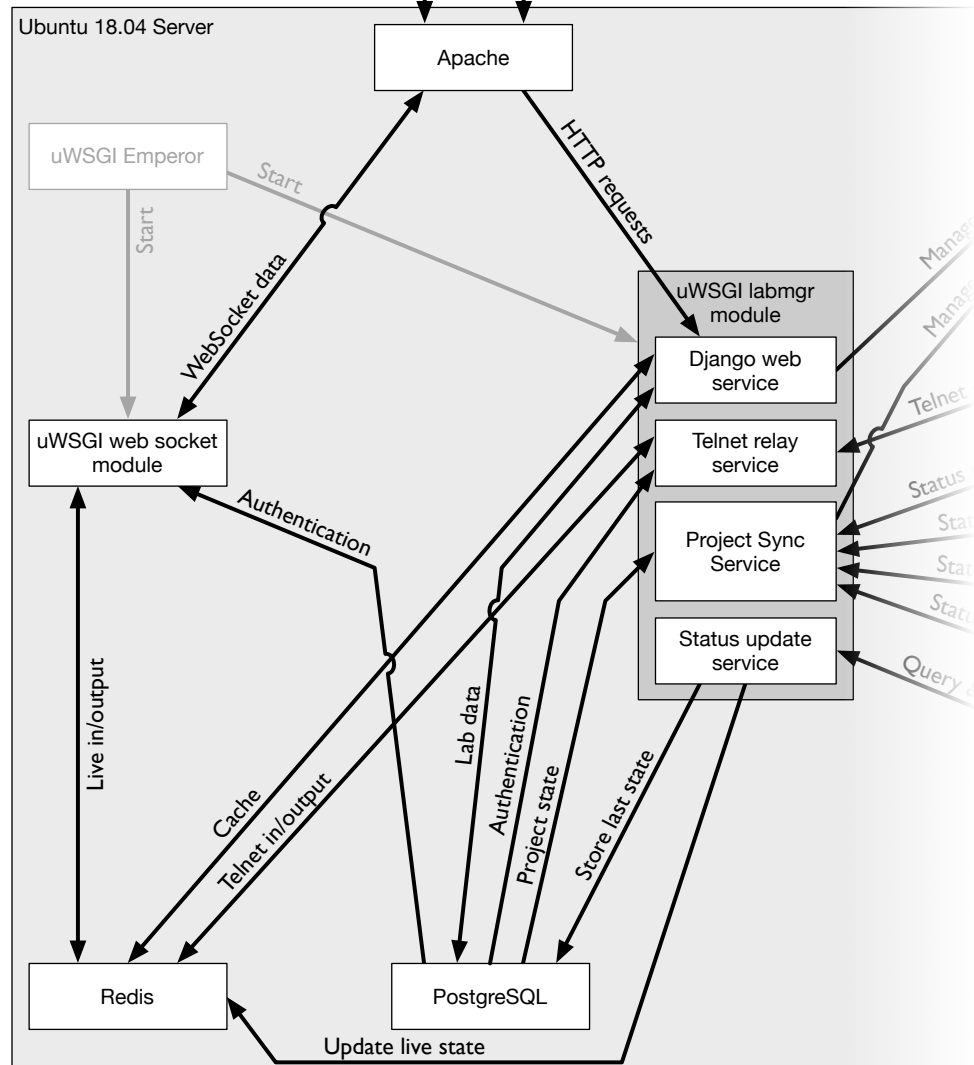
The diagram illustrates the MANRS for Cisco network topology. It features a central 'MANRS Participant' router (AS64500) connected to three other components: a 'Transit' router (AS64510) via Gi0/0, a 'Peer' router (AS64511) via Gi0/1, and two 'Customer' routers (AS64501 and AS64502) via Gi0/2 and Gi0/3 respectively. An 'IRR' (Internet Routing Registry) icon is also shown. The background is divided into colored regions: blue for Transit, green for Peer, and orange for Customer.

Software architecture

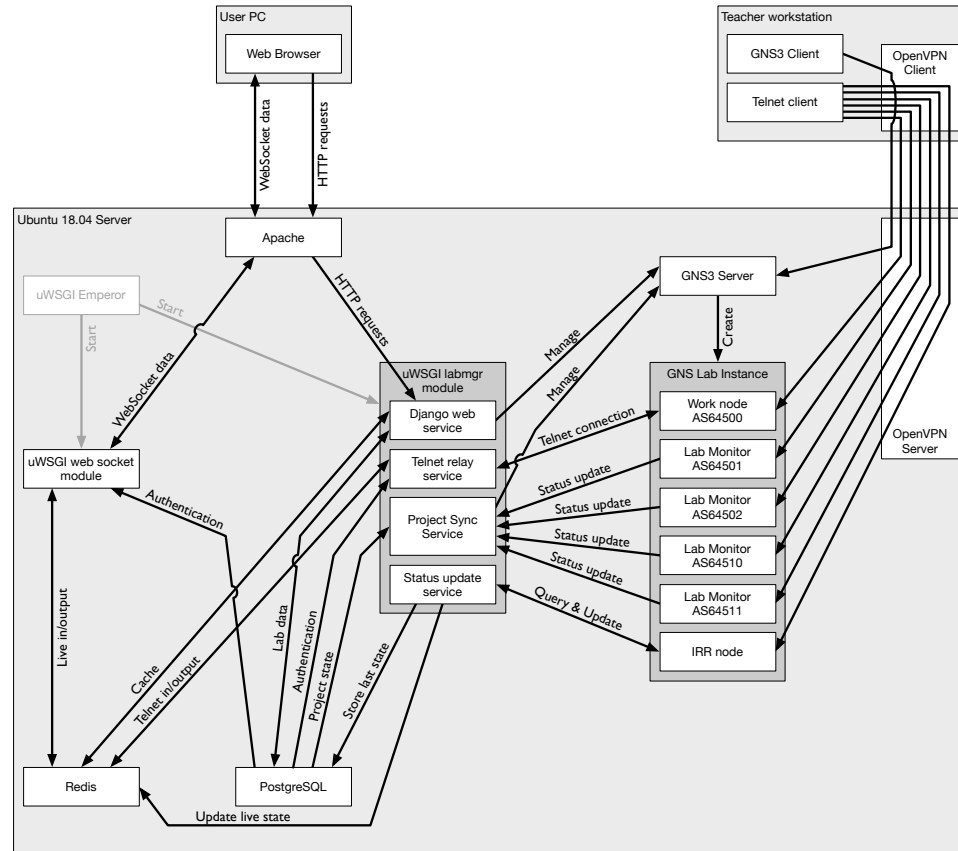








Software architecture



Future developments

- Add other types of router for the student
 - Juniper cRPD, Alcatel/Nokia etc...
- Add RPKI validation to the lab
- Optimise performance of the IRR node under load

Questions?

