Ethereum Multi-Member Consortium Blockchain in Azure Marketplace

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Overview

As your blockchain application development efforts and pilots mature, we realize that the requirements for the underlying consortium network will change, and that you will need to easily and securely create and deploy across multiple regions and support members comprised from organizations that exist within separate administrative and trust boundaries. We continue to expand our support of blockchain on Microsoft Azure addressing enterprise scenarios that require a deployment of a private network across Azure regions, subscriptions, and Azure Active Directory (Azure AD) tenants.

To that end, we are releasing a set of solution templates (Azure Multi-Member Blockchain) in the Azure Marketplace that configure multi-region and multi-member Ethereum Consortium Blockchain Networks with a simple multi-step process through the Azure Portal or cmdline. The first template (Ethereum Consortium Leader) deploys and configures the footprint for the initial consortium member (or region), while the second template (Ethereum Consortium Member) deploys, connects, and configures additional members (or regions) to form the overarching private network.

After reading this article, you will:

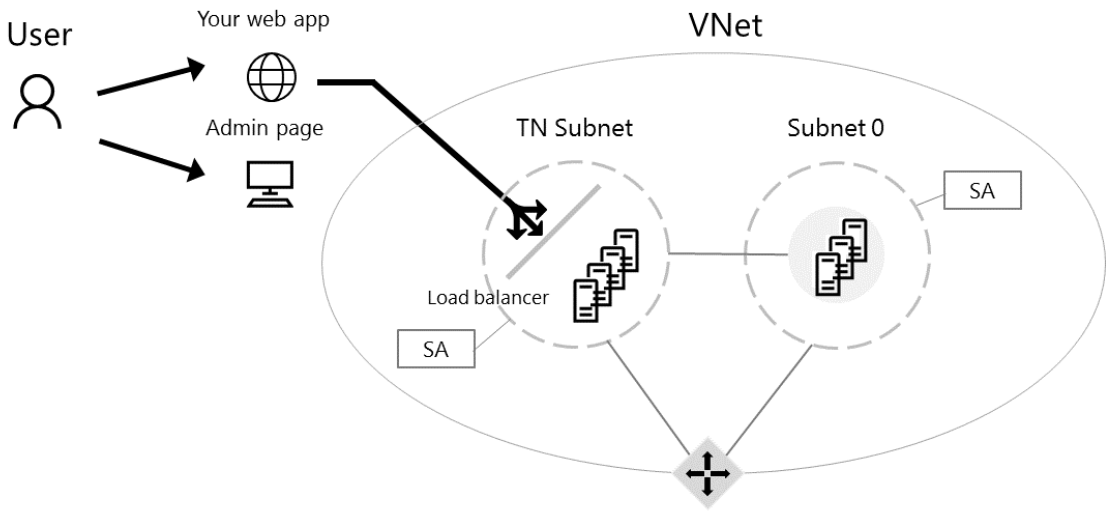
- Obtain working knowledge of blockchain, Ethereum, and more complicated consortium network architectures
- Learn how to deploy and configure a multi-member Ethereum consortium network with the new ARM templates

About blockchain

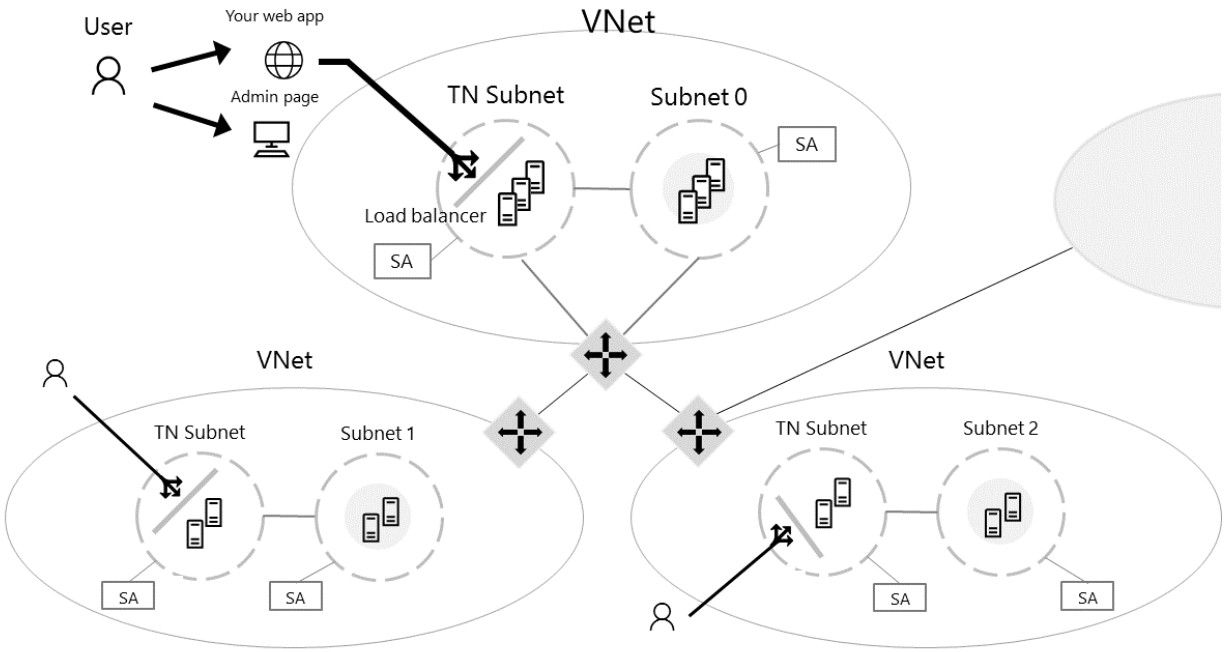
For those of you new to the blockchain community, the release of this solution is a great opportunity to learn about the technology in an easy and configurable manner on Azure. However, to get started, we recommend deploying the simpler Ethereum consortium network topology with this guided walkthrough, before building out multi-member networks.

Consortium Architecture on Azure

While there is no single canonical architecture for a multi-member consortium network, this template provides a sample architecture for a network that spans across different consortium members with different Azure subscriptions and Azure AD tenants when node privacy is important. In this architecture, each member has its own footprint of a set of load-balanced transaction nodes with which an application can interact to submit transactions and a set of mining nodes to record transactions. All member's nodes are within the same virtual network. A member's deployment footprint is illustrated in the figure below.



The separate VNets of each member are connected through VPN Gateways to form the broader consortium blockchain network. A multi-member network is illustrated below:



Joining members can connect to the consortium leader (initial member) to form a hub-and-spoke model or any existing network member to form a mesh. It is important to note that the consortium should determine the network connectivity model; the solution does not dictate how to set up connectivity. The solution will help orchestrate a single connection, although a member may choose to explicitly connect to more than one member for higher availability.

Mining Node Details

We have explicitly separated the nodes that mine transactions from the nodes that accept transactions to ensure that the two actions are not competing for the same resources.

A consortium member has a subnet containing one or more mining nodes, backed by a storage account. The first default VM in the subnet is configured as a boot node to support dynamic discoverability of the nodes in the network. Mining nodes communicate with other mining nodes to come to consensus on the state of the underlying distributed ledger. There is no need for your application to be aware of or communicate with these nodes. Since we are focusing on private networks, the mining nodes are isolated from inbound public internet traffic to add a secondary layer of protection. Outbound traffic is allowed, but not to the Ethereum discovery port.

All nodes have a stable version of the Go Ethereum (Geth) client and are configured to be mining nodes. If you did not supply a custom genesis block, all nodes use the same Ethereum address and key pair that is protected by the Ethereum account password. The Ethereum passphrase you provided is used to generate the default account (coinbase) for each mining node. As mining nodes mine, they collect fees that are added to this account.

The number of mining nodes per consortium member depends on the overall size of the network desired and the amount of hashing power dedicated to each member. The larger the network, the more nodes that need to be compromised to gain an unfair advantage. The template supports up to 15 mining nodes per consortium member.

Transaction Node Details

A consortium member also has a set of load-balanced transaction nodes. These nodes are reachable from outside the virtual network, so that applications can use these nodes to submit transactions or execute smart contracts within the blockchain network. All nodes have a stable version of the Go Ethereum (Geth) client and are configured to maintain a complete copy of the distributed ledger. If a custom genesis block is not provided, these nodes use the same Ethereum account, protected by the Ethereum account password.

We have load-balanced the transaction nodes within an availability set to maintain high availability. The template supports up to 5 transaction nodes.

Ethereum configuration

Besides the infrastructural footprint and configuration of nodes, the templates and associated process also create the blockchain network itself. The genesis block is configured with the desired Ethereum network id, an appropriate mining difficulty, and a pre-configured account. The mining difficulty varies depending on the number of mining nodes deployed to ensure mining time remains short even at the inception of the network. The pre-configured account contains 1 trillion Ether to seed the consortium network with enough gas (Ethereum's fuel) to handle millions of transactions. Since the mining nodes use this account, their collected fees feed back into the account to ensure continual funds. If you provide a custom genesis block, the network is seeded with this block and any configuration and accounts that were specified.

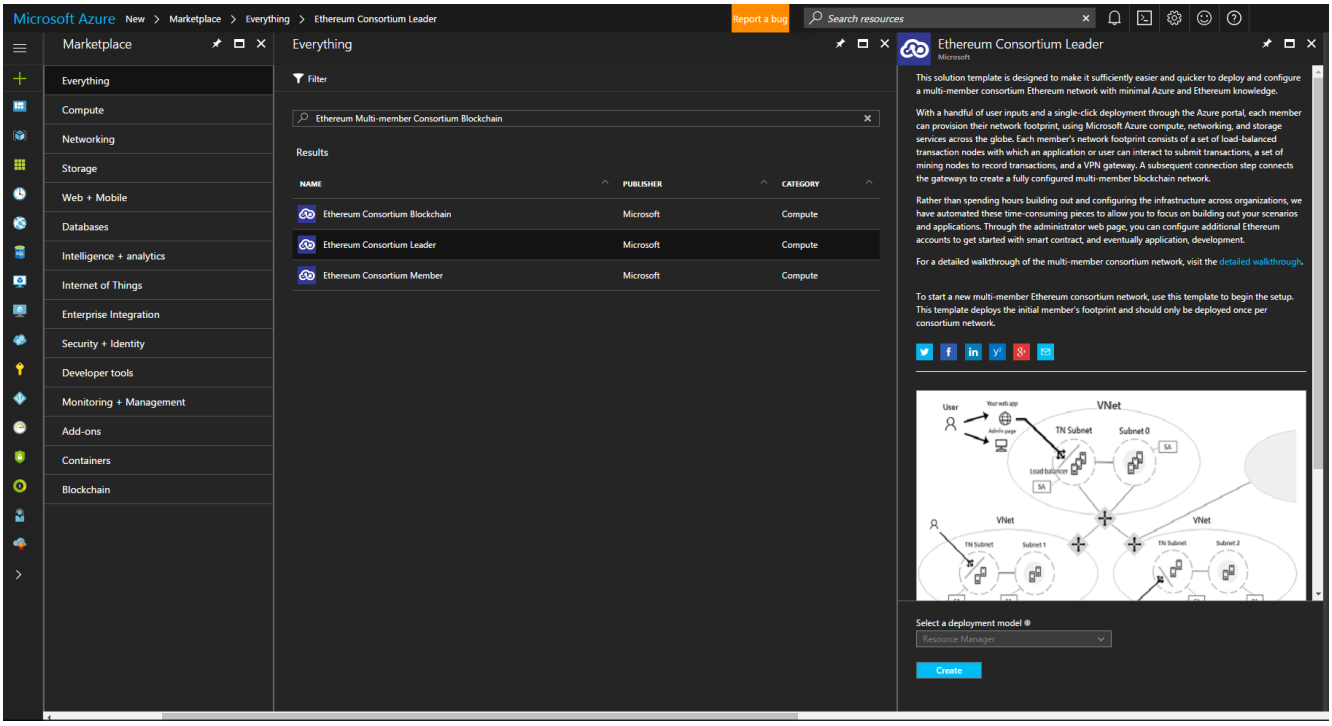
Getting Started

To begin, you will need an Azure subscription that can support deploying several virtual machines and standard storage accounts. If you do not have an Azure subscription, you can create a free Azure account.

By default, most subscription types support a small deployment topology without needing to increase quota. The smallest possible deployment for one member will need:

- 3 virtual machines (3 cores)
- 1 storage account
- 1 VNet
- 1 VNet Gateway
- 1 load balancer
- 1 public IP address

Once you have a subscription, go to the Azure portal. Select '+' and search for 'Ethereum Multi-member Consortium Blockchain'.



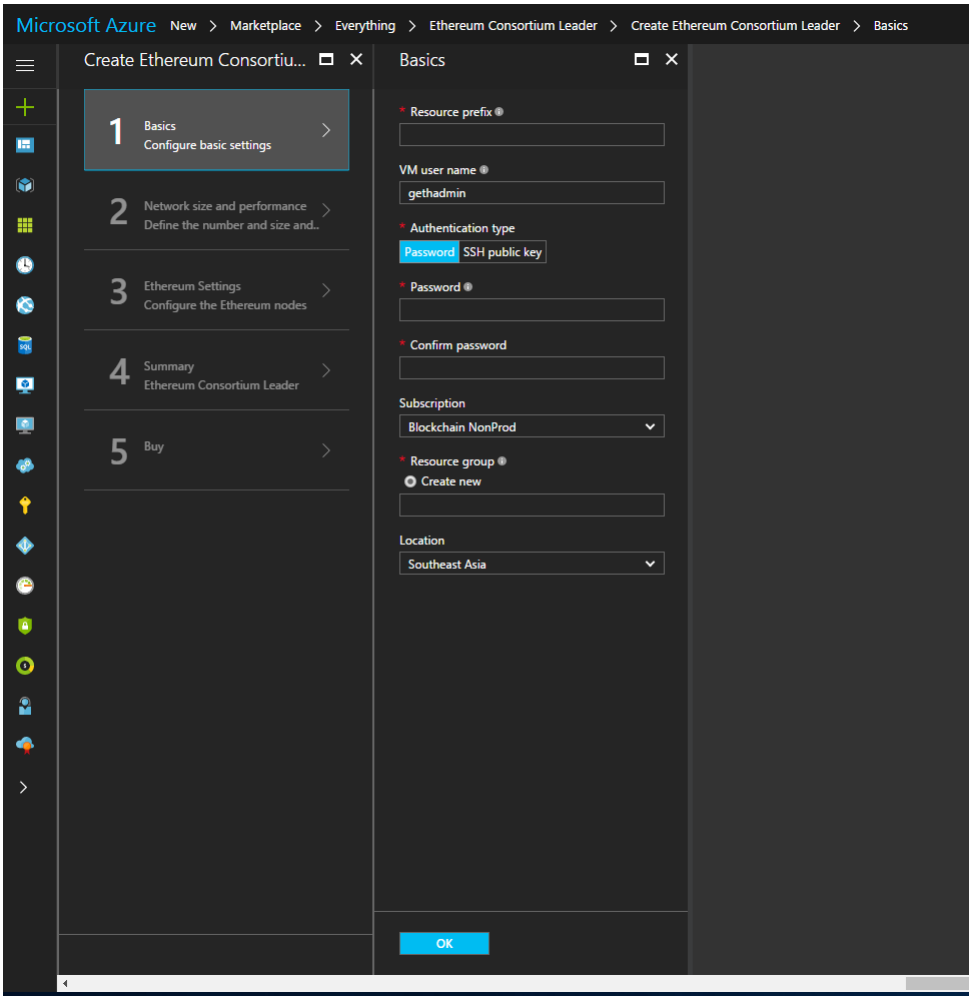
The multi-member solution consists of two sub-solutions:

1. Ethereum Consortium Leader
2. Ethereum Consortium Member

To start a network, one member (the leader) begins the process by deploying the 'Ethereum Consortium Leader' sub-solution. This template should only be deployed once per consortium network. To join other members to the network, or for the same member to deploy in another region, deploy the 'Ethereum Consortium Member' sub-solution.

Leader: Starting a New Ethereum Consortium Network

To start, select the 'Ethereum Consortium Leader' and click 'Create'. This will open the 'Basics' blade in the wizard.



The Template Deployment will walk you through configuring the first member's footprint in the network. The deployment flow is divided into three steps: Basics, Network configuration, and Ethereum configuration.

Basics

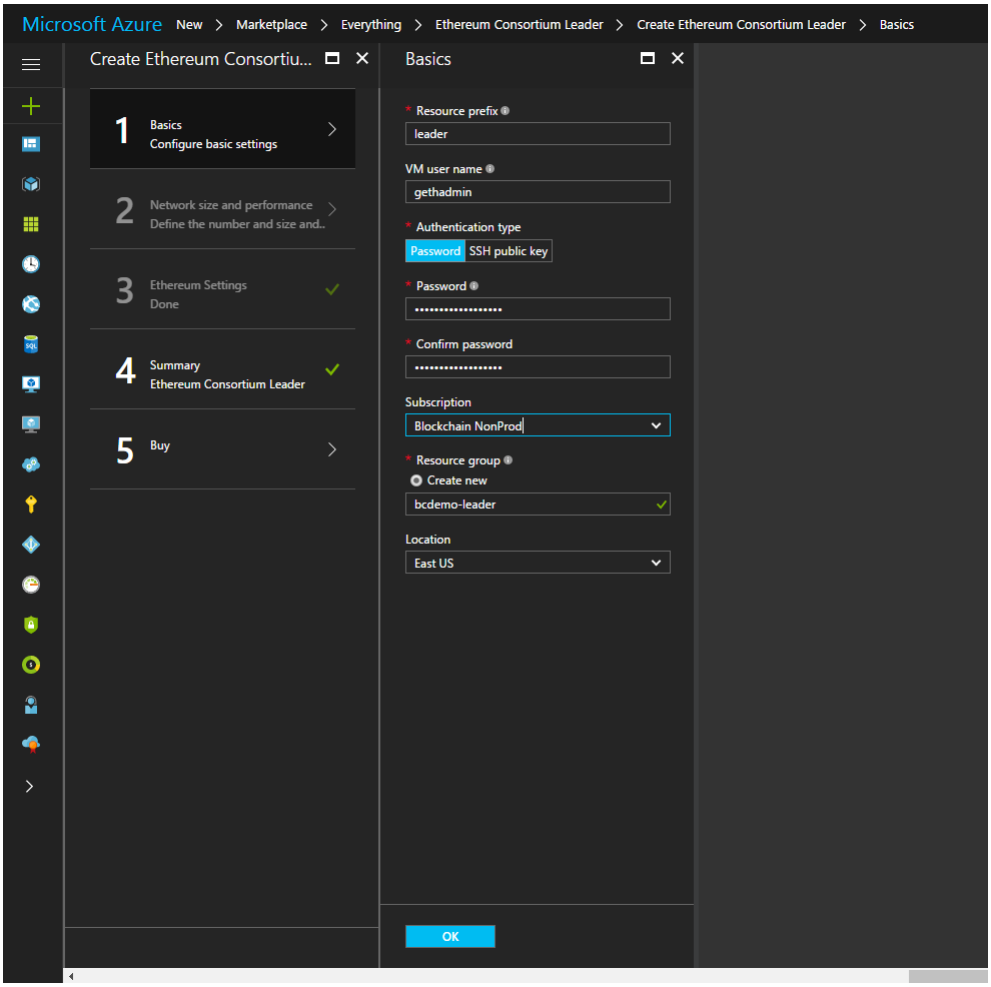
Under the 'Basics' blade, specify values for standard parameters for any deployment, such as subscription, resource group, and basic virtual machine properties.

A detailed description of each parameter follows:

Parameter Name	Description	Allowed Values	Default Value
Resource prefix	A string used as a base for naming the deployed resources.	6 characters or less	NA
VM user name	The user name of the administrator for each of the virtual machines deployed for this member. This user name is also used when creating the Ethereum account.	1-64 characters	gethadmin
Authentication type	The method to authenticate to the virtual machine.	Password or SSH public key	Password

Password (Authentication type = Password)	The password for the administrator account for each of the virtual machines deployed. The password must contain 3 of the following: 1 upper case character, 1 lower case character, 1 number, and 1 special character. While all VMs initially have the same password, you can change the password after provisioning.	12 -72 characters	NA
SSH Key (Authentication type = Public Key)	The secure shell key used for remote login.		NA
Subscription	The subscription to which to deploy.		
Resource Group	The resource group to which to deploy the consortium network.		NA
Location	The Azure region to which to deploy the first member's network footprint.	Unavailable in: West India	

A sample deployment is shown below:



Network size and performance

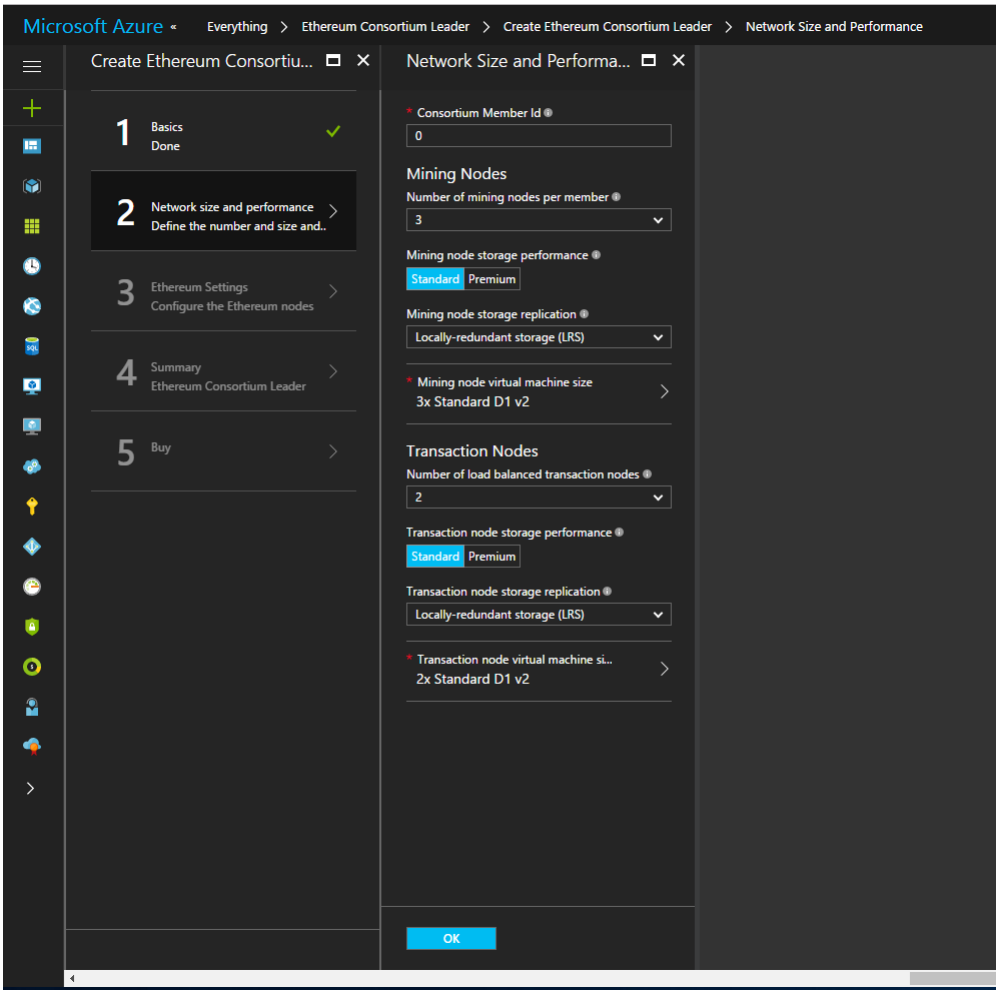
Next, under 'Network size and performance,' specify inputs for the size of the consortium network, such as number and size of mining nodes and transaction nodes.

A detailed description of each parameter follows:

Parameter Name	Description	Allowed Values	Default Value
Consortium Member ID	The ID associated with each member participating in the consortium network used to configure IP address spaces to avoid collision. Member ID should be unique across different organizations in the same network. A unique member ID is needed even when the same organization deploys to multiple regions. Make note of the value of this parameter, since you will need to share it with other joining members.	0-255	0
Number of mining nodes per member	The number of mining nodes deployed per subnet. The total number of mining nodes equals NumConsortiumMembers x NumMiningNodesPerMember.	2-15	2
Mining node storage performance	The type of storage backing each of the deployed mining nodes. To learn more about storage, visit Introduction to Microsoft Azure Storage and Premium Storage.	Standard or Premium	Standard
Mining node storage replication	All Azure storage is replicated for high availability and reliability. The storage replication policy for the backing mining node storage. To learn more, visit Azure storage replication.	LRS, GRS, RAGRS	LRS
Mining node virtual machine size	The virtual machine size used for mining nodes.	Standard A, Standard D, Standard D-v2, Standard F series, Standard DS, and Standard FS	Standard D1_v2

Number of load balanced transaction nodes	The number of transaction nodes to provision as part of the network.	1 - 5	1
Transaction node storage performance	The type of storage backing each of the deployed transaction nodes. To learn more about storage, visit Introduction to Microsoft Azure Storage and Premium Storage.	Standard or Premium	Standard
Transaction node storage replication	All Azure storage is replicated for high availability and reliability. The storage replication policy for the backing transaction node storage. To learn more, visit Azure storage replication.	LRS, GRS, RAGRS	LRS
Transaction node virtual machine size	The virtual machine size used for transactional nodes.	Standard A, Standard D, Standard D-v2, Standard F series, Standard DS, and Standard FS	Standard D1

A sample deployment is shown below:



Ethereum settings

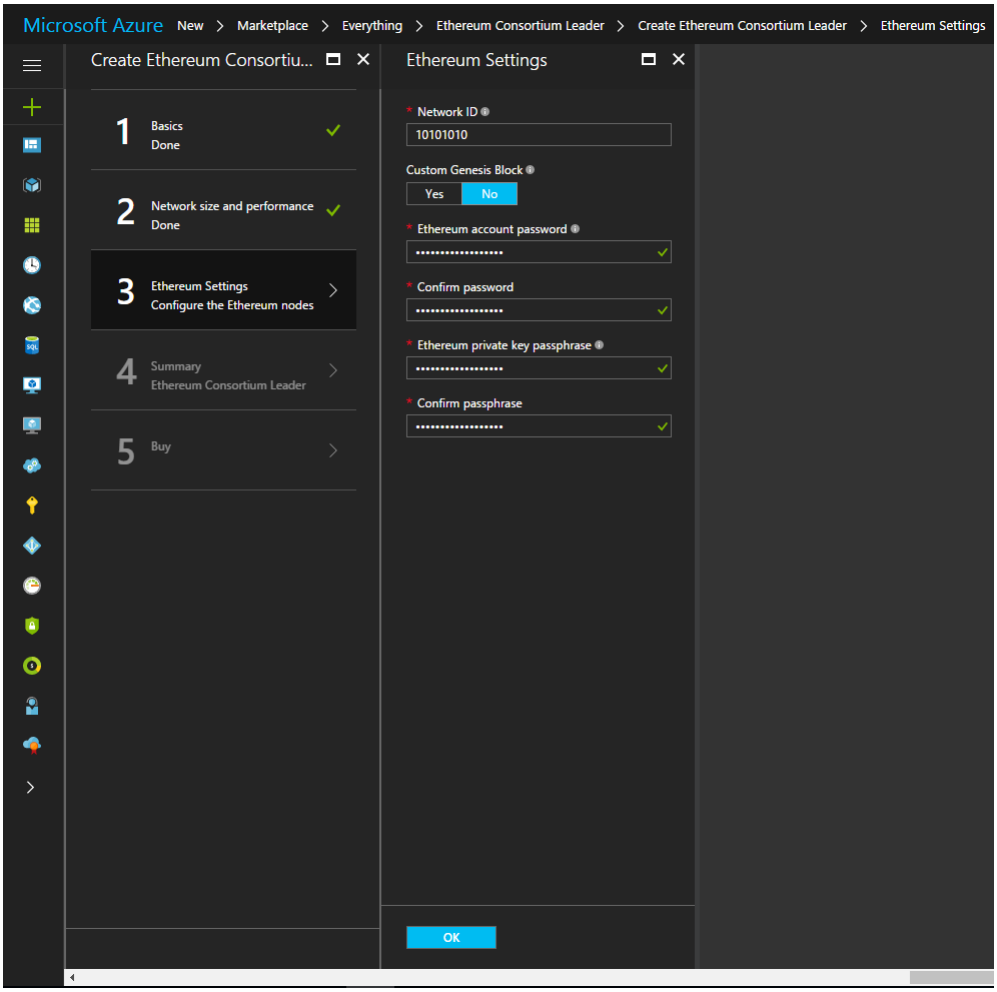
Finally, under Ethereum settings, specify Ethereum-related configuration settings, like the network id and Ethereum account password or genesis block.

A detailed description of each parameter follows:

Parameter Name	Description	Allowed Values	Default Value
Ethereum Network ID	The network ID for the consortium Ethereum network being deployed. Each Ethereum network has its own Network ID, with 1 being the ID for the public network. While we have restricted network access for mining nodes, we still recommend using a large number to prevent collisions.	5 - 999,999,999	10101010
Custom genesis block	Option to either automatically generate a genesis block or provide a custom one.	Yes/No	No
Ethereum Account Password	The administrator password used to secure the Ethereum account imported into each node. For the leader, this	12 or more characters	NA

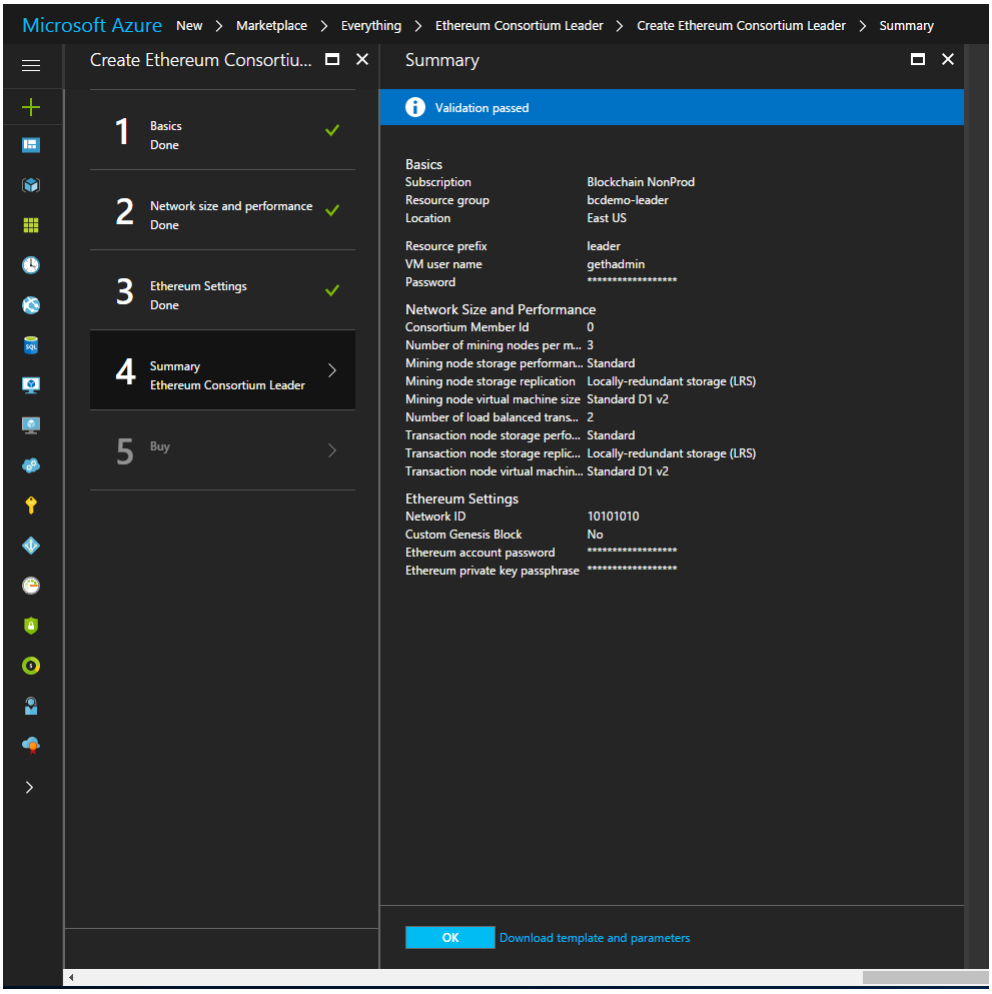
(Custom genesis block = No)	account is setup in the genesis block and pre-allocated with one trillion Ether. The password must contain the following: 1 upper case character, 1 lower case character, and 1 number.		
Ethereum private key passphrase (Custom genesis block = No)	The passphrase used to generate the ECC private key associated with the default Ethereum account that is generated. A pre-generated private key does not need to be explicitly passed in. Consider a passphrase with sufficient randomness to ensure a strong private key and no overlap with other consortium members. The passphrase must contain the following at a minimum: 1 upper case character, 1 lower case character, and 1 number. Note if two members use the same passphrase the accounts generated will be the same. This is useful if a single organization is trying to deploy across regions and wants to share a single account (coin base) across all nodes.	12 or more characters	NA
Genesis block (Custom genesis block = Yes)	JSON string representing custom genesis block. You can find more details on the format of the genesis block here, under Custom Networks. An Ethereum account is still created when providing a custom genesis block. You should still consider specifying a pre-funded Ethereum account in the genesis block to not wait for mining.	Valid JSON	NA

A sample deployment is shown below:



Deploy

Click through the summary blade to review the inputs specified and to run basic pre-deployment validation.

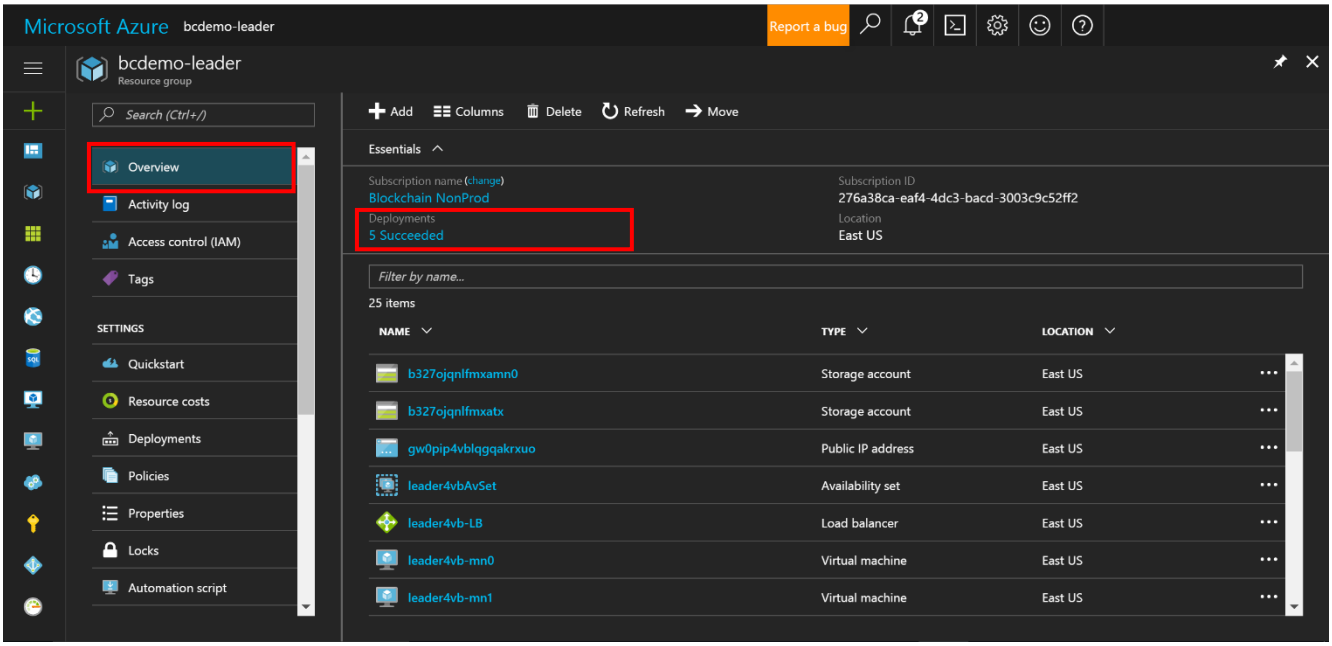


Review legal and privacy terms and click 'Purchase' to deploy. This template pre-deploys the necessary VPN Gateways to support network connectivity with other members. Deployment of the gateway can take up to 45 minutes.

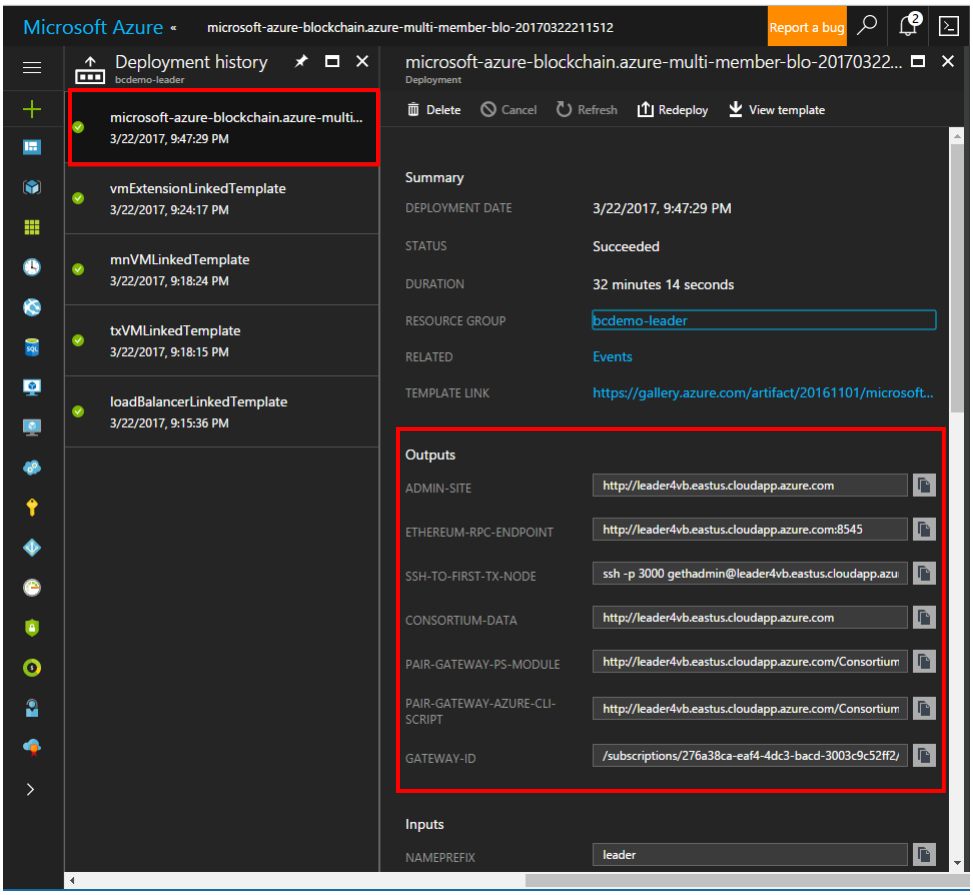
Administrator page

Once the deployment has completed successfully and all resources have been provisioned, you can go to the administrator page to get a simple view of your blockchain network and sanity check the deployment state. The URL of the admin page is the DNS name of the load balancer; it is also the first output of the template deployment.

To find it, select the resource group that was just deployed. Then, select Overview, and click on the link immediately under Deployments that shows the number that succeeded.

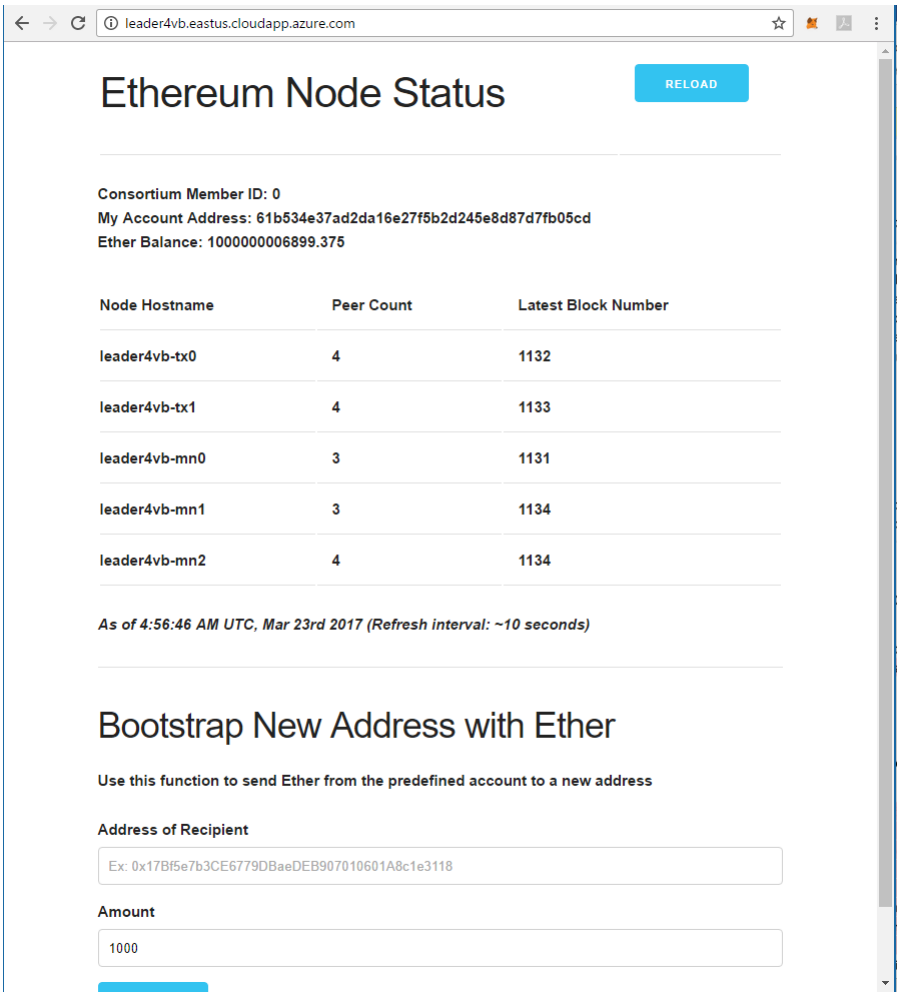


The new screen shows deployment history. Select the first template 'microsoft-azure-blockchain.azure-multi…' and look for the 'Outputs' section in the lower half of the screen. You'll see the URL for the admin page listed as the first output parameter.



To get to the admin page, copy the 'ADMIN-SITE' output and open it in another tab.

On the admin page, you can get a high-level overview of the topology you just deployed by reviewing the Ethereum Node Status section. It includes all node hostnames, their peer count, and the latest block seen. The peer count for each node is the minimum of (total node count – 1) and twenty-five, where twenty-five is the configured maximum peer count. Note, that the peer count does not restrict the number of nodes that can be deployed within the network. Occasionally, you will see the peer count fluctuate and be less than the (total number of nodes -1). The difference in the count is not always a sign that the nodes are unhealthy, since forks in the ledger can cause minor changes in peer count. Finally, you can inspect the latest block seen by each node in the network to determine forks or lags in the system.



The node status is refreshed every 10 seconds. Reload the page via the browser or "Reload" button to update the view.

Accessing Nodes

You can remotely connect to the virtual machines for the transaction nodes via SSH with your provided admin username and password/SSH key. Since the transaction node VMs do not have their own public IP addresses, you will need to go through the load balancer and specify the port number. The SSH command to run to access the first transaction node is the third template output, 'SSH-TO-FIRST-TX-NODE' (for the sample deployment: ssh -p 3000 gethadmin@leader4vb.eastus.cloudapp.azure.com). To get to additional transaction nodes, increment the port number by one (e.g. the first transaction node is on port 3000, the second is on 3001, the third is on 3002, etc.).

Since the virtual machines on which the mining nodes run are not externally accessible, you will need to go through one of the transaction nodes. Once you have SSH'ed into a transaction node, install your private key on the transaction node or use your password to SSH into any of the mining nodes.

Leader or Existing Member: Network Establishment and Acceptance

Sharing Data

As the first member (or a connected member) of the consortium, you may need to provide other members a few pieces of information so they can join and establish their connection. Specifically:

1. **Shared Consortium Configuration Data:** There is a set of data that is used to orchestrate the Ethereum connection between two members. The necessary information, including the genesis block, consortium network ID, and boot nodes, is written to a file on the transaction nodes of the leader or another deployed member. The location of this file is the fourth template deployment output parameter named 'CONSORTIUM-DATA'.
2. **VNet Gateway:** Each member establishes a connection to the entire blockchain network through an existing member. To connect VNets, you need the resource path to the VNet Gateway of the member to which you are connecting. This is the seventh template deployment output parameter named 'GATEWAY-ID'.
3. **Shared Key:** A pre-established secret between two members of the consortium network that are establishing a connection. This is an alphanumeric string (between 1 to 128 characters) that has been agreed upon outside the context of the deployment. (e.g. "MySharedKeyAbc123")
4. **Member ID:** The consortium member ID you selected.

Acceptance of New Member

This step should be done after a joining member has deployed the 'Ethereum Consortium Member' template successfully. Before a member can join the network and see transaction traffic, the leader or member to which you connect must perform a final configuration on their VPN Gateway to accept the connection in both directions. ***This means the Ethereum nodes of the joining member will not run until a connection is established.*** This configuration can be done via PowerShell or xPlat CLI. A PowerShell module and xPlat CLI script is also stored on the transaction node, alongside the consortium data. The script location is the fifth and sixth deployment output parameters named 'PAIR-GATEWAY-PS-MODULE' and 'PAIR-GATEWAY-AZURE-CLI-SCRIPT, respectively.

PowerShell/CLI Setup

Additional information on how to get started with Azure PowerShell cmdlets and Azure xPlat CLI can be found on our Azure documentation pages.

You will need the latest version of the Azure cmdlets installed locally and a session open. Make sure to log into the session with your Azure subscription credentials.

PowerShell: Establish Connection

Download the PowerShell module and store it locally. The location of the PowerShell module is specified in the fifth template deployment parameter named 'PAIR-GATEWAY-PS-MODULE.'

If not already enabled, use the Set-ExecutionPolicy cmdlet for the local session to allow running an unsigned module.

```
Set-ExecutionPolicy Unrestricted CurrentUser
```

Next, import the module:

```
Import-Module <filepath to downloaded file>
```

Finally, run the function with the appropriate input:

- **MyGatewayResourceId:** Resource path of your Gateway. This is the seventh template deployment output parameter named 'GATEWAY-ID'.
- **OtherGatewayResourceId:** Resource path of the joining member's gateway. This is provided by the joining member and is the seventh template deployment parameter of their deployment also named 'GATEWAY-ID'.
- **ConnectionName:** A name for you to identify this Gateway connection.
- **Shared Key:** The pre-established secret between the two members of the consortium network that are establishing a connection.

```
CreateConnection -MyGatewayResourceId "<resource path of your Gateway>" -
OtherGatewayResourceId "<resource path of the joining member's gateway>" -
ConnectionName "myConnection" -SharedKey "MySharedKeyAbc123"
```

xPlat CLI: Establish Connection

Download the Azure CLI script and store it locally. The location of the Azure CLI script is specified in the sixth template deployment parameter named 'PAIR-GATEWAY-AZURE-CLI-SCRIPT.'

Run the script with the appropriate input:

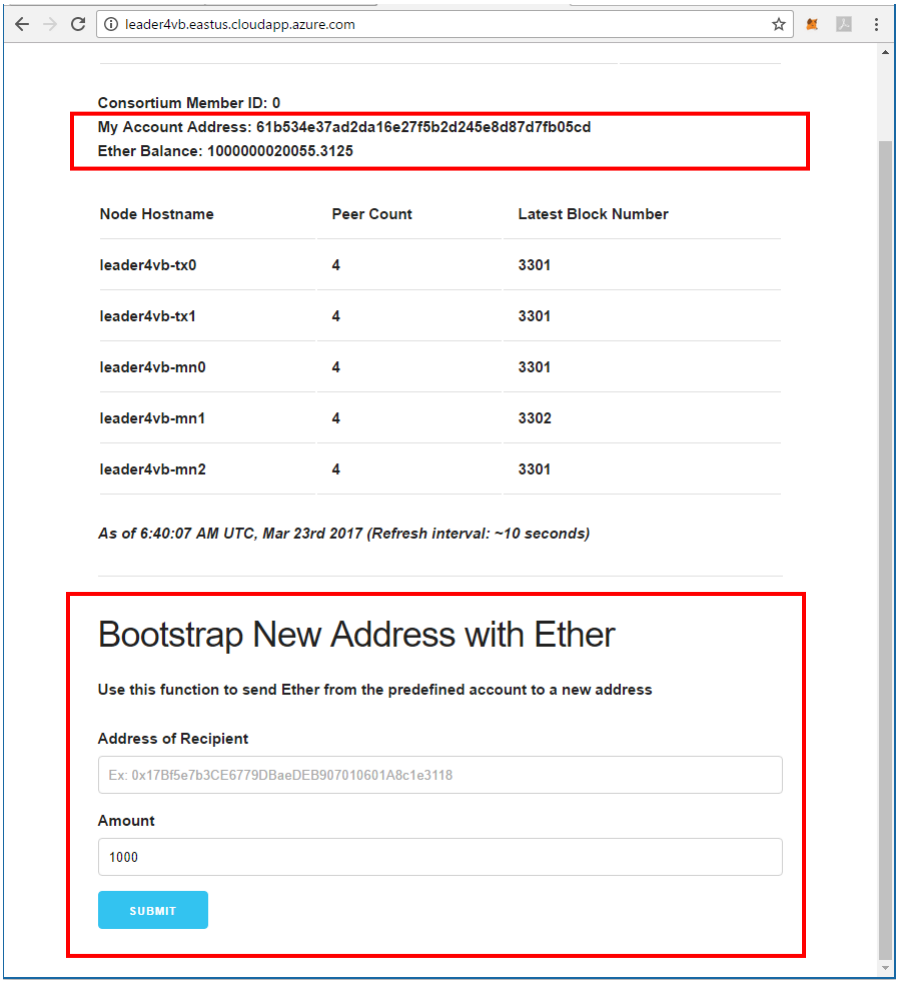
- **MyGatewayResourceId:** Resource path of your Gateway. This is the seventh template deployment output parameter named 'GATEWAY-ID'.
- **OtherGatewayResourceId:** Resource path of the joining member's gateway. This is provided by the joining member and is the seventh template deployment parameter of their deployment also named 'GATEWAY-ID'.
- **ConnectionName:** A name for you to identify this Gateway connection.
- **Shared Key:** The pre-established secret between the two members of the consortium network that are establishing a connection.

Leader or Existing Member: Fund New Member Ethereum Account

Generated Genesis Block

As the first member, your Ethereum account is funded with one trillion ether if the deployment generates the genesis block (Genesis Block = No). Other members will have an account that is not pre-funded and must wait to accumulate Ether as their mining nodes begin to mine blocks. To avoid having new members wait for Ether, you will need to explicitly fund joining members' Ethereum accounts.

To do so, joining members must provide you with the Ethereum account that is displayed on their admin website. You can then use your admin website to transfer Ether from your account to their account by simply entering the account provided.



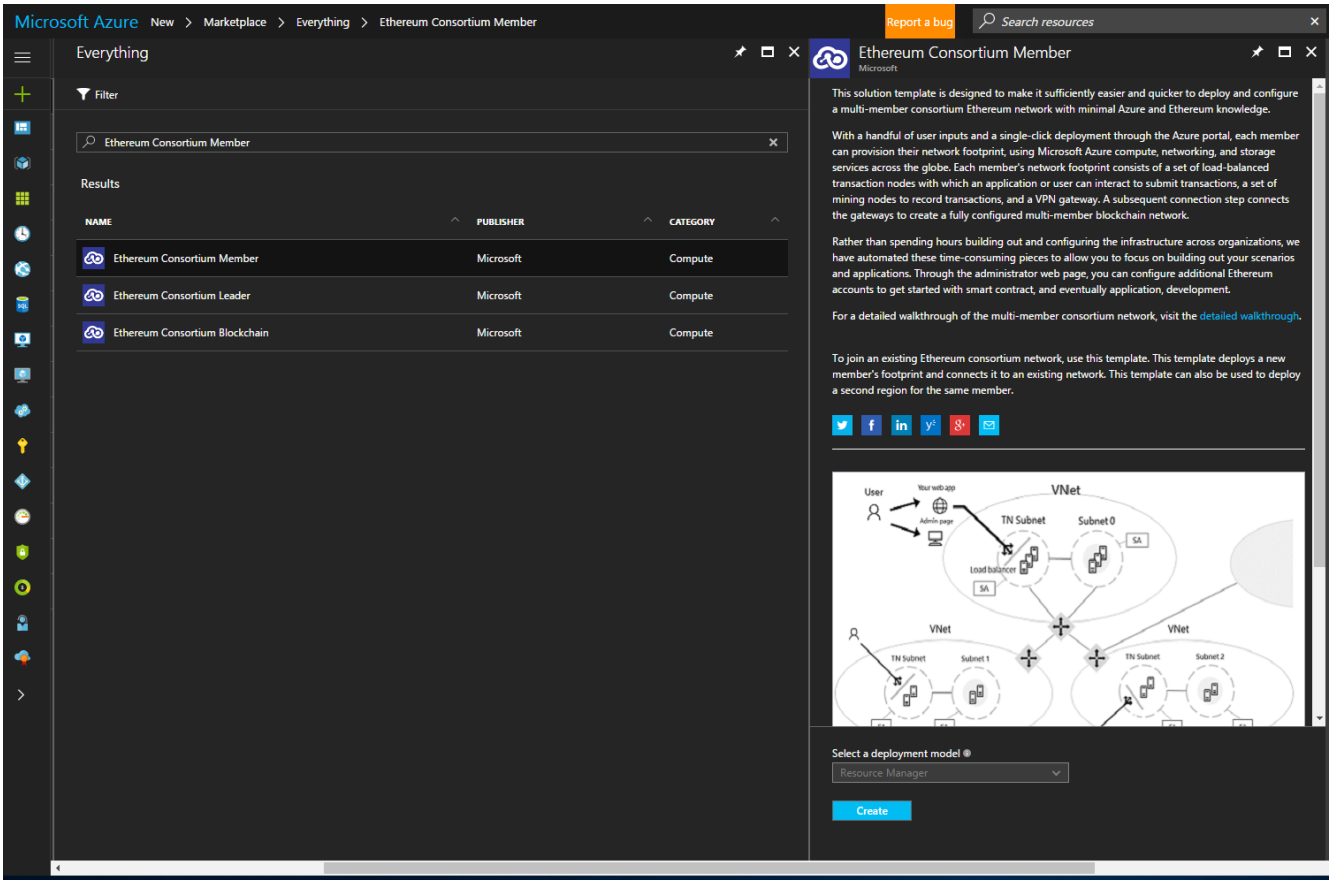
Custom Genesis Block

If a custom genesis block is provided with a specified Ethereum account, you can use MetaMask or another tool to transfer ether from that specified account to the pre-generated Ethereum account visible in the admin website. For instructions on how to use MetaMask, skip ahead to the last section, “Creating Ethereum Account.”

If a custom genesis block is provided without an account or you do not have access to any pre-allocated accounts, you will need to wait until your mining nodes begin to mine to generate Ether into your account (coin base). How quickly the funds are generated depends on the difficulty level you specify in the custom genesis block.

Member: Joining an Existing Consortium Network

To join an existing consortium network (i.e. a member has already deployed the above solution), select the ‘Ethereum Consortium Member’ and click ‘Create’.

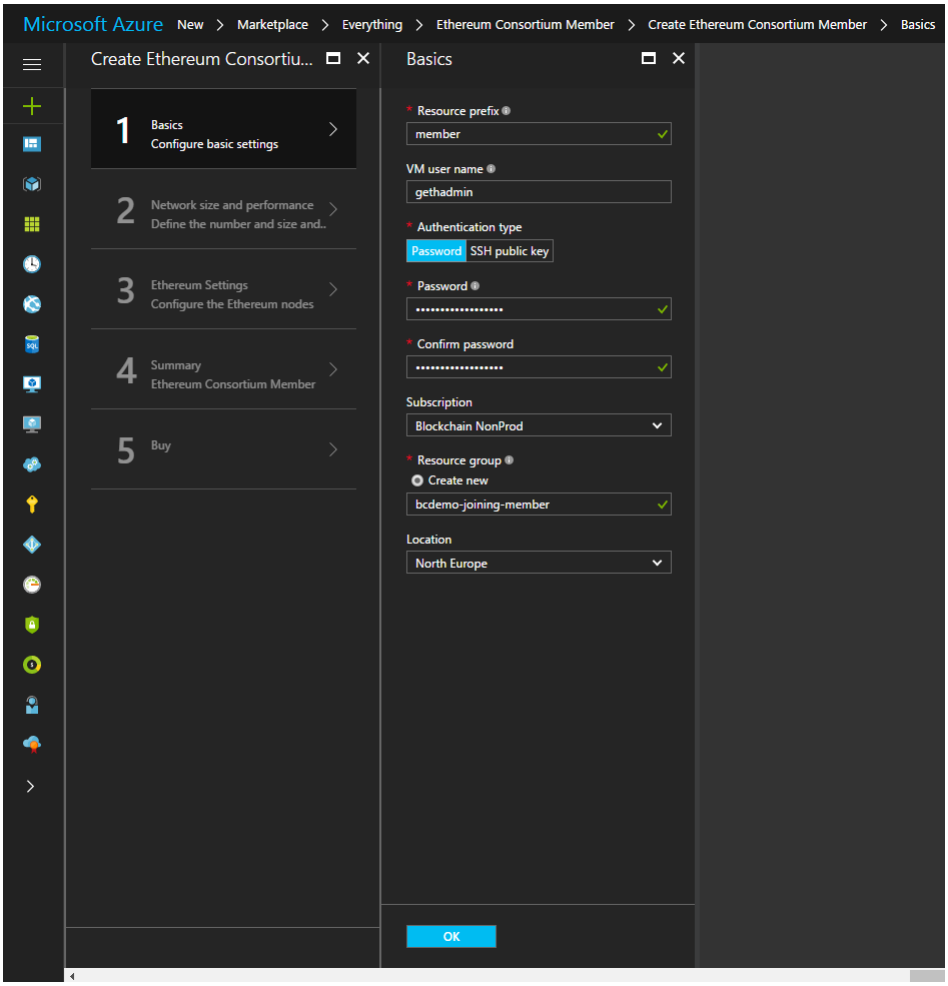


Before you begin, you will need a few pieces of information from either the leader or another active (already deployed) consortium member:

1. **Shared Consortium Configuration Data:** There is a set of data that is used to orchestrate the Ethereum connection between two members. The necessary information, including genesis block, consortium network ID, and boot nodes, is written to a file on the transaction nodes of the leader or another deployed member. The leader or member you are connecting through must provide you with the file path.
2. **VNet Gateway:** Each member establishes a connection to the entire blockchain network through an existing member. To connect VNets, you need the resource path to the VNet Gateway of the member to which you are connecting.
3. **Shared Key:** A pre-established secret between the members of the consortium network that are establishing a connection. This is an alphanumeric string (between 1 to 128 characters) that has been agreed upon outside the context of the deployment. (e.g. "MySharedKeyAbc123")
4. **Member IDs:** The consortium member IDs already used by other members in the network.

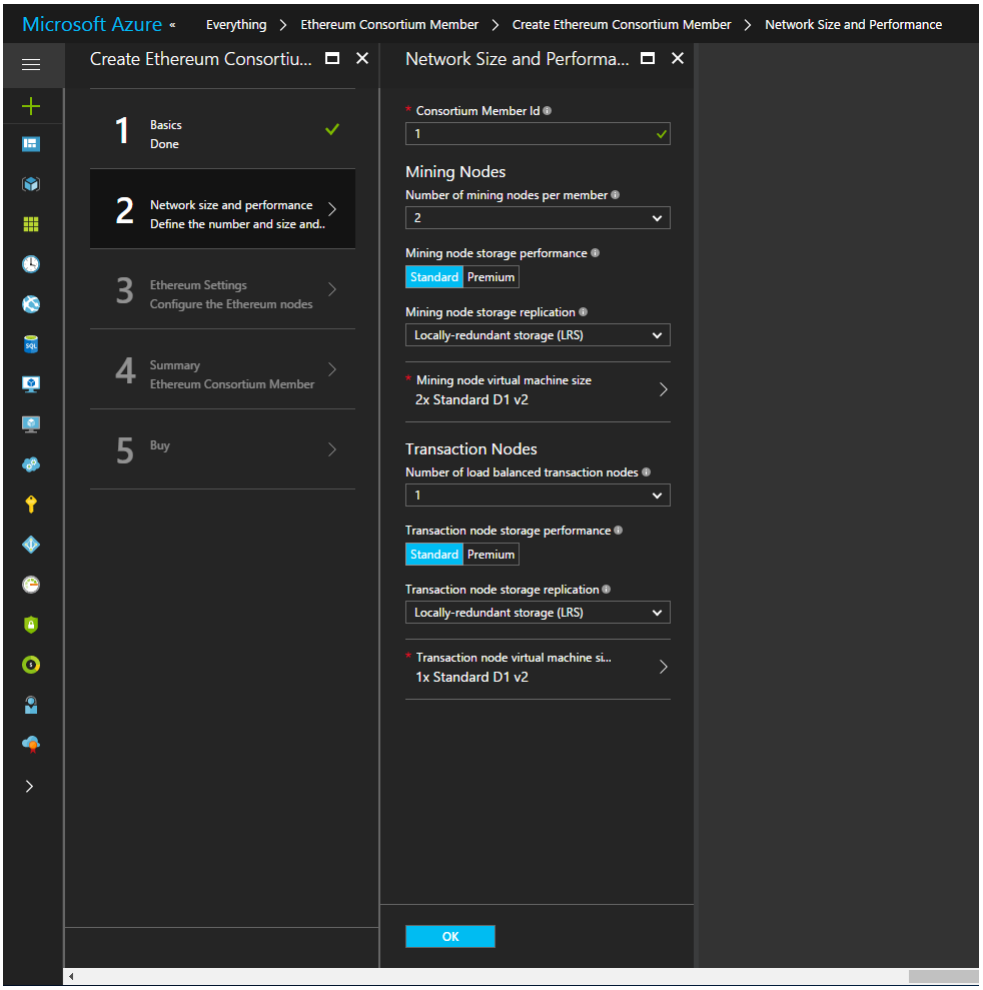
Basics

The basic deployment parameters are the same as for the 'Ethereum Consortium leader' above. There are no restrictions on the region or subscription to which this member footprint is deployed. A sample deployment is shown below:



Network Size and Performance

The network size and performance parameters are the same as for the 'Ethereum Consortium leader' above. Pay close attention to ensure that you do not use the same consortium member ID as the other members in the network. A sample deployment is shown below:



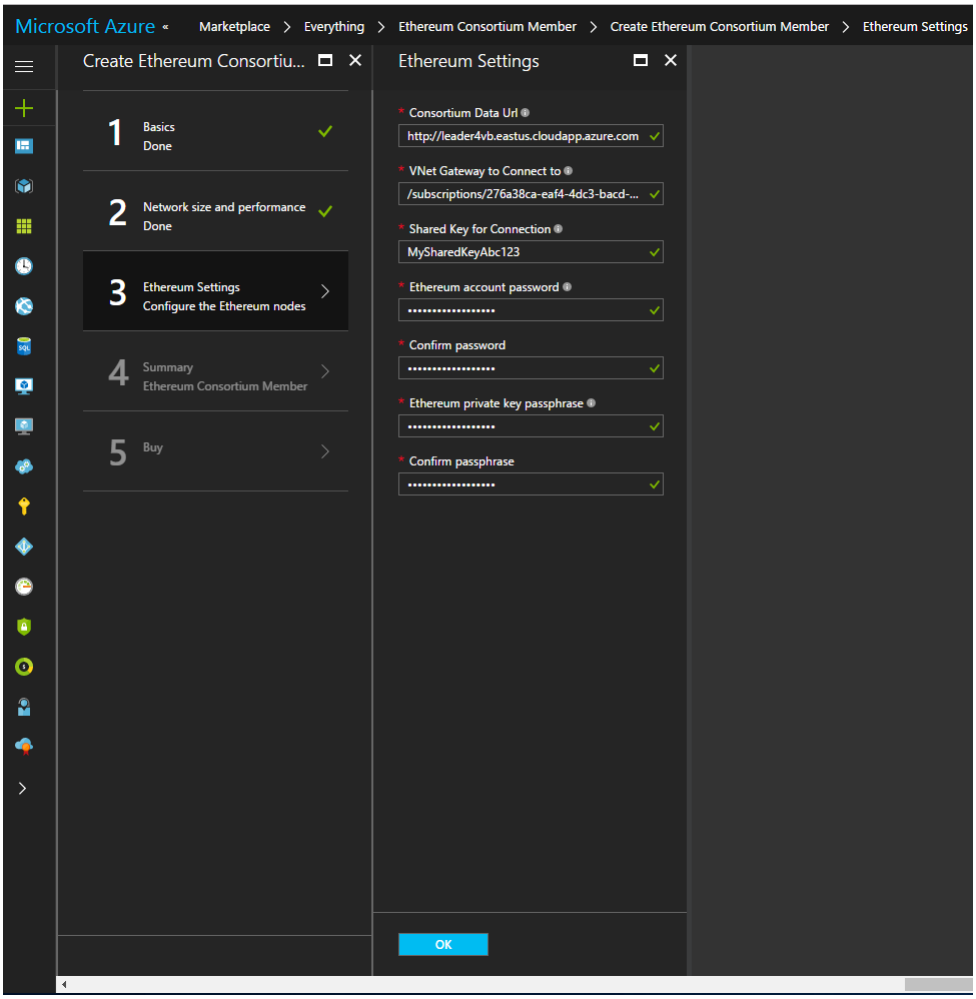
Ethereum settings

Finally, under Ethereum settings, specify Ethereum related configuration settings to be able to connect to the blockchain network.

Parameter Name	Description	Allowed Values	Default Value
Consortium Data Url	The URL pointing to the relevant consortium configuration data provided by another member's deployment. This information is provided by an already connected member who has a deployment. If you deployed the rest of the network, the URL is the fourth template deployment output, named CONSORTIUM-DATA.		NA
VNet Gateway to Connect to	The resource path of the VNet Gateway to which to connect. This information is provided by an already connected member who has a		NA

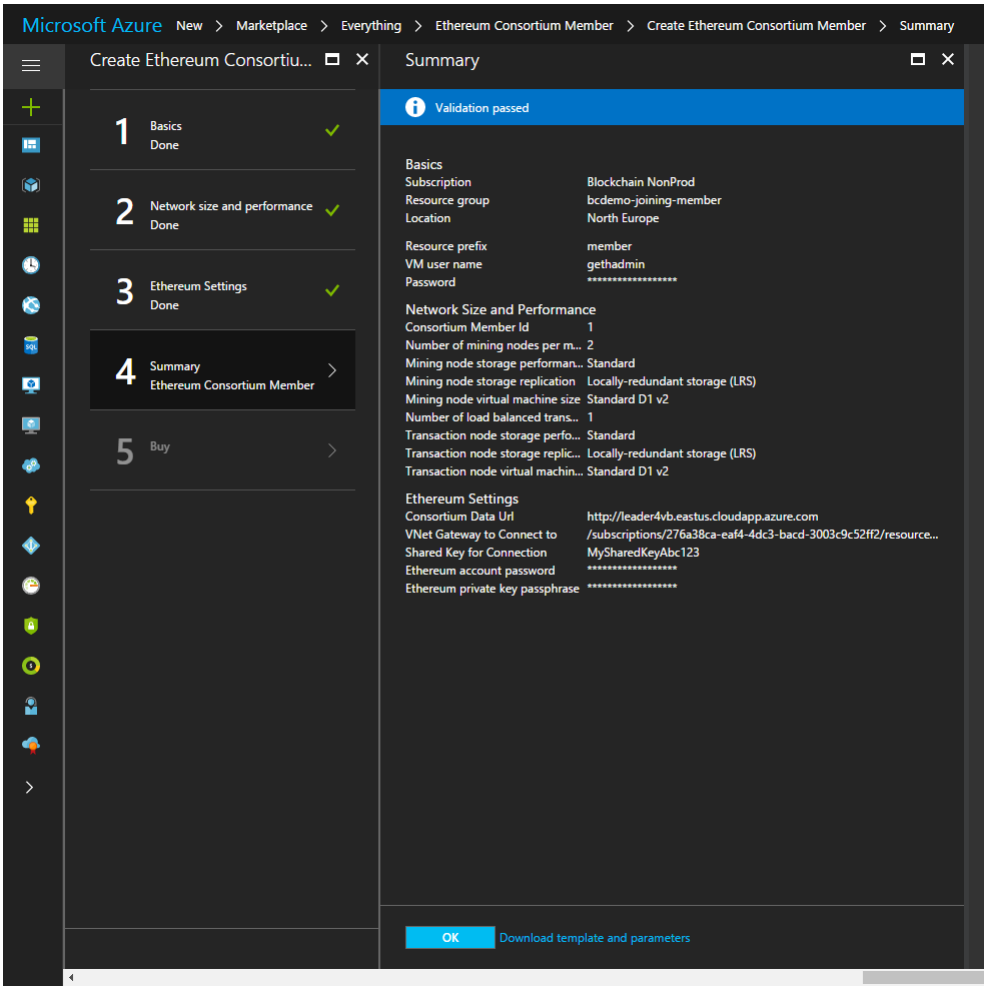
	deployment. If you deployed the rest of the network, the URL is the seventh template deployment output, named GATEWAY_ID. Note: The same member's consortium data URL and VNet Gateway resource must be used.		
Shared Key	A pre-established secret between the members of the consortium network that are establishing a connection. This information is provided by an already connected member who has a deployment.	1-255 characters	NA
Ethereum Account Password	The administrator password used to secure the Ethereum account imported into each node. The password must contain the following: 1 upper case character, 1 lower case character, and 1 number.	12 or more characters	NA
Ethereum private key passphrase	The passphrase used to generate the ECC private key associated with the default Ethereum account that is generated. A pre-generated private key does not need to be explicitly passed in. Consider a passphrase with sufficient randomness to ensure a strong private key and no overlap with other consortium members. The passphrase must contain the following at a minimum: 1 upper case character, 1 lower case character, and 1 number. Note if two members use the same passphrase the accounts generated will be the same. This is useful if a single organization is trying to deploy across regions and wants to share a single account (coin base) across all nodes.	12 or more characters	NA

A sample deployment is shown below:



Deploy

Click through the summary blade to review the inputs specified and to run basic pre-deployment validation.



Finally, review legal and privacy terms and click 'Purchase' to deploy. This template pre-deploys and configures the necessary VPN Gateways to support network connectivity with other members. Deployment of the gateway can take upwards of 45 minutes.

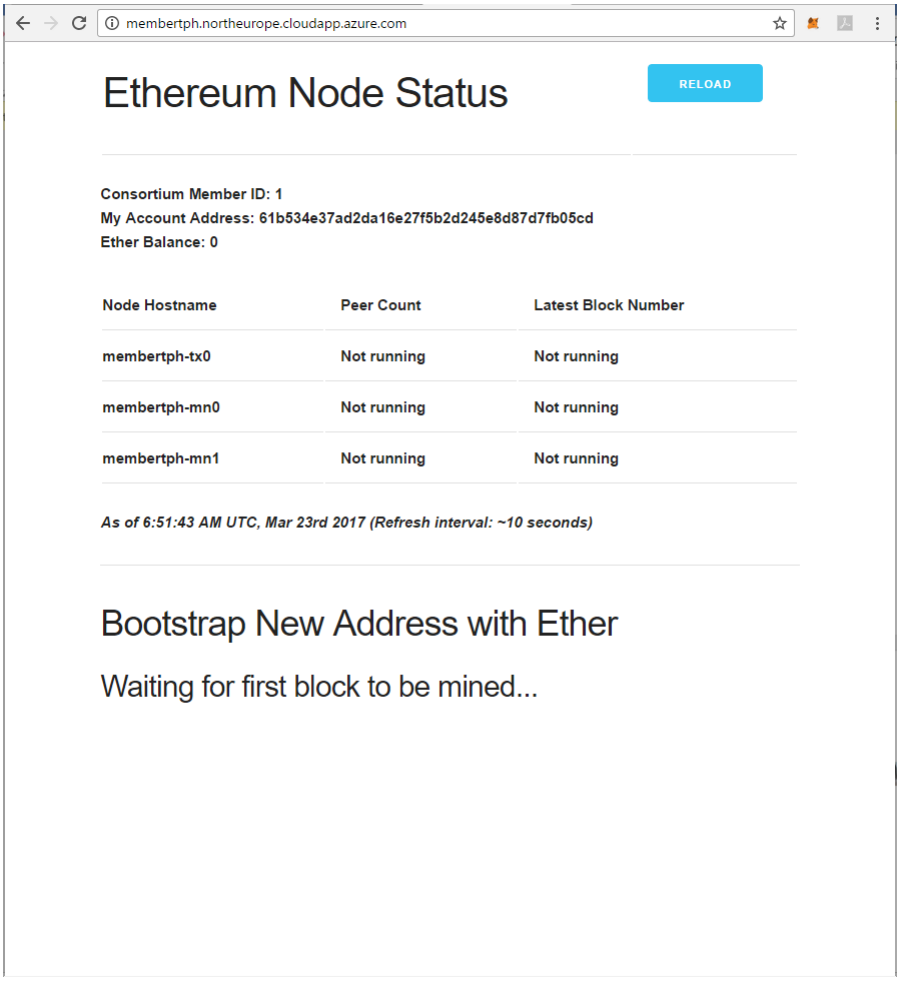
Request Acceptance

Once the deployment has completed successfully and all resources have been provisioned, you need to reach out to the member to which you are connecting for them to accept the connection. This is a simple configuration step that the existing member must execute as specified in the 'Acceptance of New Member' section.

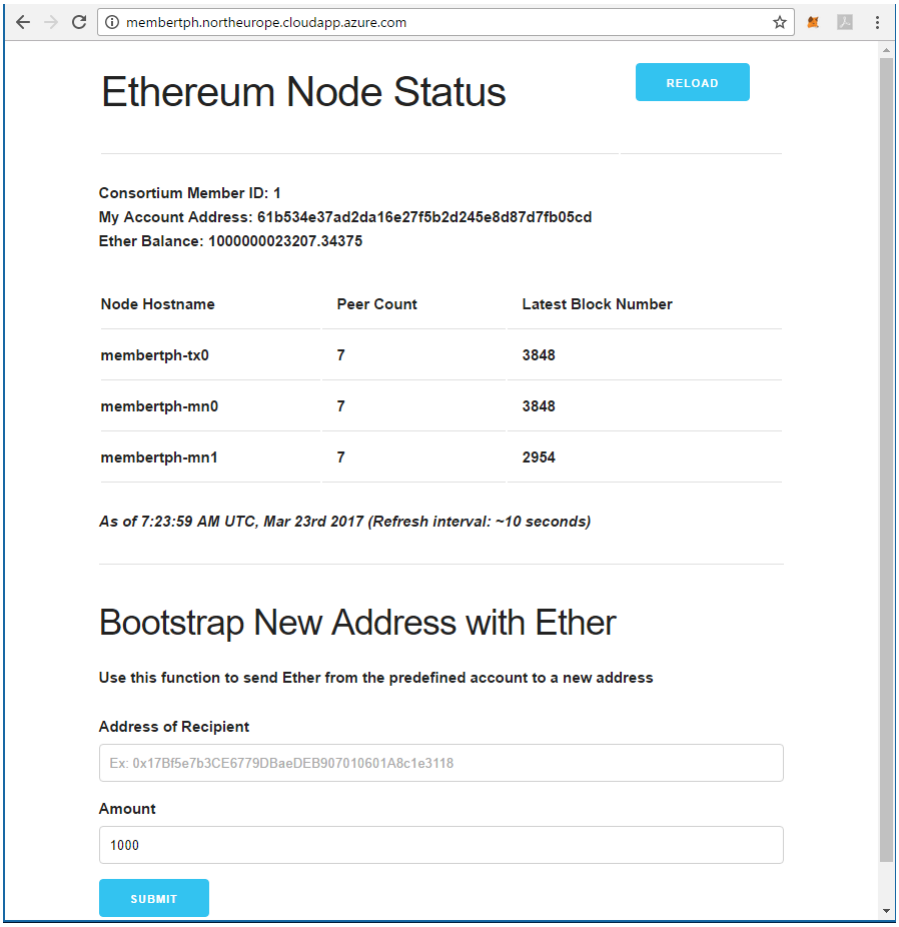
Administrator Page

You can go to the administrator page to get a simple view of your blockchain network and to sanity check the deployment state. The instructions on how to access the administrator page are the same as for the leader deployment above. Note, the network will not be visible on the admin page until the final gateway to gateway connection is established by the member to which you are connecting.

The admin page before the connection is established:



Refresh the admin page after the connection has been established by the member to whom you are joining. The admin page after the connection is established:



Accessing Nodes

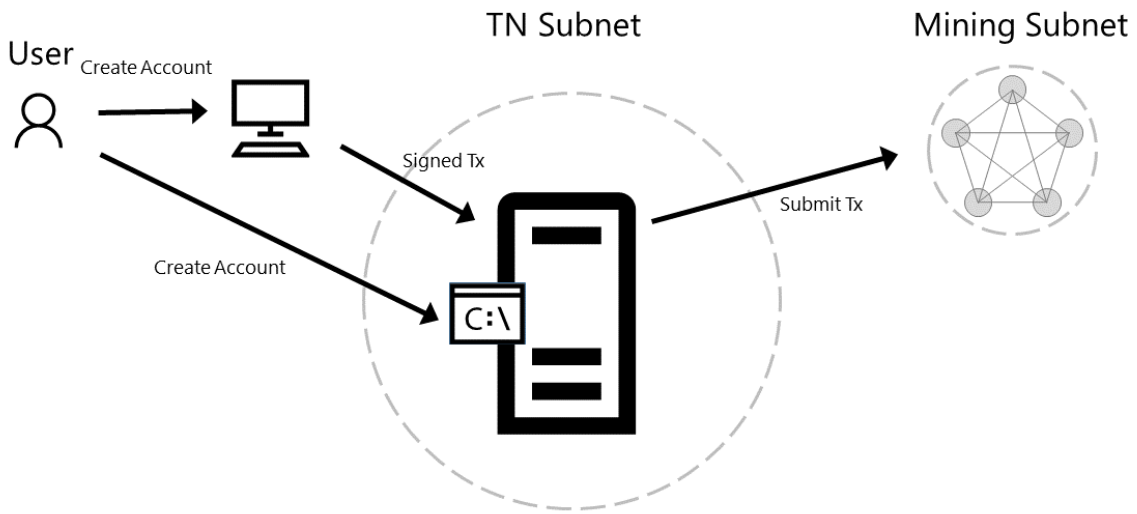
You can remotely connect to the virtual machines on which the transaction nodes run via SSH with your provided admin username and password/SSH key. The instructions on how to access nodes are the same as for the leader deployment above.

Funding Ethereum Account

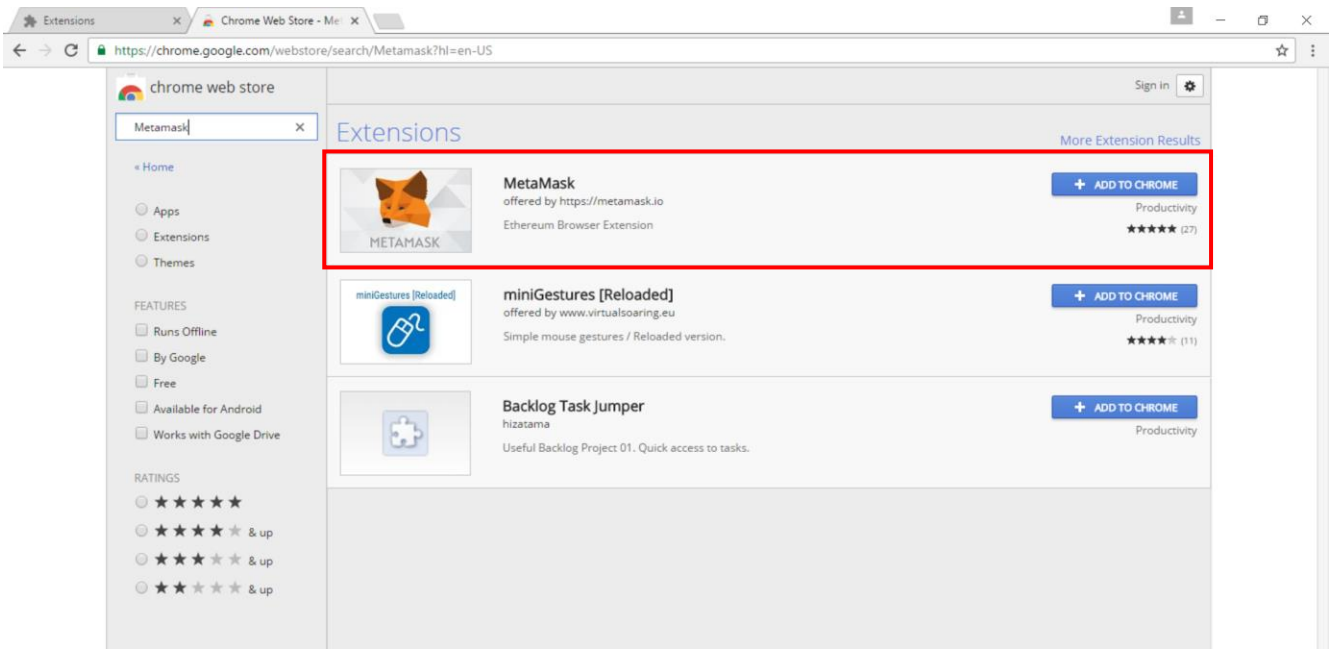
As a new member, your generated Ethereum account will not be pre-funded. You will need to provide your account to the leader or another connected member to quickly fund your account. Your account address is displayed at the top of the admin page. If you do not do this step, you will need to wait until your mining nodes begin to mine to generate Ether into your account (coin base).

Leader or Member: Create Ethereum Account

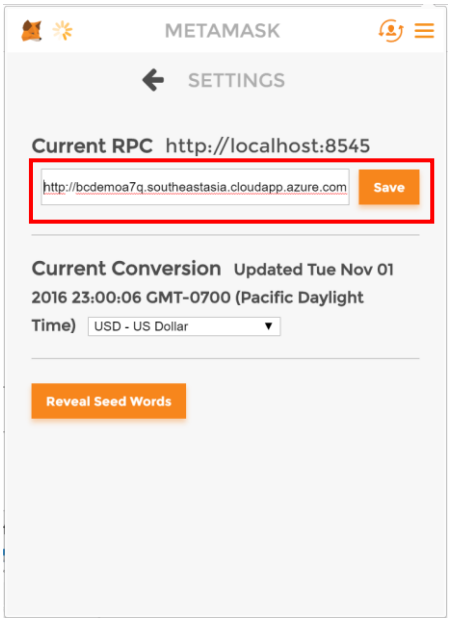
To create an additional account, you can use a variety of solutions. One such solution is MetaMask, a Chrome extension that provides an "identity vault" and connection to an Ethereum network, public, test or custom. MetaMask formulates a transaction to register the account in the network. This transaction, like any other transaction, will go to one of the transaction nodes, and eventually be mined into a block as illustrated below.



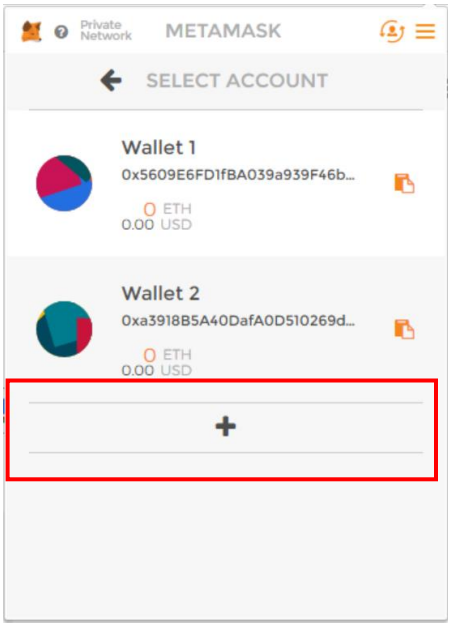
To install the extension in Chrome, go to Customize and control Google Chrome (Overflow button), More Tools, Extensions, Get More Extensions, and search for MetaMask.



Once installed, open MetaMask and create a new vault. By default, the vault will be connected to the Morden Test Network. You will need to change this to connect to the deployed private consortium network, specifically to the load balancer in front of the transaction nodes. From the template output, retrieve the exposed Ethereum RPC endpoint at port 8545, the second template output, and enter it in custom RPC as shown below.

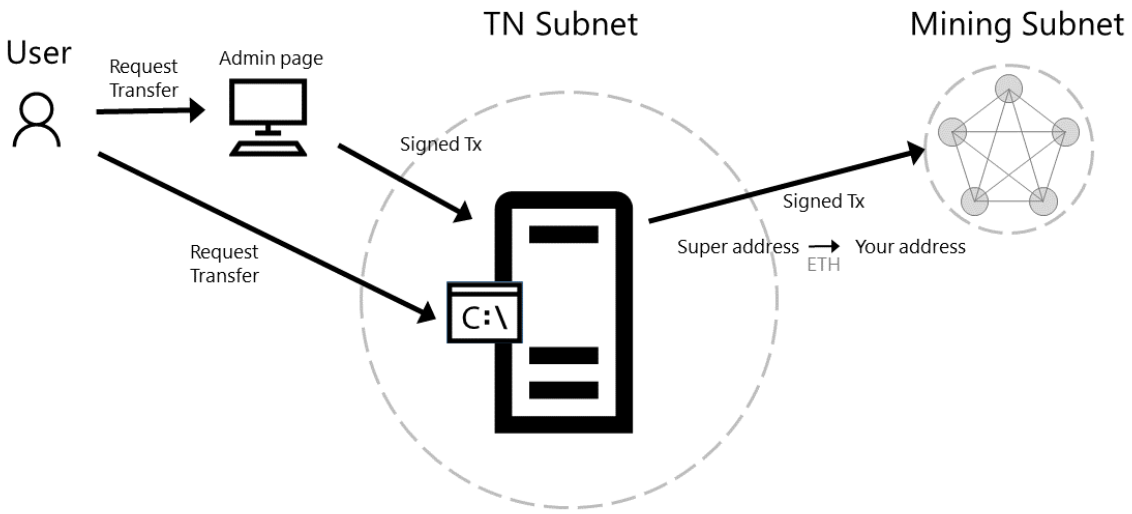


By creating the vault, you create a wallet containing an account. To create additional accounts, select Switch Accounts and then the '+' button as shown below.

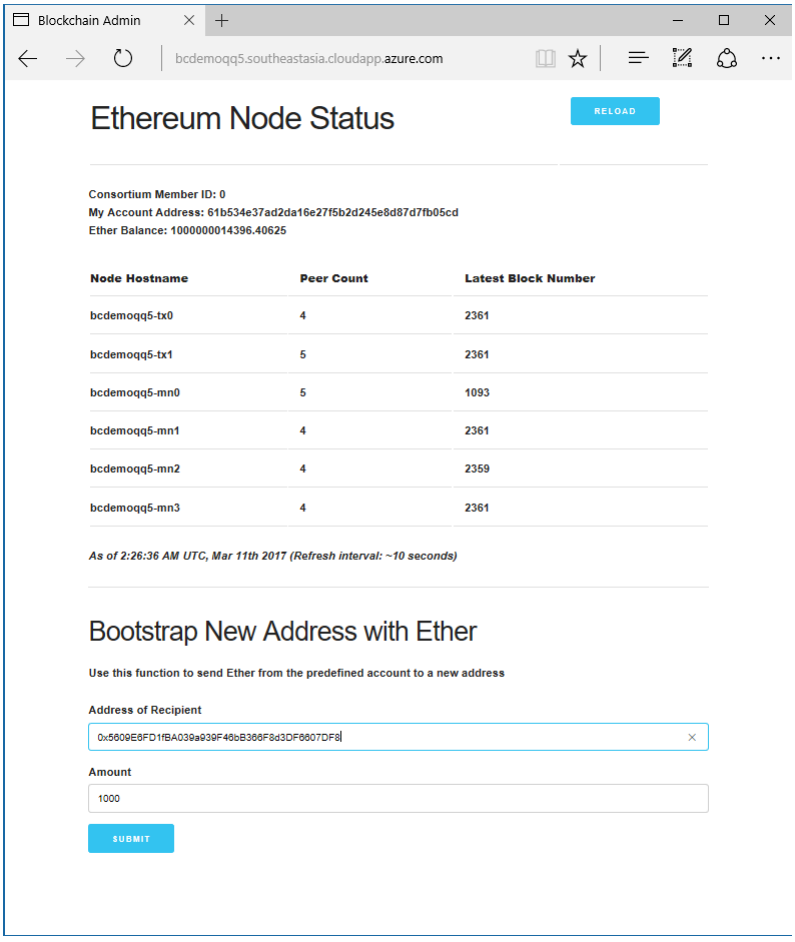


Initiate Initial Ether Allocation

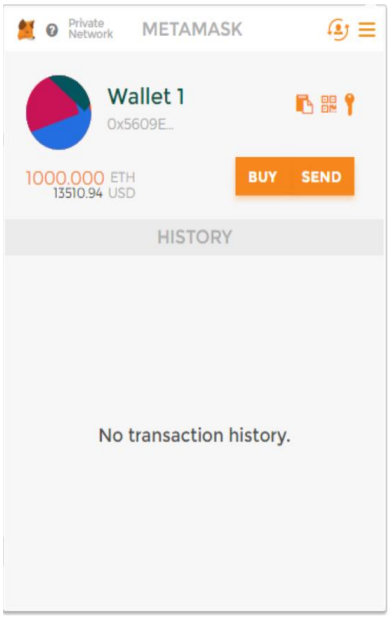
Through the administrator page, you can formulate a transaction to transfer Ether from the pre-allocated account to another Ethereum account. This Ether transfer is a transaction that is sent to the transaction node and mined into a block as illustrated below.



Via the clipboard icon in the MetaMask wallet, copy the address of the Ethereum account to which you want to transfer ether and go back to the administrator page. Paste the copied account into the input field to transfer 1000 ether from the pre-allocated Ethereum account to your newly created account. Click submit and wait for the transaction to be mined into a block.



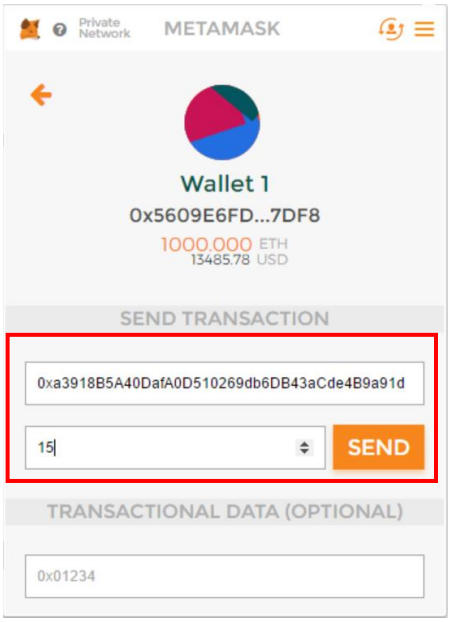
Once the transaction is committed into a mined block, the account balance in MetaMask for your account will reflect the transfer of 1000 Ether.



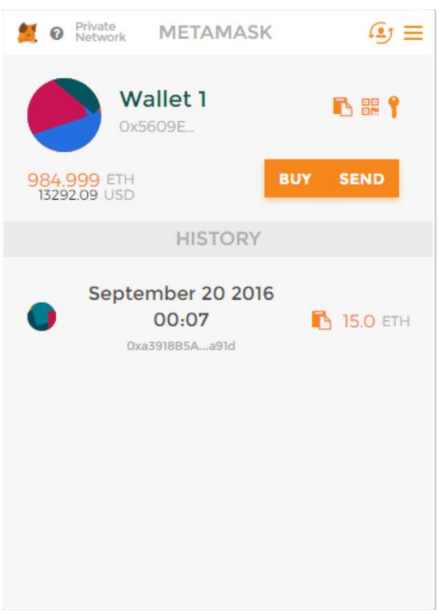
Transfer of Ether between Accounts

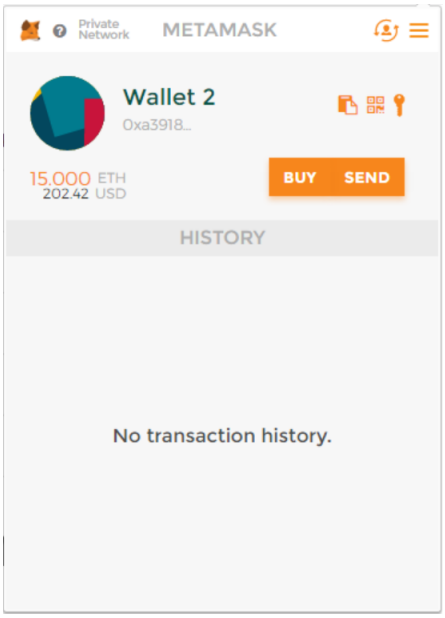
At this point, you are ready to execute transactions within your private consortium network. The simplest transaction is to transfer Ether from one account to another. To formulate such a transaction, you can use MetaMask once again, transferring money from the first account used above to a second account.

From Wallet 1 in MetaMask, click on send. Copy the address of the second wallet created into Recipient Address input field and amount of Ether to transfer in the Amount input field. Click send and accept the transaction.



Once again, when the transaction is mined and committed into a block, the account balances will be reflected accordingly. Note, wallet 1's balance is deducted a bit more than 15 Ether, since you had to pay a mining fee to process the transaction.





Next Steps

You are now ready to focus on application and smart contract development against your multi-member consortium blockchain network. Happy coding!