

## INTRODUCTION TO CLOUD COMPUTING

### Lab Task 03 (Implement Virtual Networking)

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## Task 1: Create a virtual network with subnets using the portal.

- Create a Virtual network “CoreServicesVnet”:

The screenshot shows the 'Create virtual network' wizard in the Microsoft Azure portal. On the left, there's a sidebar with 'Project details' (Subscription: Azure for Students, Resource group: az104-rg4), 'Instance details' (Virtual network name: CoreServicesVnet, Region: (Asia Pacific) East Asia), and a note about deploying to an Azure Extended Zone. At the bottom, there are 'Previous', 'Next', and 'Review + create' buttons.

- Configure IP Address Space & Create SharedServicesSubnet:

The screenshot shows the 'IP addresses' step of the 'Create virtual network' wizard. It displays the configured address space (10.20.0.0/16) and the addition of a new subnet named 'SharedServicesSubnet'. The subnet details are: IPv4 address range 10.20.0.0/16, starting address 10.20.10.0, and size /24 (256 addresses). A note indicates that this virtual network has no IPv6 address ranges. Navigation buttons Previous, Next, and Review + create are at the bottom.

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- Create DatabaseSubnet:

**Create virtual network**

IP addresses

Subnets	IP address range	Size	NAT gateway
default	10.20.0.0 - 10.20.255.255	/24 (256 addresses)	-
SharedServicesSubnet	10.20.10.0 - 10.20.10.255	/24 (256 addresses)	-

Add a subnet

Subnet purpose: Default  
Name: DatabaseSubnet

**IPv4**

Include an IPv4 address space:   
IPv4 address range: 10.20.0.0/16  
Starting address: 10.20.20.0  
Size: /24 (256 addresses)  
Subnet address range: 10.20.20.0 - 10.20.20.255

**IPv6**

Include an IPv6 address space:

**Private subnet**

Private subnets are security groups providing default outbound access. To enable outbound connectivity for virtual machines to access the internet, it is necessary to explicitly grant outbound access. A NAT gateway is the recommended way to provide outbound connectivity for virtual machines in the subnet.

Enable private subnet (no default outbound access):

**Add** **Cancel** **Review + create**

- Verify Virtual Network and Subnets:

**CoreServicesVnet | Address space**

Address space: 10.20.0.0/16  
Address range: 10.20.0.0 - 10.20.255.255  
Address count: 65,536 addresses

**Peered virtual network address space**

No items found

**Save** **Cancel** **Give feedback**

**CoreServicesVnet | Subnets**

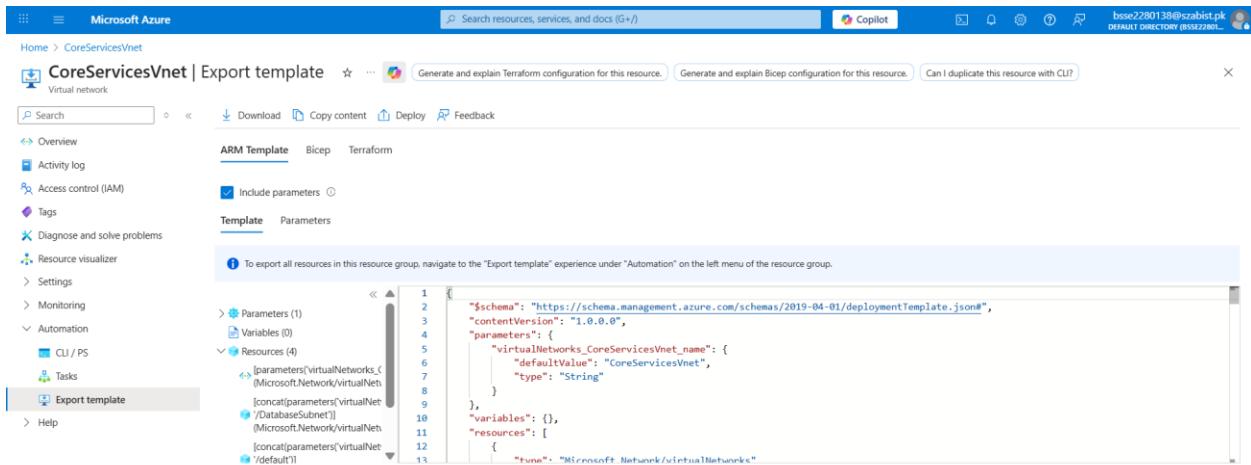
Create subnets to segment the virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet.

Name	IPv4	IPv6	Available IPs	Delegated to	Security group	Route table
default	10.20.0.0/24	-	251	-	-	-
SharedServicesSubnet	10.20.10.0/24	-	251	-	-	-
DatabaseSubnet	10.20.20.0/24	-	251	-	-	-

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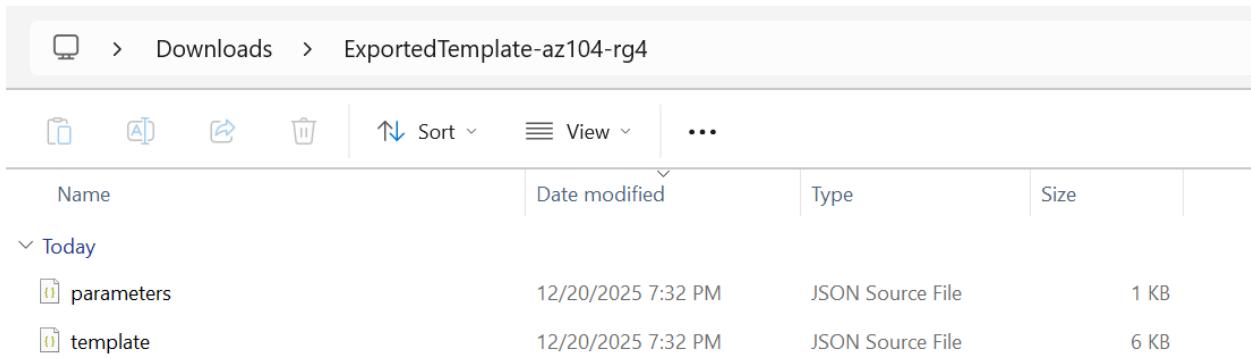
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#### • Export ARM Template:



The screenshot shows the Microsoft Azure portal interface for the 'CoreServicesVnet' resource group. The left sidebar has 'Export template' selected under the 'Automation' section. The main content area is titled 'CoreServicesVnet | Export template' and shows the 'ARM Template' tab selected. A code editor displays the ARM template JSON code, which includes sections for schema, content version, parameters, variables, and resources. The 'Template' tab is also visible.

```
$schema": "https://schema.management.azure.com/schemas/2019-04-01/deploymentTemplate.json#", "contentVersion": "1.0.0.0", "parameters": { "virtualNetworks_CoreServicesVnet_name": { "defaultValue": "CoreServicesVnet", "type": "String" } }, "variables": {}, "resources": [ { "type": "Microsoft.Network/virtualNetworks", "name": "[parameters('virtualNetworks_CoreServicesVnet_name')]", "properties": { "addressSpace": { "subnets": [ { "name": "DatabaseSubnet", "cidr": "10.0.1.0/24" } ] } } } ] }
```



The screenshot shows the Microsoft Azure Storage Explorer interface. The file structure is displayed under 'ExportsTemplate-az104-rg4'. It contains two files: 'parameters' (1 KB) and 'template' (6 KB), both of which are JSON source files. The 'parameters' file contains the parameter definitions from the ARM template, and the 'template' file contains the full ARM template JSON code.

Name	Date modified	Type	Size
parameters	12/20/2025 7:32 PM	JSON Source File	1 KB
template	12/20/2025 7:32 PM	JSON Source File	6 KB

### **Task 2: Create a virtual network and subnets using a template.**

- **Edit ARM Template for ManufacturingVnet & Modify Address Space and Subnets:**

C: > Users > hp > Downloads > ExportedTemplate-az104-rg4 > {} template.json > [] resources > {} 0 > {} properties > [] subnets > {} 1 > {} properties >

```
1 {
2     "$schema": "https://schema.management.azure.com/schemas/2019-04-01/deploymentTemplate.json#",
3     "contentVersion": "1.0.0.0",
4     "parameters": {
5         "virtualNetworks_ManufacturingVnet_name": {
6             "defaultValue": "ManufacturingVnet",
7             "type": "String"
8         }
9     },
10    "variables": {},
11    "resources": [
12        {
13            "type": "Microsoft.Network/virtualNetworks",
14            "apiVersion": "2024-07-01",
15            "name": "[parameters('virtualNetworks_ManufacturingVnet_name')]",
16            "location": "eastasia",
17            "properties": {
18                "addressSpace": {
19                    "addressPrefixes": [
20                        "10.30.0.0/16"
21                    ]
22                },
23                "encryption": {
24                    "enabled": false,
25                    "enforcement": "AllowUnencrypted"
26                },
27                "privateEndpointVNetPolicies": "Disabled",
28                "subnets": [
29                    {
30                        "name": "ManufacturingSubnet"
31                    }
32                ]
33            }
34        }
35    ]
36 }
```

C: > Users > hp > Downloads > ExportedTemplate-az104-rg4 > `template.json` > `resources` > `0` > `properties` > `subnets` > `1` > `properties` > `privateLinkServiceNetworkPolicies`

```
"name": "SensorSubnet2",
"id": "[resourceId('Microsoft.Network/virtualNetworks/subnets', parameters('virtualNetworks_ManufacturingVnet_name'), 'SensorSubnet2')]",
"properties": {
    "addressPrefixes": [
        "10.30.21.0/24"
    ],
    "delegations": [],
    "privateEndpointNetworkPolicies": "Disabled",
    "privateLinkServiceNetworkPolicies": "Enabled"
},
"type": "Microsoft.Network/virtualNetworks/subnets"
```

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```
73  {
74      "type": "Microsoft.Network/virtualNetworks/subnets",
75      "apiVersion": "2024-07-01",
76      "name": "[concat(parameters('virtualNetworks_ManufacturingVnet_name'), '/SensorSubnet2')]",
77      "dependsOn": [
78          "[resourceId('Microsoft.Network/virtualNetworks', parameters('virtualNetworks_ManufacturingVnet_name'))]"
79      ],
80      "properties": {
81          "addressPrefixes": [
82              "10.30.21.0/24"
83          ],
84          "delegations": [],
85          "privateEndpointNetworkPolicies": "Disabled",
86          "privateLinkServiceNetworkPolicies": "Enabled"
87      }
88 },
89 {
90     "type": "Microsoft.Network/virtualNetworks/subnets",
91     "apiVersion": "2024-07-01",
92     "name": "[concat(parameters('virtualNetworks_ManufacturingVnet_name'), '/default')]",
93     "dependsOn": [
94         "[resourceId('Microsoft.Network/virtualNetworks', parameters('virtualNetworks_ManufacturingVnet_name'))]"
95     ],
96     "properties": {
97         "addressPrefixes": [
98             "10.30.0.0/24"
99         ],
100        "delegations": [],
101        "privateEndpointNetworkPolicies": "Disabled",
102        "privateLinkServiceNetworkPolicies": "Enabled"
103    }
104 },
105 {
106     "type": "Microsoft.Network/virtualNetworks/subnets",
107     "apiVersion": "2024-07-01",
108     "name": "[concat(parameters('virtualNetworks_ManufacturingVnet_name'), '/SensorSubnet1')]",
109     "dependsOn": [
110         "[resourceId('Microsoft.Network/virtualNetworks', parameters('virtualNetworks_ManufacturingVnet_name'))]"
111     ],
112     "properties": {
113         "addressPrefixes": [
114             "10.30.20.0/24"
115         ],
116         "delegations": [],
117         "privateEndpointNetworkPolicies": "Disabled",
118         "privateLinkServiceNetworkPolicies": "Enabled"
119     }
120 },
121 ]
122 }
```

- **Update Parameters File:**



```
LAB_04-Implement_Virtual_Networking.md  parameters.json  template.json 1

C: > Users > hp > Downloads > ExportedTemplate-az104-rg4 > parameters.json > ...

1  {
2      "$schema": "https://schema.management.azure.com/schemas/2015-01-01/deploymentParameters.json#",
3      "contentVersion": "1.0.0.0",
4      "parameters": {
5          "virtualNetworks_ManufacturingVnet_name": {
6              "value": null
7          }
8      }
9  }
10 }
```

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#### • Deploy Custom ARM Template:

The screenshot shows the 'Custom deployment' page in the Microsoft Azure portal. At the top, there are tabs for 'Select a template', 'Basics', 'Review + create', and 'Copilot'. Below the tabs, a section titled 'Automate deploying resources with Azure Resource Manager templates in a single, coordinated operation. Create or select a template below to get started.' includes a link 'Learn more about template deployment'. There is a button 'Build your own template in the editor'. Under 'Common templates', there are links for 'Create a Linux virtual machine', 'Create a Windows virtual machine', 'Create a web app', 'Create a SQL database', and 'Azure landing zone'. A section 'Start with a quickstart template or template spec' allows selecting 'Template source': 'Quickstart template' (selected) or 'Template spec'. A dropdown 'Quickstart template (disclaimer)' is shown.

The screenshot shows the 'Edit template' page in the Microsoft Azure portal. At the top, there are tabs for '+ Add resource', 'Quickstart template', 'Load file', and 'Download'. Below the tabs, a tree view shows 'Parameters (1)', 'Variables (0)', and 'Resources (4)'. The 'Resources' node is expanded, showing an ARM template code snippet. The code defines a virtual network named 'ManufacturingVnet' with an address space of '10.30.0.0/16'. The 'Save' and 'Discard' buttons are at the bottom.

```
$schema": "https://schema.management.azure.com/schemas/2019-04-01/deploymentTemplate.json#", "contentVersion": "1.0.0.0", "parameters": { "virtualNetworks_ManufacturingVnet_name": { "defaultValue": "ManufacturingVnet", "type": "String" } }, "variables": {}, "resources": [ { "type": "Microsoft.Network/virtualNetworks", "apiVersion": "2024-07-01", "name": "[parameters('virtualNetworks_ManufacturingVnet_name')]", "location": "eastasia", "properties": { "addressSpace": { "addressPrefixes": [ "10.30.0.0/16" ] }, "encryption": { "enabled": false } } } ]
```

The screenshot shows the 'Custom deployment' page in the Microsoft Azure portal. At the top, there are tabs for 'Custom deployment', 'Can I deploy multiple resources within a single ARM template?', 'Where can I find sample ARM templates?', and 'Difference between ARM Template, Terraform & Bicep?'. Below the tabs, a message 'New! Deployment Stacks let you manage the lifecycle of your deployments. Try it now →' is displayed. The 'Template' section shows a 'Customized template' (4 resources) with 'Edit template', 'Edit parameters', and 'Visualize' buttons. The 'Project details' section includes 'Subscription' (set to 'Azure for Students'), 'Resource group' (set to 'az104-r4'), and 'Region' (set to '(Asia Pacific) East Asia'). The 'Virtual Networks\_ManufacturingVnet\_name' field is also visible. At the bottom, there are 'Previous', 'Next', and 'Review + create' buttons.

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- Verify ManufacturingVnet and Subnets:

**Screenshot 1: Microsoft Azure - ManufacturingVnet Overview**

**Screenshot 2: Microsoft Azure - ManufacturingVnet | Address space**

**Screenshot 3: Microsoft Azure - ManufacturingVnet | Subnets**

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## Task 3: Create and configure communication between an Application Security Group and a Network Security Group.

- Create Application Security Group (ASG):

The screenshot shows the Microsoft Azure portal interface for creating an Application Security Group (ASG). The top navigation bar includes 'Microsoft Azure', a search bar, and various icons. The main title is 'Create an application security group'. A green banner at the top indicates 'Validation passed'. Below, the 'Basics' tab is selected, showing the following configuration:

Subscription	Azure for Students
Resource group	az104-rg4
Location	East Asia
Name	asg-web

At the bottom, there are 'Create' and 'Next >' buttons, along with a link to 'Download a template for automation'.

The screenshot shows the 'Overview' page for the ASG 'asg-web'. The left sidebar has 'Overview' selected. The main pane displays the following details:

- Resource group: az104-rg4
- Location: East Asia
- Subscription: Azure for Students
- Subscription ID: 57a8b5a5-89cd-44d7-aaa-fc65ebdf15a43
- Provisioning state: Succeeded

On the right, there's a 'Virtual Network' section and a 'JSON View' button. At the bottom, there are links for 'Add or remove resources from this resource group' and 'Add tags'.

- Create Network Security Group (NSG):

The screenshot shows the Microsoft Azure portal interface for creating a Network Security Group (NSG). The top navigation bar includes 'Microsoft Azure', a search bar, and various icons. The main title is 'Create network security group'. A green banner at the top indicates 'Validation passed'. Below, the 'Basics' tab is selected, showing the following configuration:

Subscription	Azure for Students
Resource group	az104-rg4
Region	East Asia
Name	myNSGSecure

At the bottom, there are 'Create' and 'Next >' buttons, along with a link to 'Download a template for automation'.

The screenshot shows a deployment success message: 'Deployment succeeded'. It states: 'Deployment 'CreateNetworkSecurityGroupBladeV2-20251220200604' to resource group 'az104-rg4' was successful.' At the bottom, there are 'Go to resource' and 'Pin to dashboard' buttons.

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- Associate NSG with Subnet:

The screenshot shows the Microsoft Azure portal interface. The user is navigating through the 'CreateNetworkSecurityGroupBladeV2-20251220200604 | Overview > myNSGSecure' section. On the left, there's a sidebar with options like Overview, Activity log, Access control (IAM), Tags, and Diagnose and solve problems. The main area shows a table for 'Subnets' with one entry: 'SharedServicesSubnet' (Address range: 10.20.10.0/24, Virtual network: CoreServicesVnet). A success message box is visible in the top right corner: 'Saving subnet' and 'Successfully saved network security group for subnet 'SharedServicesSubnet''. There are also 'Associate' and 'Give feedback' buttons.

- Configure Inbound Rule to Allow ASG Traffic:

The screenshot shows the 'myNSGSecure | Inbound security rules' page. The sidebar includes 'Overview', 'Activity log', 'Access control (IAM)', 'Tags', 'Diagnose and solve problems', 'Resource visualizer', 'Settings', 'Inbound security rules' (selected), 'Outbound security rules', 'Network interfaces', 'Subnets', 'Properties', 'Locks', 'Monitoring', 'Automation', and 'Help'. The main area displays a table of existing rules: 'AllowVnetInBound' (Priority 65000, Port Any, Protocol Any, Source VirtualNetwork, Destination Any), 'AllowAzureLoadBalancerInBo...' (Priority 65001, Port Any, Protocol Any, Source AzureLoadBalancer, Destination Any), and 'DenyAllInBound' (Priority 65500, Port Any, Protocol Any, Source Any, Destination Any). To the right, a modal window titled 'Add inbound security rule' is open, showing fields for 'Source' (set to 'Application security group' and 'asg-web'), 'Source port ranges' (set to 'Any'), 'Destination' (set to 'Any'), 'Service' (set to 'Custom'), 'Destination port ranges' (set to '80,443'), and 'Protocol' (set to 'TCP'). Buttons for 'Add' and 'Cancel' are at the bottom of the modal.

Action	Name	Port	Protocol	Source	Destination	Allow/Deny	
<input checked="" type="radio"/> Allow	AllowASG	80,443	TCP	ASG-WEB	Any	Allow	
<input type="radio"/> Deny	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow	
<input type="radio"/> Deny	AllowAzureLoadBalancerInBo...	Any	Any	AzureLoadBalancer	Any	Allow	
<input type="radio"/> Deny	DenyAllInBound	Any	Any	Any	Any	Deny	

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- Configure Outbound Rule to Deny Internet Access:

**Add outbound security rule**

Source: Any

Destination: Service Tag - Internet

Action: Deny

Priority: 4096

Name: DenyInternetOutbound

Priority	Name	Port	Protocol	Source	Destination	Action
65000	AllowVNetOutBound	Any	Any	VirtualNetwork	Internet	Allow
65001	AllowInternetOutBound	Any	Any	Internet	Internet	Allow
65500	DenyAllOutBound	Any	Any	Any	Any	Deny

Action

- Allow
- Deny

Priority \*

4096

Name \*

DenyInternetOutbound

Priority	Name	Port	Protocol	Source	Destination	Action
4096	DenyInternetOutbound	Any	Any	Any	Internet	Deny
65000	AllowVNetOutBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow
65001	AllowInternetOutBound	Any	Any	Internet	Internet	Allow
65500	DenyAllOutBound	Any	Any	Any	Any	Deny

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## Task 4: Configure public and private Azure DNS zones.

### Public DNS Zone

- Create Public DNS Zone:

The screenshot shows the 'Create a DNS Zone' wizard in the Microsoft Azure portal. The 'Review + Create' step is selected. Basic configuration details are listed:

- Subscription: Azure for Students
- Resource group: az104-rg4
- Resource group location: East Asia
- Name: contoso.az104

DNS Zone Record Set(s): 0 record set(s).

Buttons at the bottom include 'Create' (highlighted), '< Previous', 'Next >', and 'Give feedback'.

- Add A Record (www):

The screenshot shows the 'Add record set' dialog for the 'contoso.az104' zone. The 'Name' field is set to 'www'. The 'Type' dropdown is set to 'A - IPv4 Address records'. The 'Alias record set' dropdown is set to 'No'. The 'TTL' field is set to '1'. The 'IP address' field contains '10.1.1.4'. The 'Add' button is highlighted.

The screenshot shows the 'Records' table for the 'contoso.az104' zone. It lists three entries:

Name	Type	TTL	Value	Alias resource type	Alias target
@	NS	172800	ns1.05.azure-dns.com. ns2.05.azure-dns.net. ns3.05.azure-dns.org. ns4.05.azure-dns.info.		
@	SOA	3600	Email: azuredns-hostmaster.microsoft.com Host: ns1.05.azure-dns.com. Refresh: 3600 Retry: 300 Expire: 2419200 Minimum TTL: 300 Serial number: 1		
www	A	3600	10.1.1.4		

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- Verify DNS Resolution Using nslookup:

```
PS /home/ariha> nslookup www.contoso.az104 ns1-05.azure-dns.com
Server:      ns1-05.azure-dns.com
Address:     13.107.236.5#53

Name:        www.contoso.az104
Address:    10.1.1.4
```

## Private DNS Zone

- Create Private DNS Zone:

The screenshot shows the 'Create Private DNS Zone' wizard in the Microsoft Azure portal. The 'Review + Create' tab is selected. A green validation bar at the top indicates 'Validation passed'. Below it, there are tabs for Basics, Private DNS Zone Editor, Virtual Network Links, Tags, and Review + Create. The Basics section shows the following details:

Subscription	Azure for Students
Resource group	az104-r4
Resource group location	East Asia
Name	private.contoso.az104

The DNS Zone Record Set(s) section shows 0 record set(s). The Virtual network link(s) section shows 0 virtual network link(s). At the bottom, there are 'Create' and 'Next >' buttons.

- Link Private DNS Zone to Virtual Network:

The screenshot shows the 'private.contoso.az104 | Overview' page in the Microsoft Azure portal. The left sidebar has sections like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource visualizer, Settings, DNS Management, Recordsets, and Virtual Network Links (which is currently selected). The main area shows a table of virtual network links:

Link Name	Link Status	Virtual Network	Auto-Registration	Fallback to Internet
manufacturing-link	Completed	ManufacturingVnet	Disabled	Disabled

A success message in a toast notification says: 'Creating virtual network link' and 'Successfully created virtual network link 'manufacturing-link''. The URL in the address bar is 'Home > private.contoso.az104\_1766245871614 | Overview > private.contoso.az104'.

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#### • Add Private DNS A Record:

The screenshot shows the Microsoft Azure Private DNS zone interface for the domain `private.contoso.az104`. On the left, the navigation menu includes options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource visualizer, Settings, DNS Management, and Records. The Records section is selected, showing a table with one existing SOA record. On the right, a modal window titled "Add record set" is open, allowing the creation of a new A record named "sensorvm". The IP address is set to "10.1.1.4". Other fields include TTL (set to 1) and TTL unit (set to Hours). The "Add" button is visible at the bottom of the modal.

The screenshot shows the same Microsoft Azure Private DNS zone interface after the A record has been added. The table now displays two records: a SOA record and the newly created A record "sensorvm" with the value "10.1.1.4". The "Auto registered" column shows "False" for both entries. The "Edit" and "Delete" icons are visible next to each record entry.