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Title of report

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Assignment 2: Practical

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Introduction

Virtual machines (VMs) represent one of the most important resources in cloud environments such as Microsoft Azure. They provide an opportunity to build virtual computer systems that can be used to run various applications, web servers, databases, etc.

Virtual hard disks (VHDs) are one of the primary resources used to store data in Azure VMs. These are files that contain the operating system, applications, and data needed to run the virtual machine. Creating VMs in Azure is easy and requires minimal configuration. To create a VM, you need to select an operating system, VM size, number of processors, amount of memory, etc. Next, you need to set up network connections and select network security options such as creating network security groups (NSGs).

vNets are virtual networks that allow VMs to connect to other VMs or to systems outside the cloud. These can be set to ensure a secure connection between VMs, such as restricting access to certain ports or IP addresses.

Network security groups are an important element in securing the network connections of VMs in Azure. They allow traffic rules to be set up, such as blocking certain ports or protocols, as well as specifying traffic sources and destinations. This helps strengthen network security and prevent unauthorized access to virtual machines.

To demonstrate the use of VMs in Azure, two VMs can be created - one with an Nginx web server and another with a PostgreSQL database.

VM resources, such as virtual hard disks, and VM creation and management

Virtual machines (VMs) are the core elements of cloud infrastructure that provide the ability to run applications, operating systems, and services. A VM includes multiple resources that must be configured and managed to function successfully.

Virtual hard disks (VHDs) are one of the primary resources associated with a VM. These are files that store the virtual machine's information, including the operating system, applications, and data. Virtual hard disks can be created as dynamic or static, the difference being that dynamic disks expand as needed, while static disks have a fixed size.

VMs are created by configuring various parameters, including the size of the virtual machine, the operating system, which can be done through the cloud management console or using tools such as machine templates, containers or orchestration.

VMs can also be managed, including configuration of network connections, security settings, monitoring and logs. A virtual network (vNet) can be included in the network settings, which allows VMs to communicate with each other within one or more networks.

To ensure the security of the VM and the network, a Network Security Group (NSG) can be used to define access and traffic rules on the virtual network. This may include setting rules for incoming or outgoing traffic, blocking certain ports or protocols, or setting rules for specific IP addresses.

When creating a VM, various parameters such as operating system, virtual machine size, memory, number of processor cores, hard disk size and others need to be specified. Network configuration such as IP address and network security settings must also be determined.

VMs are managed through the service provider's cloud management console. This allows users to start, stop and change virtual machine parameters. Virtual machine management software can also be used, which gives more flexibility and automation in the management process.

In addition to virtual hard disks, a VM can also access other resources such as cloud storage, databases, media files, and more. These resources are connected to VMs through virtual networks.

Virtual networks (vNets) are designed to enable communication between virtual machines in a cloud environment. These can be configured to provide isolation and security between different VMs and applications. When creating a VM, it determines which virtual network to connect to.

Network security groups are a tool that allows users to set traffic rules in the cloud environment. They can determine which IP addresses or network protocols can access the VM and which information can be sent and received. This allows greater flexibility and security in the network configuration of the cloud infrastructure.

Images are virtual disks that contain an operating system and other software. They can be used to quickly create VMs without needing to be installed.

Once the VM is created, it can be managed through various tools and interfaces such as the Azure portal, Azure PowerShell, Azure CLI, and Azure API. The user can perform operations such as starting, stopping, restarting, resizing, and deleting the VM.

In addition to virtual hard drives, VMs also have other associated resources such as virtual CPUs, memory, and network interfaces. The virtual CPUs and memory determine the processing power and memory available to the VM, while the network interfaces allow the VM to communicate with other resources in the virtual network.

Speaking of virtual networks, vNets provide a way to logically isolate resources within an Azure subscription. They allow the user to create a private network in Azure, to which VMs and other resources can be connected. A vNet can be subdivided into smaller subnets, each with its own IP address range, and different subnets can be connected through network peering.

Network security groups (NSGs) provide an additional layer of security to vNets by controlling inbound and outbound traffic. NSGs are essentially firewall rules that allow or deny traffic based on the source and destination IP addresses, protocols, and ports. They can be applied to both subnets and individual VMs.

In summary, VMs are a fundamental building block of cloud computing and offer a way to create and manage virtualized compute resources in Azure. They are associated with virtual hard drives, virtual CPUs, memory, and network interfaces, and can be managed through various tools and interfaces. vNets provide a way to logically isolate resources within an Azure subscription, while NSGs add an additional layer of security to vNets by controlling inbound and outbound traffic.

vNets and network security groups

The virtual network (VNet) data gateway facilitates secure connectivity to data sources associated with your Vnet. Users in your organization can access data secured by a VNet to which they already have access. But before these users can connect to these data sources from Microsoft Cloud services, a VNet gateway needs to be registered and configured.

First look at what happens when you interact with a Power BI report that's connected to a data source within a VNet. Power BI cloud service (or one of the other supported cloud services) kicks off a query and sends the query, data source details, and credentials to the Microsoft Power Platform VNet service. The Microsoft Power Platform VNet then securely injects a container running the VNet data gateway into the subnet. This VNet data gateway can now connect to data services accessible from within this subnet.

The Microsoft Power Platform VNet service then sends the query, data source details, and credentials to the VNet data gateway. The VNet data gateway gets the query and connects to the data sources with those credentials. The query is then sent to the data source for execution. After execution, the results are sent to the VNet data gateway and the Microsoft Power Platform VNet service securely pushes the data from the container to the cloud service.

Here's a network diagram illustrating the data pathway between Power BI cluster and a SQL database data source:

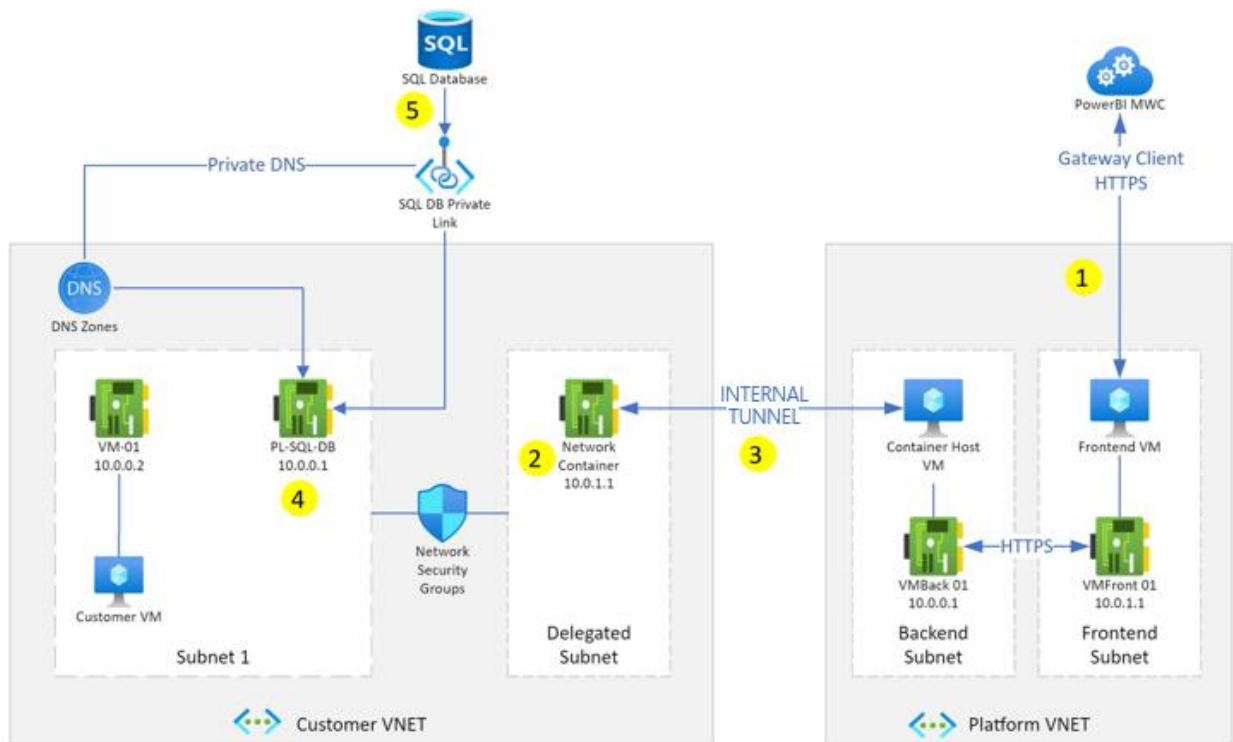


Fig. 1 Diagram illustrating the data pathway between Power BI cluster and a SQL database data source.

Global transit network architecture and Virtual WAN

Contemporary businesses necessitate seamless connectivity (Fig. 2) for their highly dispersed applications, data, and users across on-premises and cloud infrastructures. To accommodate this, enterprises are implementing global transit network architecture to centralize, connect, and manage their cloud-first, worldwide IT infrastructure.

This architecture follows a conventional hub-and-spoke connectivity pattern, where the cloud-based network 'hub' facilitates transitive connectivity between endpoints that may be dispersed across various 'spokes'. The spokes may include virtual networks (VNETs), physical branch locations, remote users, or the internet.

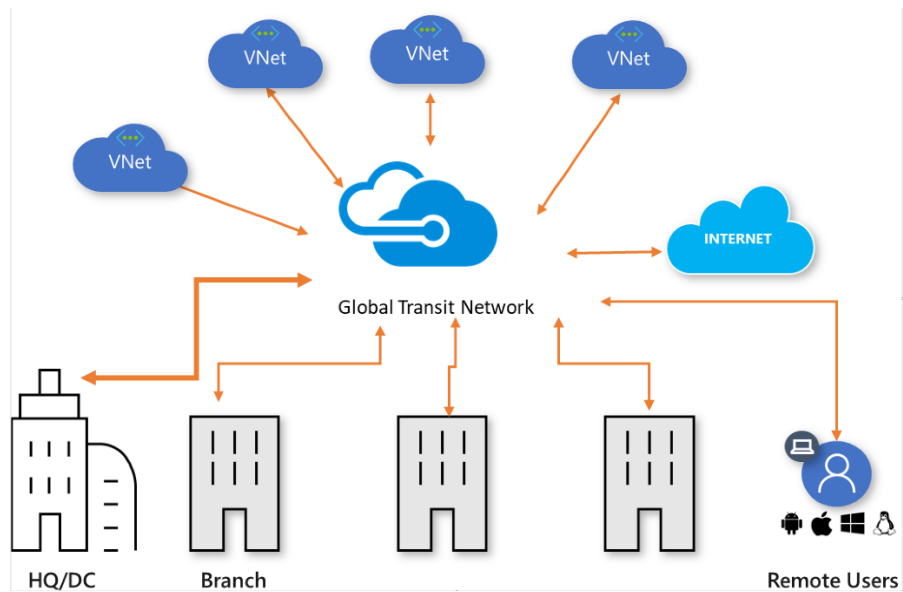


Fig.2 Global transit hub-and-spoke network.

Global transit network with Virtual WAN

Azure Virtual WAN is a cloud networking service managed by Microsoft, which includes various networking components. Virtual WAN allows any-to-any connectivity between globally dispersed cloud workloads, branch sites, SaaS and PaaS applications, and users, creating a global transit network architecture.

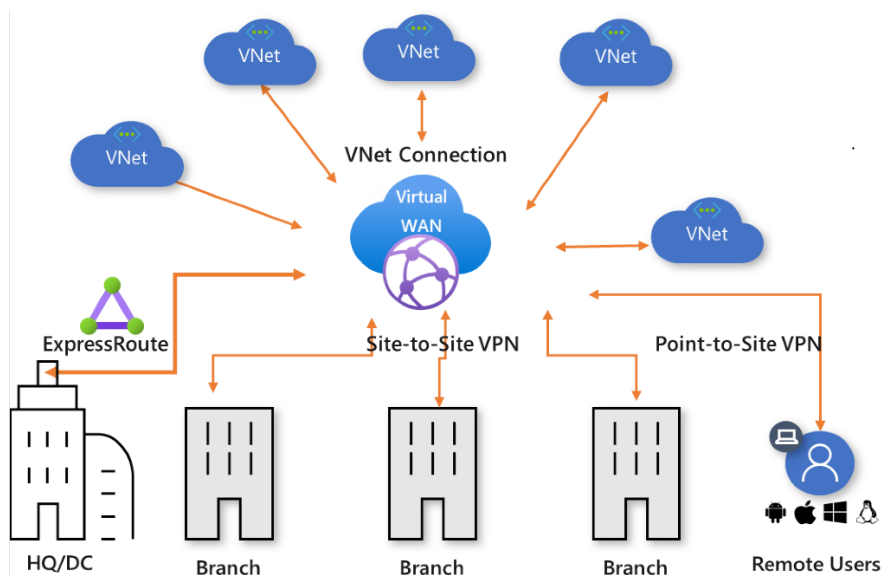


Fig. 3 Global transit network with Virtual WAN

In the Azure Virtual WAN architecture, virtual WAN hubs are established in Azure regions where branches, VNets, and remote users can connect. Branches are connected to the hub using Premium or Standard ExpressRoute or site-to-site VPNs, VNets use VNet connections, and remote users can use User VPN (point-to-site VPNs) to connect directly to the hub. The cross-region VNet connection is also supported by Virtual WAN.

To establish a virtual WAN, you can create a single virtual WAN hub in the region with the most spokes, such as branches, VNets, and users, and then connect other spokes in different regions to the hub. This option is suitable when an enterprise footprint is primarily in one region with a few remote spokes. For further details, please refer to the Virtual WAN Overview article.

Hub-to-hub connectivity

In an Enterprise's cloud infrastructure, it may be necessary to have a presence in multiple cloud regions, and it's ideal to access the cloud from a region that is closest to the physical location of the site and users for optimal latency. The global transit network architecture aims to facilitate cross-region connectivity between all on-premises and cloud network endpoints. This means that traffic from one branch that is connected to the cloud in a particular region can access another branch or a VNet in a different region through hub-to-hub connectivity enabled by Azure Global Network.

The diagram in Figure 3 illustrates cross-region connectivity using Virtual WAN. When multiple hubs are enabled in a single Virtual WAN, they are interconnected through hub-to-hub links, enabling global connectivity between branches and Vnets located in multiple regions. In addition, these hubs that are part of the same Virtual WAN can have different regional access and security policies associated with them, as explained in more detail in the "Security and policy control" section of this article.

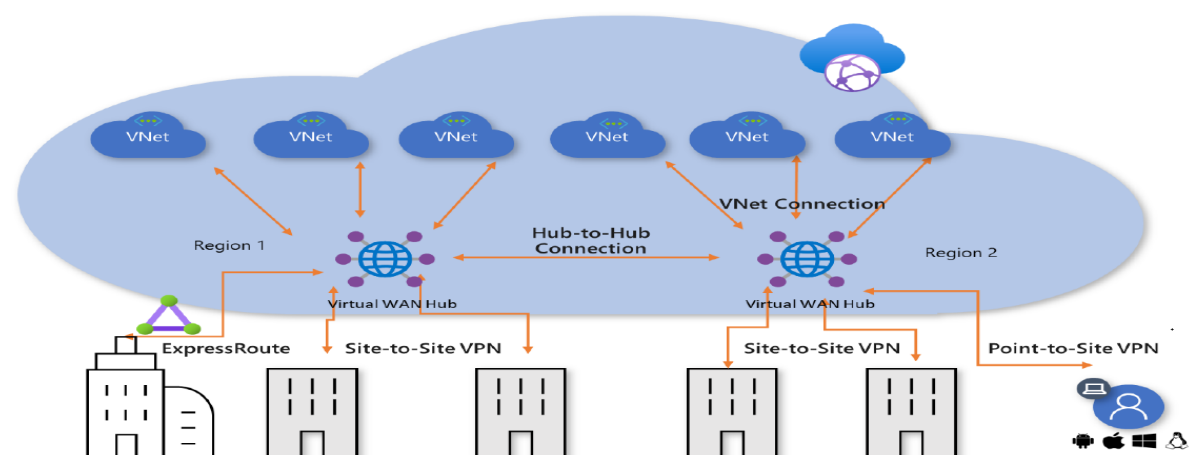


Figure 4: Virtual WAN cross-region connectivity

Any-to-any connectivity

The global transit network architecture facilitates virtual WAN hubs to enable connectivity between any two points. This approach eliminates or minimizes the requirement of full or partial mesh connectivity between spokes which is complicated to build and maintain. Moreover, the routing control in hub-and-spoke topology is more straightforward to configure and maintain than mesh networks.

When it comes to global architecture, any-to-any connectivity allows companies with distributed users, branches, data centers, VNets, and applications to connect with one another using the transit hub(s) as a global transit system. Azure Virtual WAN provides this functionality.

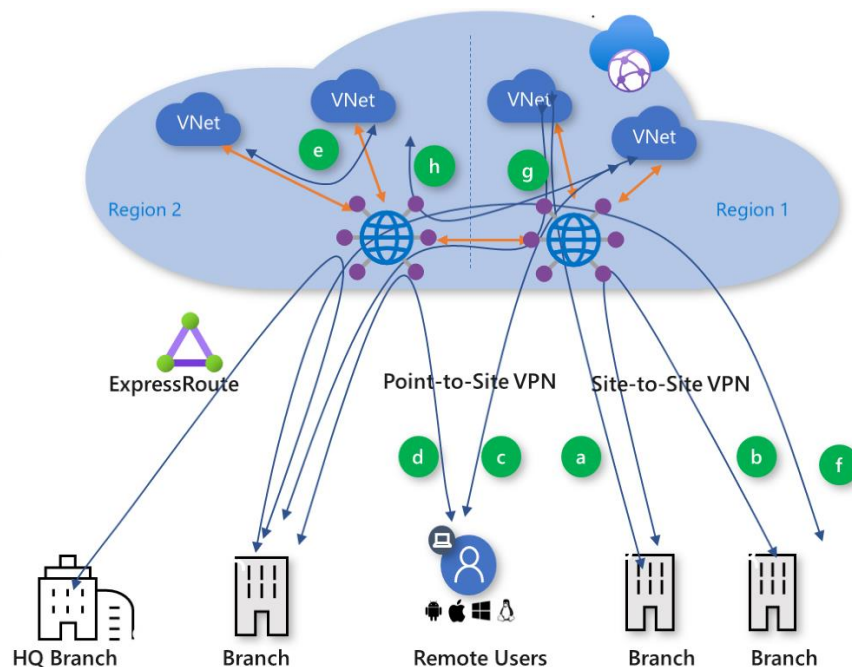


Fig. 4 Any-to-any connectivity

Additional Exercise

To accomplish this task, we will need to create two virtual machines in Azure. On one of the virtual machines, we will need to install the Nginx web server, while the other virtual machine should have an image of your choice installed, such as a database. It is important to note that the second virtual machine should not be publicly exposed, but rather private to the virtual network (vNet). Your goal is to demonstrate that we can connect from the first virtual machine to the second virtual machine.

Create a Resource Groups

Create a Resource Groups: Sign in to the Azure portal (<https://portal.azure.com/>).

In the left menu, select "Resource Groups" in the "Services" section.

Click the "+ Add" button to create a new resource group.

In the Basic dialog box, choose a name for your resource group. The name must be unique within the subscription and must be between 1 and 90 characters. You can also select a subscription, resource group location, and an optional description for the resource group.

In the Tags window, you can add tags to the resource group to organize and manage your resources. Tags are name/value pairs that can be used to group resources together. This is optional and not required.

Review the settings you selected in the Preview + Create window. Once everything looks good, we click the "Create" button to create the resource group.

Azure will create the resource pool and display a message when it is ready as seen in the image below. You can then start adding resources to the resource group. This is what I have shown in the next few pictures (Fig. 1 and Fig 2.).

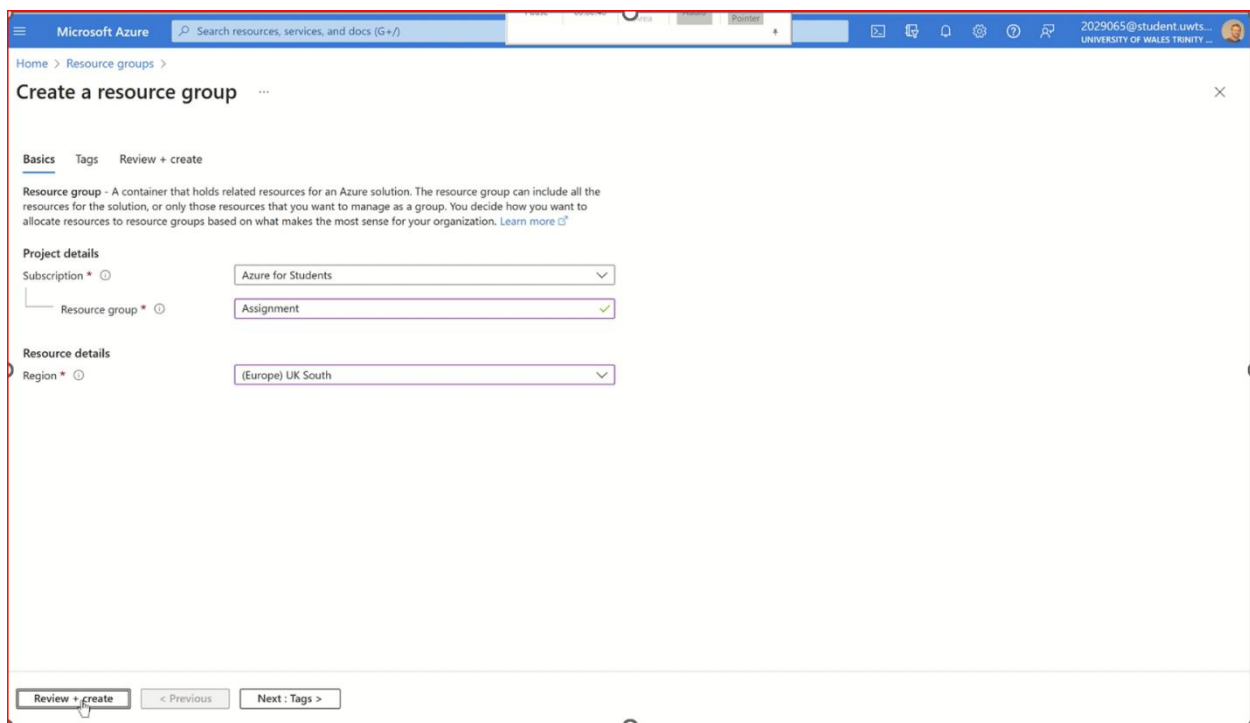
The image shows the 'Create a resource group' dialog box in the Microsoft Azure portal. The dialog has a blue header with the Microsoft Azure logo and a search bar. Below the header, there's a breadcrumb trail: 'Home > Resource groups >'. The main title is 'Create a resource group'. There are three tabs: 'Basics', 'Tags', and 'Review + create'. The 'Basics' tab is selected. Below the tabs, there's a description of a resource group. Under 'Project details', there are two dropdown menus: 'Subscription' (set to 'Azure for Students') and 'Resource group' (set to 'Assignment'). Under 'Resource details', there is a 'Region' dropdown menu set to '(Europe) UK South'. At the bottom, there are three buttons: 'Review + create', '< Previous', and 'Next: Tags >'. The 'Review + create' button is highlighted with a mouse cursor.

Fig 1.

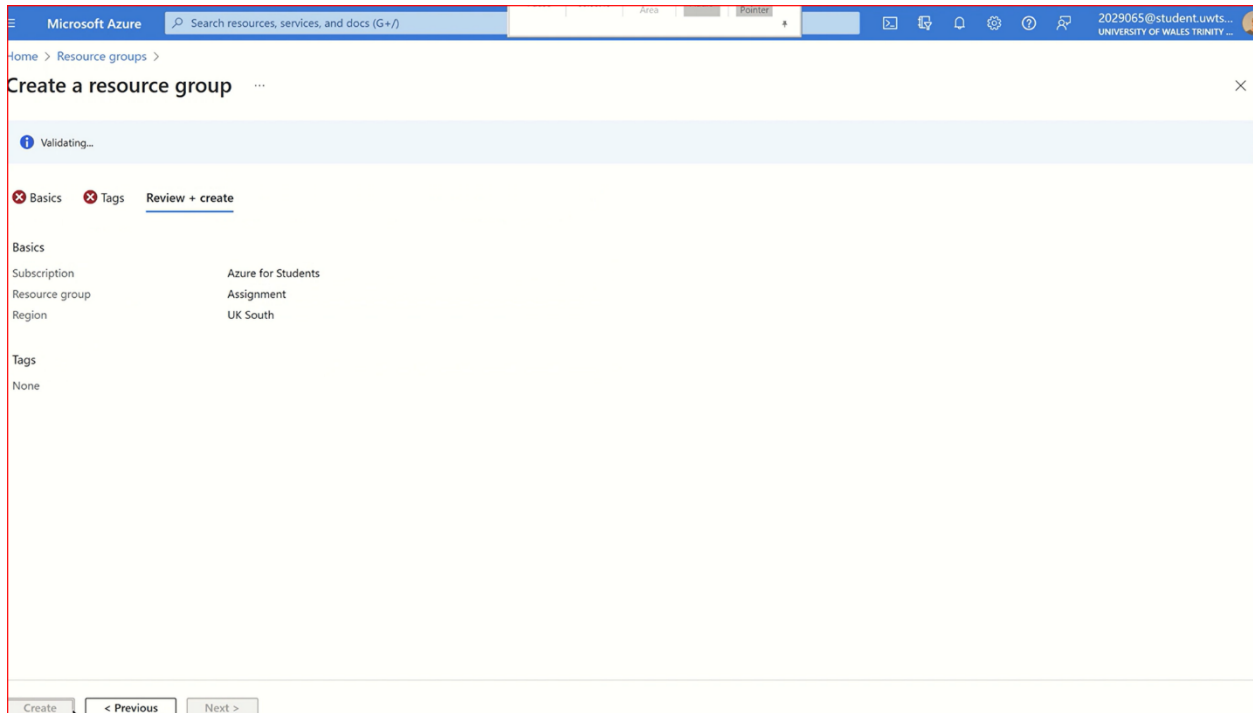


Fig 2.

Create a Virtual Network

Steps to create a virtual network in Azure:

Sign in to the Azure portal and select "Virtual Networks" from the menu on the left.

Click the "+ Add" button to start the process of creating a new virtual network.

In the Basic dialog box, select a name for the virtual network, select the region, and select the resource group that you have already created.

In the "IP Addresses" window, define the private IP address range for your virtual network. Here you can choose the network layout (address space), add subnets and set the primary DNS server.

In the "Preview + Create" window, review and confirm the settings you have chosen. After confirming that everything is correct, press the "Create" button. This is what I have done in the next few photos below (Fig 3 to Fig 7)

Microsoft Azure Search resources, services, and docs (G+)

Home > Create a resource > Marketplace > Virtual network >

Create virtual network

Basics Security IP addresses Tags Review + create

Azure Virtual Network (VNet) is the fundamental building block for your private network in Azure. VNet enables many types of Azure resources, such as Azure Virtual Machines (VM), to securely communicate with each other, the internet, and on-premises networks. VNet is similar to a traditional network that you'd operate in your own data center, but brings with it additional benefits of Azure's infrastructure such as scale, availability, and isolation. [Learn more](#)

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * Azure for Students

Resource group * Assignment [Create new](#)

Instance details

Virtual network name * assignment-vnet

Region * (Europe) UK South

[Deploy to an edge zone](#)

[Previous](#) [Next](#) [Review + create](#) [Give feedback](#)

Fig 3.

Microsoft Azure Search resources, services, and docs (G+)

Home > Create a resource > Marketplace > Virtual network >

Create virtual network

Basics Security IP addresses Tags Review + create

Configure your virtual network address space with the IPv4 and IPv6 addresses and subnets you need. [Learn more](#)

Define the address space of your virtual network with one or more IPv4 or IPv6 address ranges. Create subnets to segment the virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet. [Learn more](#)

[Add an IP address space](#)

10.0.0.0/16 [+ Add a subnet](#) [...](#)

10.0.0.0 - 10.0.255.255 (65536 addresses)

Subnets	IP address range	Size	NAT gateway
default	10.0.0.0 - 10.0.0.255	/24 (256 addresses)	-
assignment-s...	10.0.1.0 - 10.0.1.255	/24 (256 addresses)	-

[A NAT gateway is recommended for outbound internet access from subnets. Edit the subnet to add a NAT gateway. Learn more](#)

[Previous](#) [Next](#) [Review + create](#) [Give feedback](#)

Fig 4.

Microsoft Azure

Home > Create a resource > Marketplace > Virtual network >

Create virtual network

Basics Security **IP addresses** Tags Review + create

Configure your virtual network address space with the IPv4 and IPv6 addresses and subnets you need. [Learn more](#)

Define the address space of your virtual network with one or more IPv4 or IPv6 address ranges. Create subnets to segment the virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet. [Learn more](#)

[Add an IP address space](#)

Subnets	IP address range	Size	NAT gateway
default	10.0.0.0 - 10.0.0.255	/24 (256 addresses)	-

[Add a subnet](#)

Add a subnet

Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan to add select services later. [Learn more](#)

IP address space

10.0.0.0 - 10.0.255.255 (65536 addresses)

Subnet details

Subnet template

Name

Starting address

Subnet size

IP address space

Security

Simplify internet access for virtual machines by using a network address translation gateway. Filter subnet traffic using a network security group. [Learn more](#)

NAT gateway

[Create new](#)

Network security group

[Create new](#)

Route table

[Add](#) [Cancel](#)

[Previous](#) [Next](#) [Review + create](#)

Fig 5.

Microsoft Azure

Home > Create a resource > Marketplace > Virtual network >

Create virtual network

Basics Security **IP addresses** Tags Review + create

Configure your virtual network address space with the IPv4 and IPv6 addresses and subnets you need. [Learn more](#)

Define the address space of your virtual network with one or more IPv4 or IPv6 address ranges. Create subnets to segment the virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet. [Learn more](#)

[Add an IP address space](#)

Subnets	IP address range	Size	NAT gateway
default	10.0.0.0 - 10.0.0.255	/24 (256 addresses)	-

[+ Add a subnet](#)

[A NAT gateway is recommended for outbound internet access from subnets. Edit the subnet to add a NAT gateway. \[Learn more\]\(#\)](#)

[Previous](#) [Next](#) [Review + create](#)

[Give feedback](#)

Fig 6.

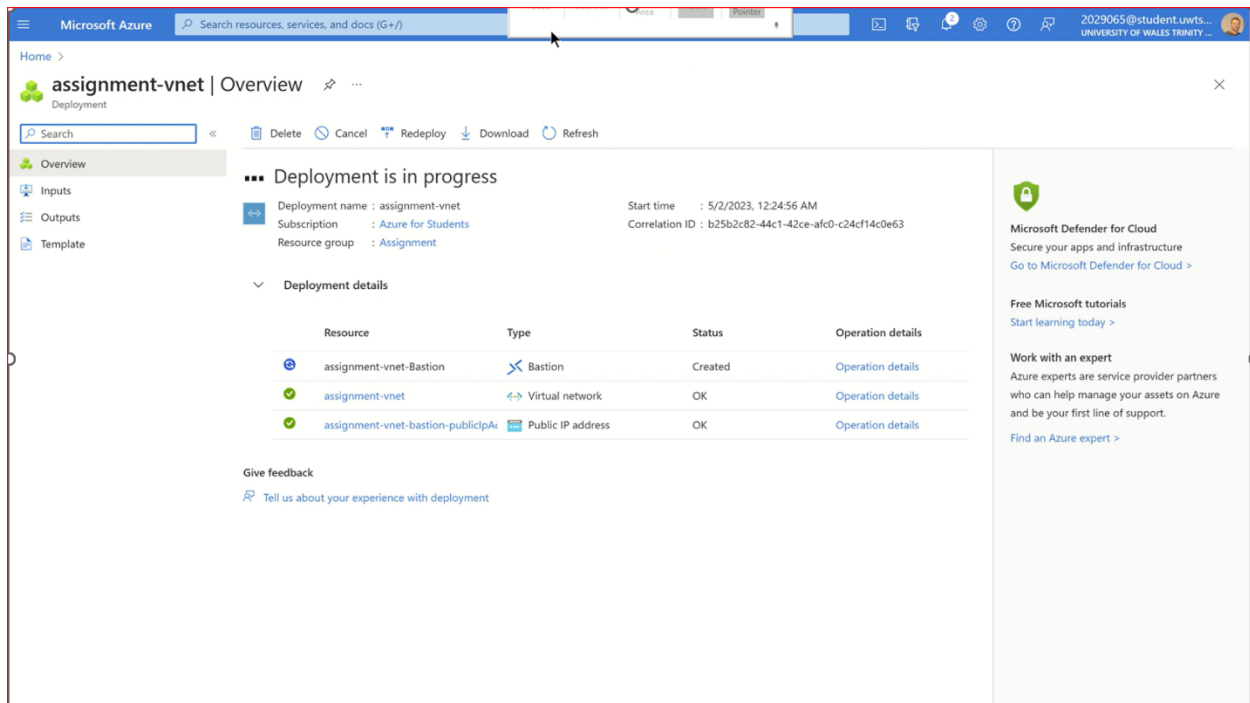


Fig 7.

Create a virtual machine.

To complete our task, we need to create two virtual machines in Azure. Follow these steps to create a virtual machine:

Log in to the Azure portal and select "Virtual Machines" from the menu on the left.

Click the "+ Add" button to start the process of creating a new virtual machine.

In the "Basic" window, select a name for your virtual machine and select the operating system you will use. Also, select the resource group in which we want to create the virtual machine.

In the Networking window, select the virtual network you want us to use for our virtual machine. Here you can also configure network settings for the device, such as opening access ports.

In the "Browse + Create" window, review all the entered options and click the "Create" button to start the process of creating your virtual machine.

Once the process is complete, you can start and manage your virtual machine through the Azure portal.

With these steps, we have successfully created two virtual machines in Azure. This is what I have done in the next few photos below (Fig 8 to Fig 10)

Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual machines >

Create a virtual machine

Basics Disks Networking Management Monitoring Advanced Tags Review + create

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#)

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * Azure for Students

Resource group * Assignment [Create new](#)

Instance details

Virtual machine name * vm1

Region * (Europe) UK South

Availability options No infrastructure redundancy required

Security type Standard

Image * Ubuntu Server 20.04 LTS - x64 Gen2 [See all images](#) | [Configure VM generation](#)

[Review + create](#) < Previous Next: Disks > [Give feedback](#)

Fig. 8

Microsoft Azure Search resources, services, and docs (G+)

Azure services

Create a resource Virtual machines Resource groups Cost Management ... Virtual networks Marketplace Subscriptions SQL databases Quickstart Center More services

Resources

Recent Favorite

Name	Type	Last Viewed
vm1	Virtual machine	a few seconds ago
Assignment	Resource group	a few seconds ago
assignment-vnet	Virtual network	4 minutes ago

Navigate

Subscriptions Resource groups All resources Dashboard

Fig. 9

Microsoft Azure Search resources, services, and docs (G+)

Home > Virtual machines >

Create a virtual machine

Basics Disks Networking Management Monitoring Advanced Tags Review + create

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#)

Subscription * ⓘ Azure for Students

Resource group * ⓘ Assignment
[Create new](#)

Instance details

Virtual machine name * ⓘ vm2 ✓

Region * ⓘ (Europe) UK South

Availability options ⓘ No infrastructure redundancy required

Security type ⓘ Standard

Image * ⓘ Ubuntu Server 20.04 LTS - x64 Gen2
[See all images](#) | [Configure VM generation](#)

[Review + create](#) < Previous Next: Disks > [Give feedback](#)

Fig 10.

Installing the Nginx web server

To install the Nginx web server on one of the two virtual machines we've created, follow the steps below:

We click on the first virtual machine on which we want to install Nginx.

We open the Connect tab and select Bastion.

Bastion Connection provides a secure way to connect to Azure virtual machines through a web browser without exposing the user to the risk of malicious attacks or data compromise.

After connecting to the virtual machine through Bastion, we can proceed with the installation of the Nginx web server.

It should be noted that Bastion Connection is a powerful tool for secure remote access to virtual machines in Azure, making it an ideal choice for accessing mission-critical applications where security and reliability are paramount. This feature can also be used for convenience when working with the Azure environment.

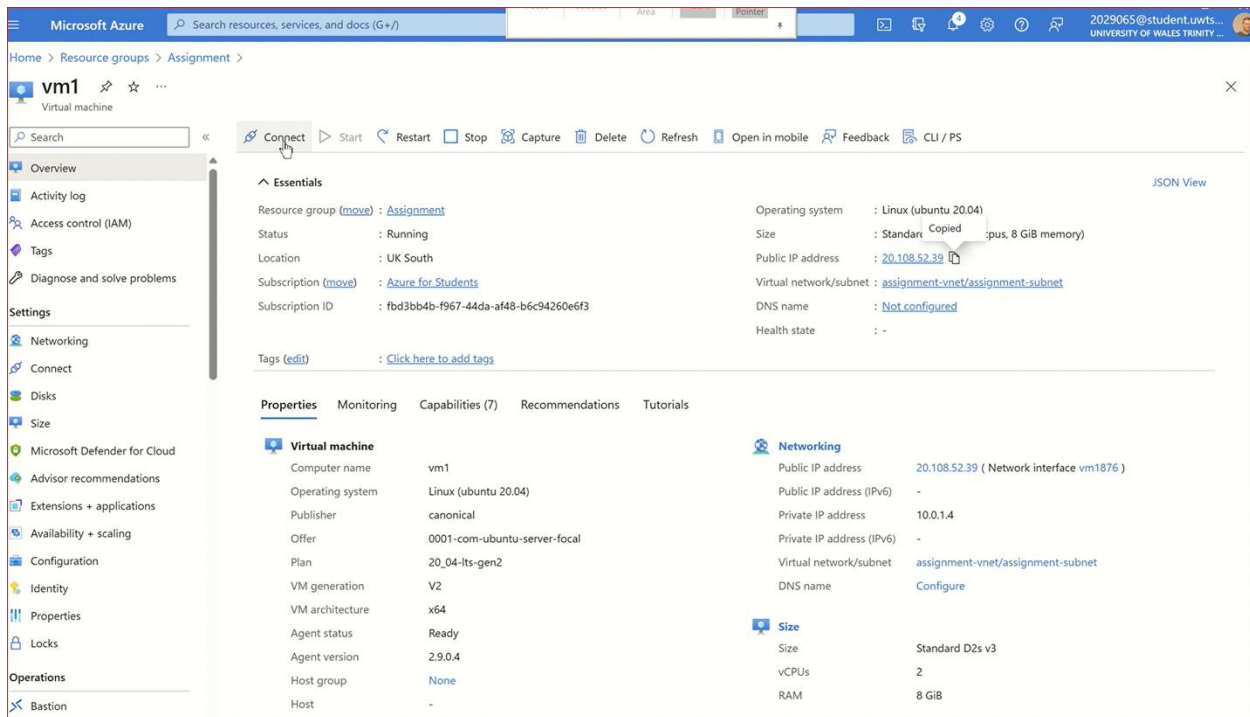


Fig. 11

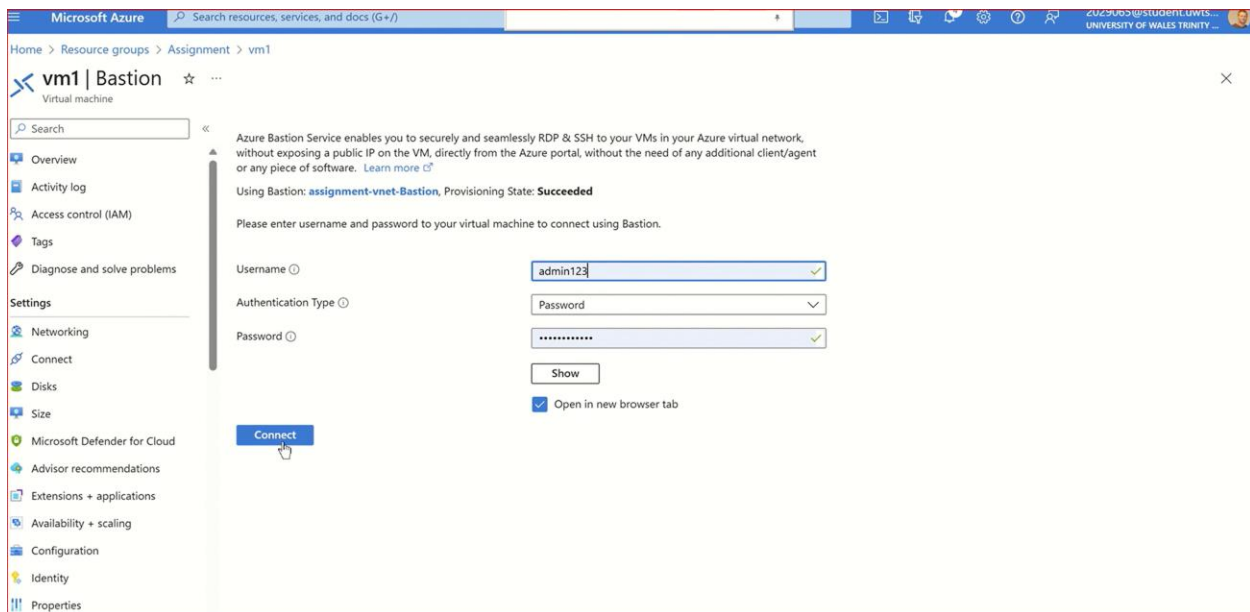


Fig. 12

```

Welcome to Ubuntu 20.04.6 LTS (GNU/Linux 5.15.0-1037-azure x86_64)
Documentation:  https://help.ubuntu.com
Management:    https://landscape.canonical.com
Support:        https://ubuntu.com/advantage

system information as of Mon May 1 23:35:22 UTC 2023

system load:  0.0      Processes:      125
Usage of /:   5.2% of 28.89GB   Users logged in:  0
Memory usage: 4%      IPv4 address for eth0: 10.0.1.4
Swap usage:   0%

Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Unattended Security Maintenance for Applications is not enabled.

Updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

All programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

min123@vml:~$
```

Fig. 13

Before to install the Nginx web server on an Azure virtual machine, follow these steps:

Open the virtual machine terminal.

We update the list of packages available on the machine with the command: `sudo apt update` We install Nginx with the command: **`sudo apt install nginx`**

We confirm the installation by selecting "Y" (yes) in the installation confirmation question. After the installation is complete, start Nginx with the command: **`systemctl start nginx`**. We check that Nginx is running by typing the IP address of your virtual machine into your web browser.

By following these steps, you can easily install and start using the Nginx web server on your Azure virtual

```
admin123@vml:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Hit:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Hit:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:5 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 Packages [8628 kB]
Get:6 http://azure.archive.ubuntu.com/ubuntu focal/universe Translation-en [5124 kB]
Get:7 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 c-n-f Metadata [265 kB]
Get:8 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 Packages [144 kB]
Get:9 http://azure.archive.ubuntu.com/ubuntu focal/multiverse Translation-en [104 kB]
Get:10 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 c-n-f Metadata [9136 B]
Hit:11 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [2529 kB]
Hit:12 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata [16.4 kB]
Hit:13 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [1054 kB]
Hit:14 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe Translation-en [249 kB]
Hit:15 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 c-n-f Metadata [24.2 kB]
Hit:16 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages [25.2 kB]
Hit:17 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse Translation-en [7408 B]
Hit:18 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 c-n-f Metadata [612 B]
Hit:19 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 Packages [45.7 kB]
Hit:20 http://azure.archive.ubuntu.com/ubuntu focal-backports/main Translation-en [16.3 kB]
Hit:21 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 c-n-f Metadata [1420 B]
Hit:22 http://azure.archive.ubuntu.com/ubuntu focal-backports/restricted amd64 c-n-f Metadata [116 B]
Hit:23 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 Packages [24.9 kB]
Hit:24 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe Translation-en [16.3 kB]
Hit:25 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 c-n-f Metadata [880 B]
Hit:26 http://azure.archive.ubuntu.com/ubuntu focal-backports/multiverse amd64 c-n-f Metadata [116 B]
Hit:27 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 Packages [2145 kB]
Hit:28 http://azure.archive.ubuntu.com/ubuntu focal-security/main Translation-en [345 kB]
Hit:29 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [12.5 kB]
Hit:30 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [1719 kB]
Hit:31 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted Translation-en [242 kB]
Hit:32 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 Packages [829 kB]
Hit:33 http://azure.archive.ubuntu.com/ubuntu focal-security/universe Translation-en [167 kB]
Hit:34 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 c-n-f Metadata [17.6 kB]
Hit:35 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [22.9 kB]
Hit:36 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse Translation-en [5488 B]
Hit:37 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 c-n-f Metadata [540 B]
Fetched 24.1 MB in 4s (6316 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
0 packages can be upgraded. Run 'apt list --upgradable' to see them.
admin123@vml:~$ sudo apt install nginx
```

Fig. 14

```
unpacking nginx-common (1.18.0-0ubuntu1.4) ...
selecting previously unselected package libnginx-mod-http-image-filter;
preparing to unpack .../11-libnginx-mod-http-image-filter_1.18.0-0ubuntu1.4_amd64.deb ...
unpacking libnginx-mod-http-image-filter (1.18.0-0ubuntu1.4) ...
selecting previously unselected package libnginx-mod-http-xslt-filter;
preparing to unpack .../12-libnginx-mod-http-xslt-filter_1.18.0-0ubuntu1.4_amd64.deb ...
unpacking libnginx-mod-http-xslt-filter (1.18.0-0ubuntu1.4) ...
selecting previously unselected package libnginx-mod-mail;
preparing to unpack .../13-libnginx-mod-mail_1.18.0-0ubuntu1.4_amd64.deb ...
unpacking libnginx-mod-mail (1.18.0-0ubuntu1.4) ...
selecting previously unselected package libnginx-mod-stream;
preparing to unpack .../14-libnginx-mod-stream_1.18.0-0ubuntu1.4_amd64.deb ...
unpacking libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
selecting previously unselected package nginx-core;
preparing to unpack .../15-nginx-core_1.18.0-0ubuntu1.4_amd64.deb ...
unpacking nginx-core (1.18.0-0ubuntu1.4) ...
selecting previously unselected package nginx;
preparing to unpack .../16-nginx_1.18.0-0ubuntu1.4_all.deb ...
unpacking nginx (1.18.0-0ubuntu1.4) ...
Setting up libxpm4:amd64 (1:3.5.12-1ubuntu0.20.04.1) ...
Setting up nginx-common (1.18.0-0ubuntu1.4) ...
Created symlink /etc/systemd/system/multi-user.target.wants/nginx.service → /lib/systemd/system/nginx.service.
Setting up libbig0:amd64 (2.1-3-1ubuntu0.20.04.1) ...
Setting up libnginx-mod-http-xslt-filter (1.18.0-0ubuntu1.4) ...
Setting up libwebp6:amd64 (0.6.1-2ubuntu0.20.04.1) ...
Setting up fonts-dejavu-core (2.37-1) ...
Setting up libjpeg-turbo8:amd64 (2.0.3-0ubuntu1.20.04.3) ...
Setting up libjpeg8:amd64 (8c-2ubuntu8) ...
Setting up libnginx-mod-mail (1.18.0-0ubuntu1.4) ...
Setting up fontconfig-config (2.13.1-2ubuntu3) ...
Setting up libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
Setting up libtiff5:amd64 (4.1.0+git191117-2ubuntu0.20.04.8) ...
Setting up libfontconfig1:amd64 (2.13.1-2ubuntu3) ...
Setting up libgd3:amd64 (2.2.5-5.2ubuntu2.1) ...
Setting up libnginx-mod-http-image-filter (1.18.0-0ubuntu1.4) ...
Setting up nginx-core (1.18.0-0ubuntu1.4) ...
Setting up nginx (1.18.0-0ubuntu1.4) ...
Processing triggers for ufw (0.36-0ubuntu1) ...
Processing triggers for systemd (245.4-4ubuntu3.21) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.9) ...
admin123@vml:~$ system start nginx
```

Fig. 15

```

o run a command as administrator (user "root"), use "sudo <command>" or simply
ee "man sudo_root" for details.

dmin123@vml1:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Hit:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Hit:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Hit:5 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 Packages [8628 kB]
Hit:6 http://azure.archive.ubuntu.com/ubuntu focal/universe Translation-en [5124 kB]
Hit:7 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 c-n-f Metadata [265 kB]
Hit:8 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 Packages [144 kB]
Hit:9 http://azure.archive.ubuntu.com/ubuntu focal/multiverse Translation-en [104 kB]
Hit:10 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 c-n-f Metadata [9136 B]
Hit:11 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [2529 kB]
Hit:12 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata [16.4 kB]
Hit:13 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [1054 kB]
Hit:14 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe Translation-en [249 kB]
Hit:15 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 c-n-f Metadata [24.2 kB]
Hit:16 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages [25.2 kB]
Hit:17 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse Translation-en [7408 B]
Hit:18 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 c-n-f Metadata [612 B]
Hit:19 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 Packages [45.7 kB]
Hit:20 http://azure.archive.ubuntu.com/ubuntu focal-backports/main Translation-en [16.3 kB]
Hit:21 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 c-n-f Metadata [1420 B]
Hit:22 http://azure.archive.ubuntu.com/ubuntu focal-backports/restricted amd64 c-n-f Metadata [116 B]
Hit:23 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 Packages [24.9 kB]
Hit:24 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe Translation-en [16.3 kB]
Hit:25 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 c-n-f Metadata [880 B]
Hit:26 http://azure.archive.ubuntu.com/ubuntu focal-backports/multiverse amd64 c-n-f Metadata [116 B]
Hit:27 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 Packages [2145 kB]
Hit:28 http://azure.archive.ubuntu.com/ubuntu focal-security/main Translation-en [345 kB]
Hit:29 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [12.5 kB]
Hit:30 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [1719 kB]
Hit:31 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted Translation-en [242 kB]
Hit:32 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 Packages [829 kB]
Hit:33 http://azure.archive.ubuntu.com/ubuntu focal-security/universe Translation-en [167 kB]
Hit:34 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 c-n-f Metadata [17.6 kB]
Hit:35 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [22.9 kB]
Hit:36 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse Translation-en [5488 B]
Hit:37 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 c-n-f Metadata [540 B]
Fetched 24.1 MB in 4s (6316 KB/s)

```

Fig. 16

```

Preparing to unpack .../14-libnginx-mod-stream_1.18.0-0ubuntu1.4_...
Unpacking libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
Selecting previously unselected package nginx-core.
Preparing to unpack .../15-nginx-core_1.18.0-0ubuntu1.4_amd64.deb ...
Unpacking nginx-core (1.18.0-0ubuntu1.4) ...
Selecting previously unselected package nginx.
Preparing to unpack .../16-nginx_1.18.0-0ubuntu1.4_all.deb ...
Unpacking nginx (1.18.0-0ubuntu1.4) ...
Setting up libxpm4:amd64 (1:3.5.12-1ubuntu0.20.04.1) ...
Setting up nginx-common (1.18.0-0ubuntu1.4) ...
Created symlink /etc/systemd/system/multi-user.target.wants/nginx.service → /lib/systemd/system/nginx.service.
Setting up libbig0:amd64 (2.1-3.1ubuntu0.20.04.1) ...
Setting up libnginx-mod-http-xslt-filter (1.18.0-0ubuntu1.4) ...
Setting up libwebp6:amd64 (0.6.1-2ubuntu0.20.04.1) ...
Setting up fonts-dejavu-core (2.37-1) ...
Setting up libjpeg-turbo8:amd64 (2.0.3-0ubuntu1.20.04.3) ...
Setting up libjpeg8:amd64 (8c-2ubuntu8) ...
Setting up libnginx-mod-mail (1.18.0-0ubuntu1.4) ...
Setting up fontconfig-config (2.13.1-2ubuntu3) ...
Setting up libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
Setting up libtiff5:amd64 (4.1.0+git191117-2ubuntu0.20.04.8) ...
Setting up libfontconfig1:amd64 (2.13.1-2ubuntu3) ...
Setting up libgd3:amd64 (2.2.5-5.2ubuntu2.1) ...
Setting up libnginx-mod-http-image-filter (1.18.0-0ubuntu1.4) ...
Setting up nginx-core (1.18.0-0ubuntu1.4) ...
Setting up nginx (1.18.0-0ubuntu1.4) ...
Processing triggers for ufw (0.36-0ubuntu1) ...
Processing triggers for systemd (245.4-4ubuntu3.21) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.9) ...
dmin123@vml1:~$ system start nginx
Command 'system' not found, did you mean:
  command 'system3' from deb simh (3.8.1-6)
  command 'systemd' from deb systemd (245.4-4ubuntu3.21)
Try: sudo apt install <deb name>
dmin123@vml1:~$ systemctl start nginx
== AUTHENTICATING FOR org.freedesktop.systemd1.manage-units ==
Authentication is required to start 'nginx.service'.
Authentication as: Ubuntu (admin123)
Password:

```

Fig. 17

```

npackaging nginx-common (1.18.0-0ubuntu1.4) ...
electing previously unselected package libnginx-mod-http-image
reparing to unpack .../11-libnginx-mod-http-image-filter_1.18.0-0ubuntu1.4_amd64.deb ...
npackaging libnginx-mod-http-image-filter (1.18.0-0ubuntu1.4) ...
electing previously unselected package libnginx-mod-http-xslt-filter.
reparing to unpack .../12-libnginx-mod-http-xslt-filter_1.18.0-0ubuntu1.4_amd64.deb ...
npackaging libnginx-mod-http-xslt-filter (1.18.0-0ubuntu1.4) ...
electing previously unselected package libnginx-mod-mail.
reparing to unpack .../13-libnginx-mod-mail_1.18.0-0ubuntu1.4_amd64.deb ...
npackaging libnginx-mod-mail (1.18.0-0ubuntu1.4) ...
electing previously unselected package libnginx-mod-stream.
reparing to unpack .../14-libnginx-mod-stream_1.18.0-0ubuntu1.4_amd64.deb ...
npackaging libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
electing previously unselected package nginx-core.
reparing to unpack .../15-nginx-core_1.18.0-0ubuntu1.4_amd64.deb ...
npackaging nginx-core (1.18.0-0ubuntu1.4) ...
electing previously unselected package nginx.
reparing to unpack .../16-nginx_1.18.0-0ubuntu1.4_all.deb ...
npackaging nginx (1.18.0-0ubuntu1.4) ...
etting up libxpm4:amd64 (1:3.5.12-1ubuntu0.20.04.1) ...
etting up nginx-common (1.18.0-0ubuntu1.4) ...
reated symlink /etc/systemd/system/multi-user.target.wants/nginx.service → /lib/systemd/system/nginx.service.
etting up libjbig0:amd64 (2.1-3.1ubuntu0.20.04.1) ...
etting up libnginx-mod-http-xslt-filter (1.18.0-0ubuntu1.4) ...
etting up libwebp6:amd64 (0.6.1-2ubuntu0.20.04.1) ...
etting up fonts-dejavu-core (2.37-1) ...
etting up libjpeg-turbo8:amd64 (2.0.3-0ubuntu1.20.04.3) ...
etting up libjpeg8:amd64 (8c-2ubuntu8) ...
etting up libnginx-mod-mail (1.18.0-0ubuntu1.4) ...
etting up fontconfig-config (2.13.1-2ubuntu3) ...
etting up libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
etting up libtiff5:amd64 (4.1.0-git191117-2ubuntu0.20.04.8) ...
etting up libfontconfig1:amd64 (2.13.1-2ubuntu3) ...
etting up libgd3:amd64 (2.2.5-5.2ubuntu2.1) ...
etting up libnginx-mod-http-image-filter (1.18.0-0ubuntu1.4) ...
etting up nginx-core (1.18.0-0ubuntu1.4) ...
etting up nginx (1.18.0-0ubuntu1.4) ...
rocessing triggers for ufw (0.36-6ubuntu1) ...
rocessing triggers for systemd (245.4-4ubuntu3.21) ...
rocessing triggers for man-db (2.9.1-1) ...
rocessing triggers for libc-bin (2.31-0ubuntu9.9) ...
dmin123@vml:~$ system start nginx

```

Fig. 18

```

o run a command as administrator (user "root"), use "sudo <com
ee "man sudo_root" for details.

dmin123@vml:~$ sudo apt update
it:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease
et:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
et:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
et:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease [114 kB]
et:5 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 Packages [8628 kB]
et:6 http://azure.archive.ubuntu.com/ubuntu focal/universe Translation-en [5124 kB]
et:7 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 c-n-f Metadata [265 kB]
et:8 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 Packages [144 kB]
et:9 http://azure.archive.ubuntu.com/ubuntu focal/multiverse Translation-en [104 kB]
et:10 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 c-n-f Metadata [9136 B]
et:11 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [2529 kB]
et:12 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata [16.4 kB]
et:13 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [1054 kB]
et:14 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe Translation-en [249 kB]
et:15 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 c-n-f Metadata [24.2 kB]
et:16 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages [25.2 kB]
et:17 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse Translation-en [7408 B]
et:18 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 c-n-f Metadata [612 B]
et:19 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 Packages [45.7 kB]
et:20 http://azure.archive.ubuntu.com/ubuntu focal-backports/main Translation-en [16.3 kB]
et:21 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 c-n-f Metadata [1420 B]
et:22 http://azure.archive.ubuntu.com/ubuntu focal-backports/restricted amd64 c-n-f Metadata [116 B]
et:23 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 Packages [24.9 kB]
et:24 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe Translation-en [16.3 kB]
et:25 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 c-n-f Metadata [880 B]
et:26 http://azure.archive.ubuntu.com/ubuntu focal-backports/multiverse amd64 c-n-f Metadata [116 B]
et:27 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 Packages [2145 kB]
et:28 http://azure.archive.ubuntu.com/ubuntu focal-security/main Translation-en [345 kB]
et:29 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [12.5 kB]
et:30 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [1719 kB]
et:31 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted Translation-en [242 kB]
et:32 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 Packages [829 kB]
et:33 http://azure.archive.ubuntu.com/ubuntu focal-security/universe Translation-en [167 kB]
et:34 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 c-n-f Metadata [17.6 kB]
et:35 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [22.9 kB]
et:36 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse Translation-en [5488 B]
et:37 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 c-n-f Metadata [540 B]
etched 24.1 MB in 4s (6316 kB/s)

```

Fig. 19

```

preparing to unpack .../14-libnginx-mod-stream_1.18.0-0ubuntu1.4 ...
unpacking libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
selecting previously unselected package nginx-core.
preparing to unpack .../15-nginx-core_1.18.0-0ubuntu1.4_amd64.deb ...
unpacking nginx-core (1.18.0-0ubuntu1.4) ...
selecting previously unselected package nginx.
preparing to unpack .../16-nginx_1.18.0-0ubuntu1.4_all.deb ...
unpacking nginx (1.18.0-0ubuntu1.4) ...
setting up libxpm4:amd64 (1:3.5.12-1ubuntu0.20.04.1) ...
setting up nginx-common (1.18.0-0ubuntu1.4) ...
created symlink /etc/systemd/system/multi-user.target.wants/nginx.service → /lib/systemd/system/nginx.service.
setting up libjpeg8:amd64 (2.1-3.1ubuntu0.20.04.1) ...
setting up libnginx-mod-http-xslt-filter (1.18.0-0ubuntu1.4) ...
setting up libwebp6:amd64 (0.6.1-2ubuntu0.20.04.1) ...
setting up fonts-dejavu-core (2.37-1) ...
setting up libjpeg-turbo8:amd64 (2.0.3-0ubuntu1.20.04.3) ...
setting up libjpeg8:amd64 (8c-2ubuntu8) ...
setting up libnginx-mod-mail (1.18.0-0ubuntu1.4) ...
setting up fontconfig-config (2.13.1-2ubuntu3) ...
setting up libnginx-mod-stream (1.18.0-0ubuntu1.4) ...
setting up libtiff5:amd64 (4.1.0+git191117-2ubuntu0.20.04.8) ...
setting up libfontconfig1:amd64 (2.13.1-2ubuntu3) ...
setting up libgd3:amd64 (2.2.5-5.2ubuntu2.1) ...
setting up libnginx-mod-http-image-filter (1.18.0-0ubuntu1.4) ...
setting up nginx-core (1.18.0-0ubuntu1.4) ...
setting up nginx (1.18.0-0ubuntu1.4) ...
processing triggers for ufw (0.36-6ubuntu1) ...
processing triggers for systemd (245.4-4ubuntu3.21) ...
processing triggers for man-db (2.9.1-1) ...
processing triggers for libc-bin (2.31-0ubuntu9.9) ...
dmin123@vml:~$ system start nginx

command 'system' not found, did you mean:

  command 'system3' from deb simh (3.8.1-6)
  command 'systemd' from deb systemd (245.4-4ubuntu3.21)

try: sudo apt install <deb name>

dmin123@vml:~$ systemctl start nginx
=== AUTHENTICATING FOR org.freedesktop.systemd1.manage-units ===
Authentication is required to start 'nginx.service'.
Authenticating as: Ubuntu (admin123)
password:

```

Fig. 20

```

dmin123@vml:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Hit:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Hit:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Hit:5 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 Packages [8628 kB]
Hit:6 http://azure.archive.ubuntu.com/ubuntu focal/universe Translation-en [5124 kB]
Hit:7 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 c-n-f Metadata [265 kB]
Hit:8 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 Packages [144 kB]
Hit:9 http://azure.archive.ubuntu.com/ubuntu focal/multiverse Translation-en [104 kB]
Hit:10 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 c-n-f Metadata [9136 B]
Hit:11 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [2529 kB]
Hit:12 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata [16.4 kB]
Hit:13 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [1054 kB]
Hit:14 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe Translation-en [249 kB]
Hit:15 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 c-n-f Metadata [24.2 kB]
Hit:16 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages [25.2 kB]
Hit:17 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse Translation-en [7408 B]
Hit:18 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 c-n-f Metadata [612 B]
Hit:19 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 Packages [45.7 kB]
Hit:20 http://azure.archive.ubuntu.com/ubuntu focal-backports/main Translation-en [16.3 kB]
Hit:21 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 c-n-f Metadata [1420 B]
Hit:22 http://azure.archive.ubuntu.com/ubuntu focal-backports/restricted amd64 c-n-f Metadata [116 B]
Hit:23 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 Packages [24.9 kB]
Hit:24 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe Translation-en [16.3 kB]
Hit:25 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 c-n-f Metadata [880 B]
Hit:26 http://azure.archive.ubuntu.com/ubuntu focal-backports/multiverse amd64 c-n-f Metadata [116 B]
Hit:27 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 Packages [2145 kB]
Hit:28 http://azure.archive.ubuntu.com/ubuntu focal-security/main Translation-en [345 kB]
Hit:29 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [12.5 kB]
Hit:30 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [1719 kB]
Hit:31 http://azure.archive.ubuntu.com/ubuntu focal-security/restricted Translation-en [242 kB]
Hit:32 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 Packages [829 kB]
Hit:33 http://azure.archive.ubuntu.com/ubuntu focal-security/universe Translation-en [167 kB]
Hit:34 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 c-n-f Metadata [17.6 kB]
Hit:35 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [22.9 kB]
Hit:36 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse Translation-en [5488 B]
Hit:37 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 c-n-f Metadata [540 B]
Fetched 24.1 MB in 4s (6316 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
Some packages can be upgraded. Run 'apt list --upgradable' to see them.
dmin123@vml:~$ sudo apt install nginx

```

Fig. 21

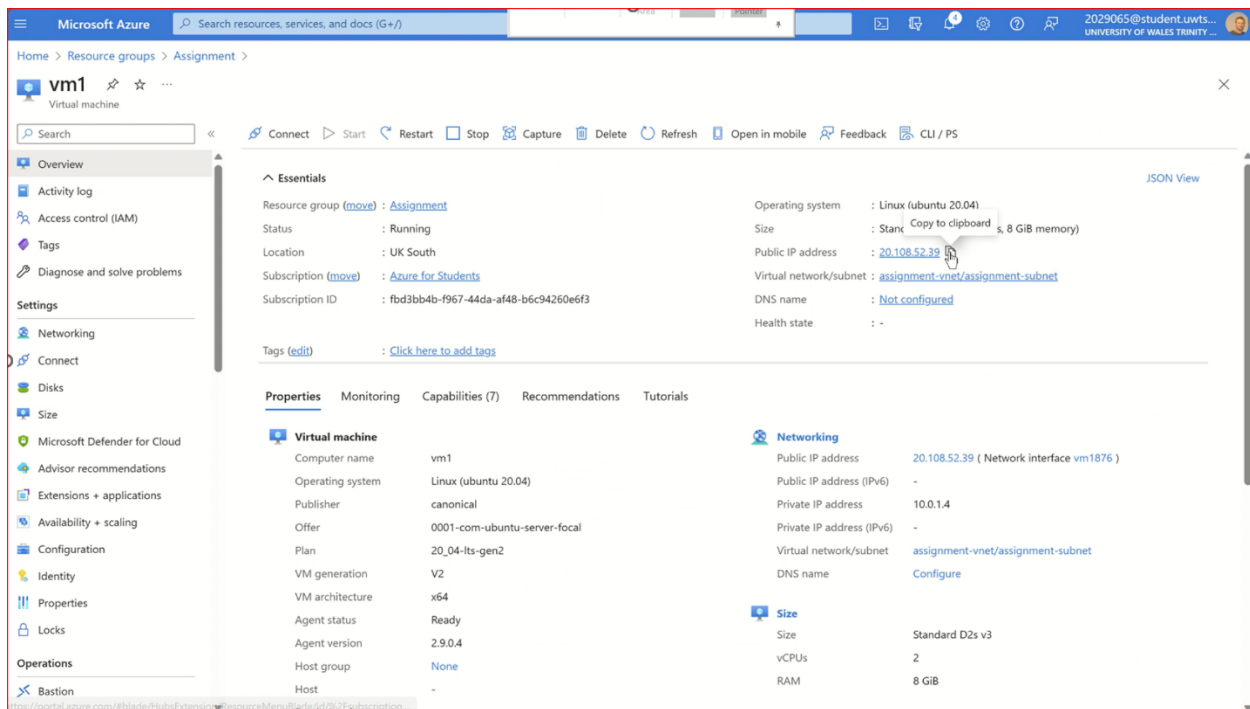


Fig. 22

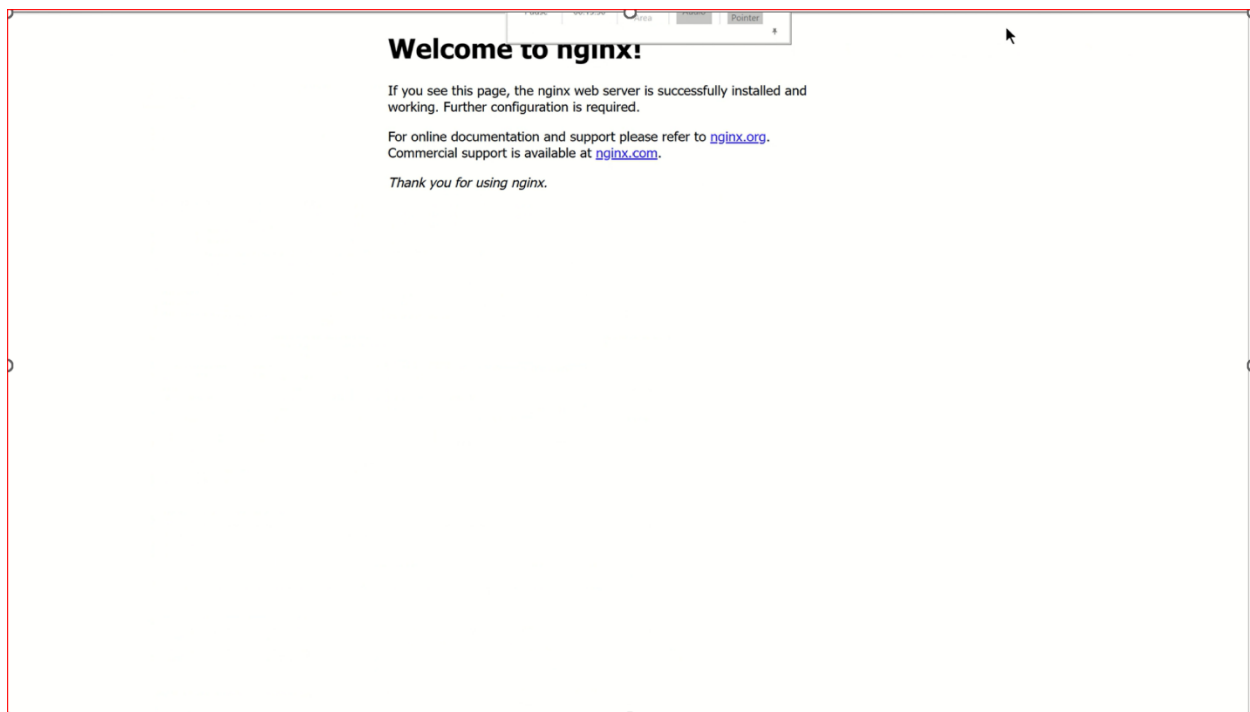
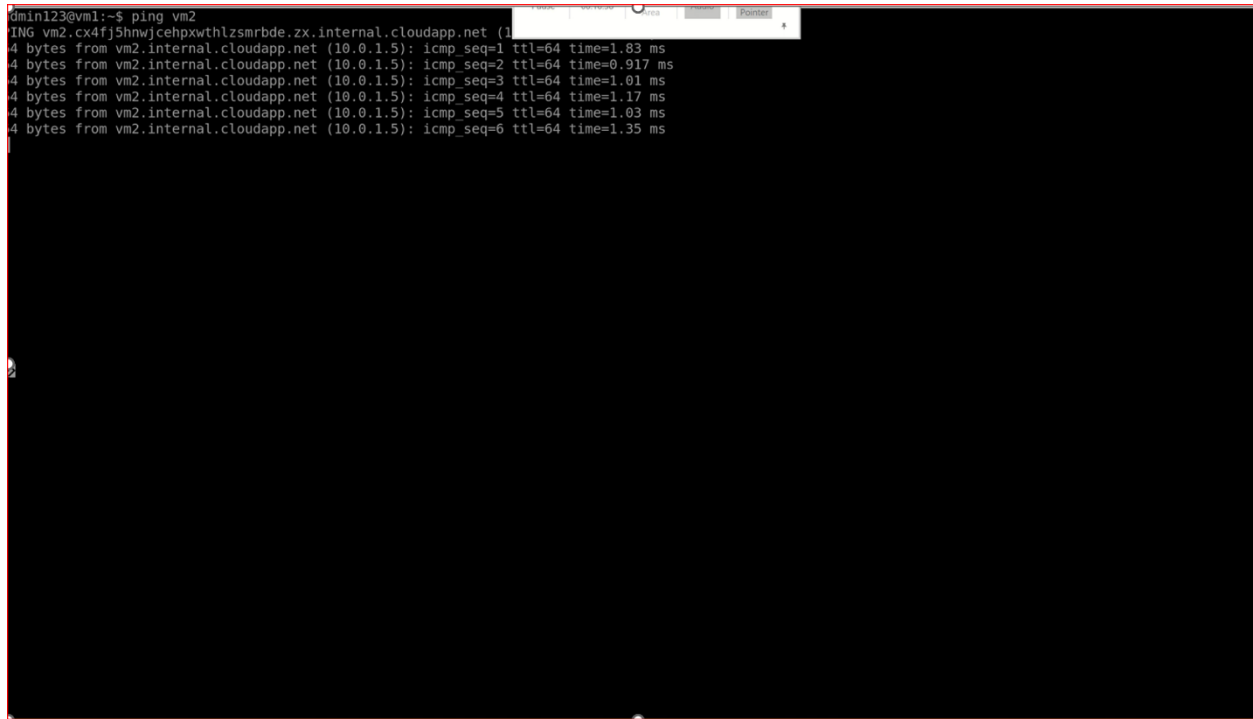


Fig. 23

The last thing we need to check is the connection between the first and second virtual machine, which is shown in the next picture.

A screenshot of a terminal window with a black background and white text. The prompt is 'dmin123@vm1:~\$'. The command entered is 'ping vm2'. The output shows six successful ping responses from 'vm2.internal.cloudapp.net (10.0.1.5)'. Each response indicates 4 bytes received, an icmp_seq number from 1 to 6, a TTL of 64, and a response time in milliseconds. The times are: 1.83 ms, 0.917 ms, 1.01 ms, 1.17 ms, 1.03 ms, and 1.35 ms. The terminal window has a title bar at the top with 'VM1' and 'PowerShell' visible.

```
dmin123@vm1:~$ ping vm2
PING vm2.cx4fj5hwwjcehpwxthlzsmrbde.zx.internal.cloudapp.net (10.0.1.5): 64 bytes of data:
4 bytes from vm2.internal.cloudapp.net (10.0.1.5): icmp_seq=1 ttl=64 time=1.83 ms
4 bytes from vm2.internal.cloudapp.net (10.0.1.5): icmp_seq=2 ttl=64 time=0.917 ms
4 bytes from vm2.internal.cloudapp.net (10.0.1.5): icmp_seq=3 ttl=64 time=1.01 ms
4 bytes from vm2.internal.cloudapp.net (10.0.1.5): icmp_seq=4 ttl=64 time=1.17 ms
4 bytes from vm2.internal.cloudapp.net (10.0.1.5): icmp_seq=5 ttl=64 time=1.03 ms
4 bytes from vm2.internal.cloudapp.net (10.0.1.5): icmp_seq=6 ttl=64 time=1.35 ms
```

Fig. 24

Link to my Video demonstrating creation of VM and vNet:

<https://youtu.be/MJZlddJQgwE>

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