

Joining a Microsoft Azure Active Directory Domain Services Managed Domain

with SUSE Linux Enterprise Server

SUSE Linux Enterprise Server 12
Microsoft Azure Active Directory Domain Services

Kirk Evans, Principal Program Manager AzureCAT (Microsoft)

Joining a Microsoft Azure Active Directory Domain Services Managed Domain with SUSE Linux Enterprise Server

This article will show how to use Azure Active Directory Domain Services, providing Active Directory capabilities as a managed service in Microsoft Azure to enable NTLM, Kerberos, and LDAP capabilities with SUSE Linux Enterprise Server.

Disclaimer: Documents published as part of the SUSE Best Practices series have been contributed voluntarily by SUSE employees and third parties. They are meant to serve as examples of how particular actions can be performed. They have been compiled with utmost attention to detail. However, this does not guarantee complete accuracy. SUSE cannot verify that actions described in these documents do what is claimed or whether actions described have unintended consequences. SUSE LLC, its affiliates, the authors, and the translators may not be held liable for possible errors or the consequences thereof.

Contents

- 1 Background 4
- 2 What is Microsoft Azure Active Directory Domain Services 4
- 3 Getting Started 6
- 4 Create a SUSE Linux Enterprise Server Virtual Machine 8
- 5 Connect Via SSH Using Your Certificate 12
- 6 Domain Join SUSE Linux Enterprise Server Using YaST 14
- 7 More Information 17
- 8 Legal notice 19
- 9 GNU Free Documentation License 20

1 Background

If you want to use Microsoft Azure AD Domain Services with Linux to test your product, you will struggle to find easy-to-use documentation. Documentation that shows how to walk through this end to end does not exist. And there is no general step-by-step explanation for Linux distributions available, as the package management systems for the different Linux distributions differ from each other. SUSE Linux Enterprise Server uses zypper, Red Hat Enterprise Linux uses yum, Ubuntu uses apt-get.

In addition, the packages to use and the instructions for configuring are often hard to understand. However, it turns out it is quite easy to domain join a machine using SUSE Linux Enterprise Server.

2 What is Microsoft Azure Active Directory Domain Services

The Azure Active Directory service does not directly provide NTLM, Kerberos, or LDAP services, while by default it provides WS-Trust, OpenID Connect, and OAuth capabilities. Applications hosted in Azure virtual machines however may need these authentication capabilities but cannot afford the latency of communicating back to on-premises infrastructure, requiring domain controllers to be hosted in the cloud. Many customers do not want to install their own domain controllers in cloud-hosted virtual machines, configure a VPN or ExpressRoute, and manage AD replication to on-premises domain controllers.

This is exactly what Azure AD Domain Services (AAD-DS) provides: a managed domain controller with the same users and groups as you have in your Azure Active Directory (AAD). AAD-DS makes it easy to join a virtual machine to the managed domain so that your application can use NTLM, Kerberos, or LDAP with the same credentials that they use to log in to Office 365 or Azure services.

Azure AD Domain Services will provision managed domain controllers into the Azure Virtual Network that you specify. In the image below, the managed domain controller virtual machines are greyed out. This indicates they are there but you cannot access them or do anything with the virtual machine directly. You simply use the familiar Windows Active Directory Domain Services (ADDS) as a service.

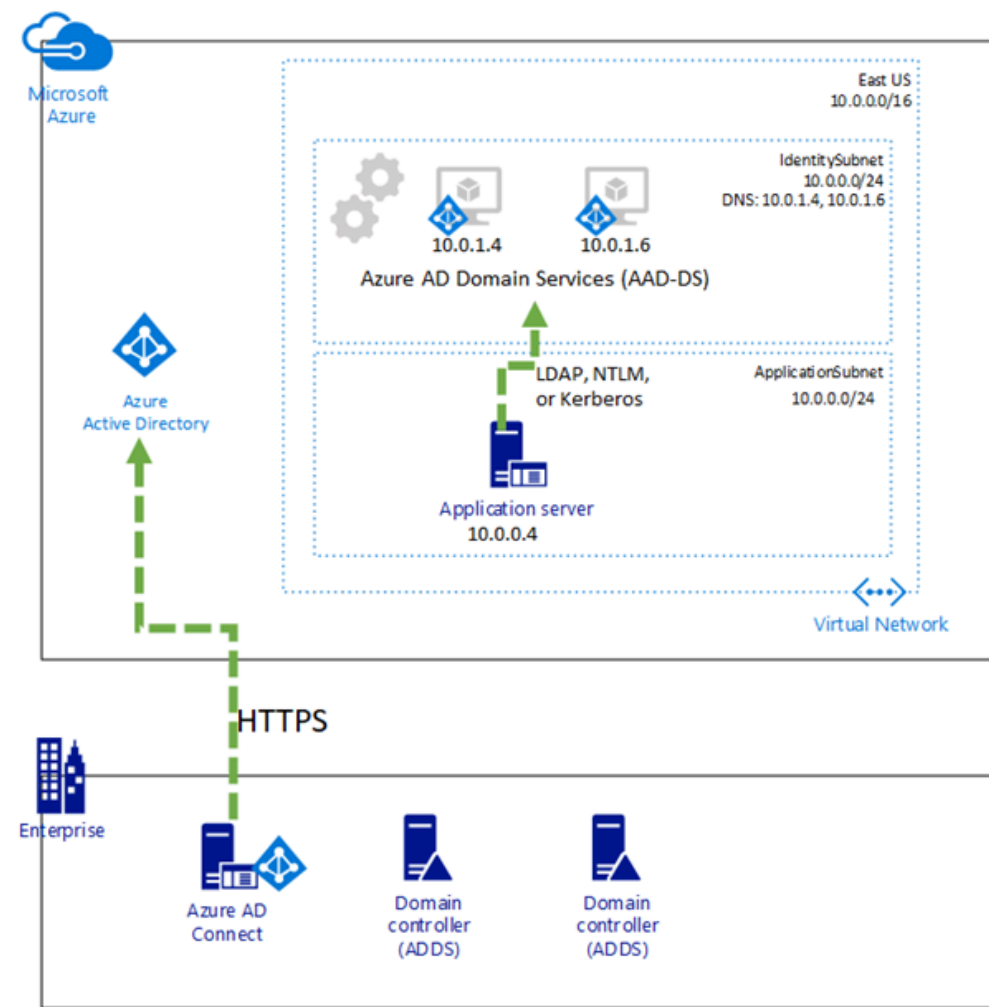



FIGURE 1: MICROSOFT AZURE AAD-DS OVERVIEW

In this picture, you see that AAD-DS is enabled for the directory, creating two virtual machines in the subnet of choice. The application server can now communicate with those domain controllers to domain join the machine and enable authentication and authorization. Azure AD Domain Services works with either cloud-only or hybrid directories. If there is an existing ADDS infrastructure on-premises, you synchronize users to the AAD directory using HTTPS to enable single sign on to cloud resources such as Microsoft Office 365.

3 Getting Started

The documentation how to set up Azure AD Domain Services is easy to follow. You do not need to install any software on your machine, and you do not need to perform any local configuration. Go to the Azure portal and follow the directions given in the article “Enable Azure Active Directory Domain Services using the Azure portal” at <https://docs.microsoft.com/en-us/azure/active-directory-domain-services/active-directory-ds-getting-started> 

As result, you get an Azure classic virtual network with the settings you chose.

Resource group (change)	Address space
Default-Networking	10.0.1.0/24
Location	DNS servers
Central US	10.0.1.6, 10.0.1.4
Subscription name (change)	Gateway routing type
MSDN	-
Subscription ID	
b697fa44-1b50-43bd-8b36-e93333d56d25	

FIGURE 2: AZURE CLASSIC VIRTUAL NETWORK SETTINGS



Note: Classic VNets

At the time of writing this document, AAD-DS only supports classic VNets.

If you need to add users or groups, do this using Azure Active Directory.

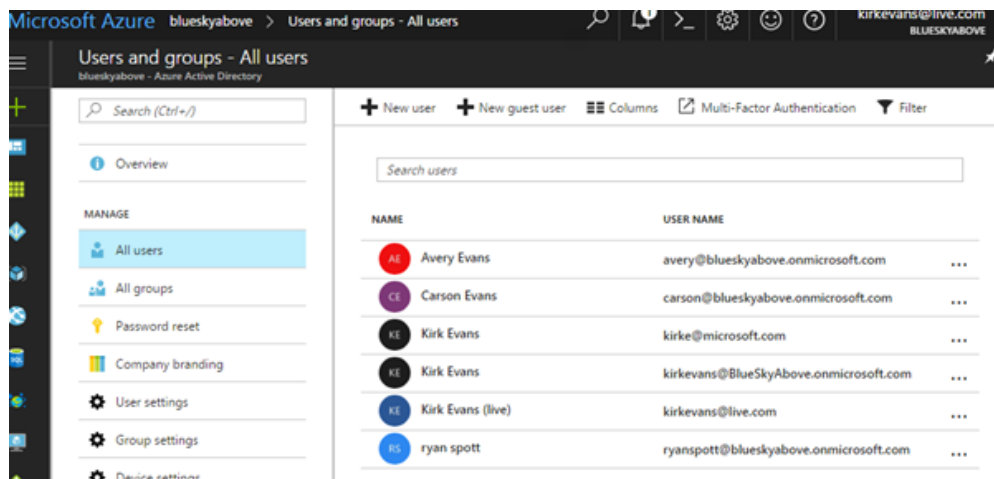


FIGURE 3: MICROSOFT AZURE AD - ADDING USERS

You can also create a group that contains the users who are administrators of the AAD-DS domain, enabling them to configure tasks like service principals and constrained delegation.

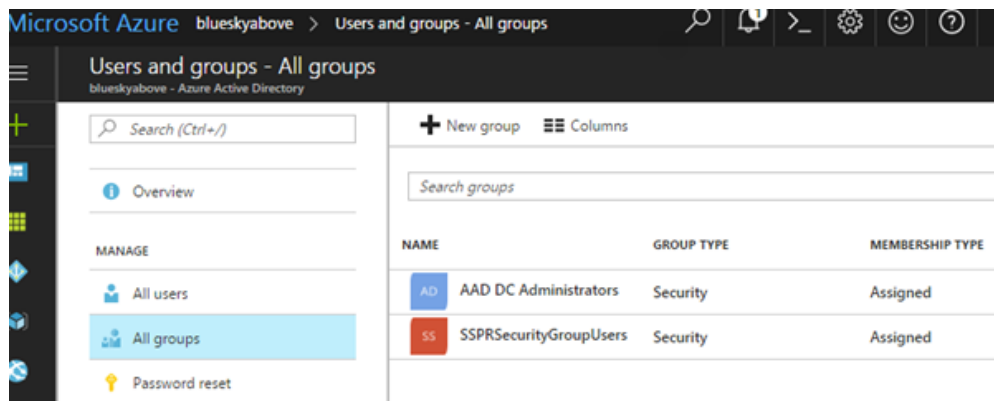


FIGURE 4: MICROSOFT AZURE AD - ADDING GROUPS

Now you can add a Windows virtual machine to the same virtual network and join the machine to the domain blueskyabove.onmicrosoft.com.

Keep in mind that the example at hand is using a cloud-only directory. There are no users sourced from on-premises. When you are prompted by Windows for the credentials to join a machine to the domain, use your cloud-only account abc@blueskyabove.onmicrosoft.com. When you connect to your new Windows VM using Remote Desktop Connection (RDC), use the same credentials:

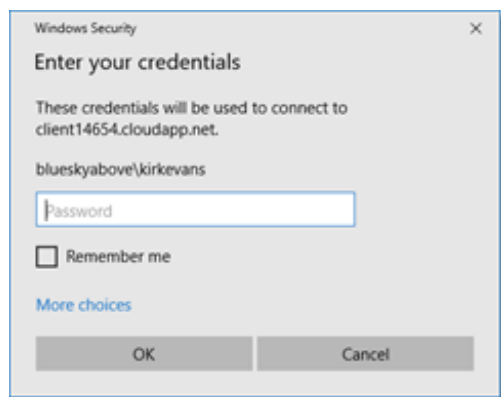


FIGURE 5: WINDOWS VIRTUAL MACHINE - ENTER CREDENTIALS

When you are logged in, open PowerShell and run the command:

```
Add-WindowsFeature -Name RSAT-ADDS-Tools
```

This command will add the Active Directory tools such as “Users and Computers”. Now you can view the domain information from your new Windows virtual machine.

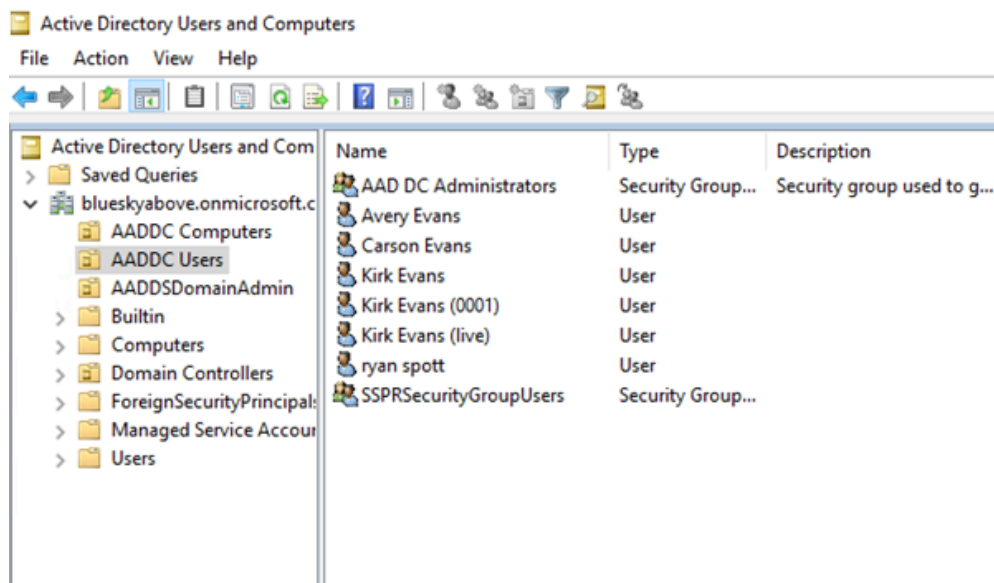


FIGURE 6: ACTIVE DIRECTORY USERS AND COMPUTERS

Your Windows environment is now prepared and ready. The next chapter explains how to create your Linux virtual machine.

4 Create a SUSE Linux Enterprise Server Virtual Machine

In the Azure portal, create a new SUSE Linux Enterprise Server virtual machine in the same VNet that you used previously. Filter for “SUSE” and choose your starting ISO image. In this example, SLES 11 SP4 has been chosen.

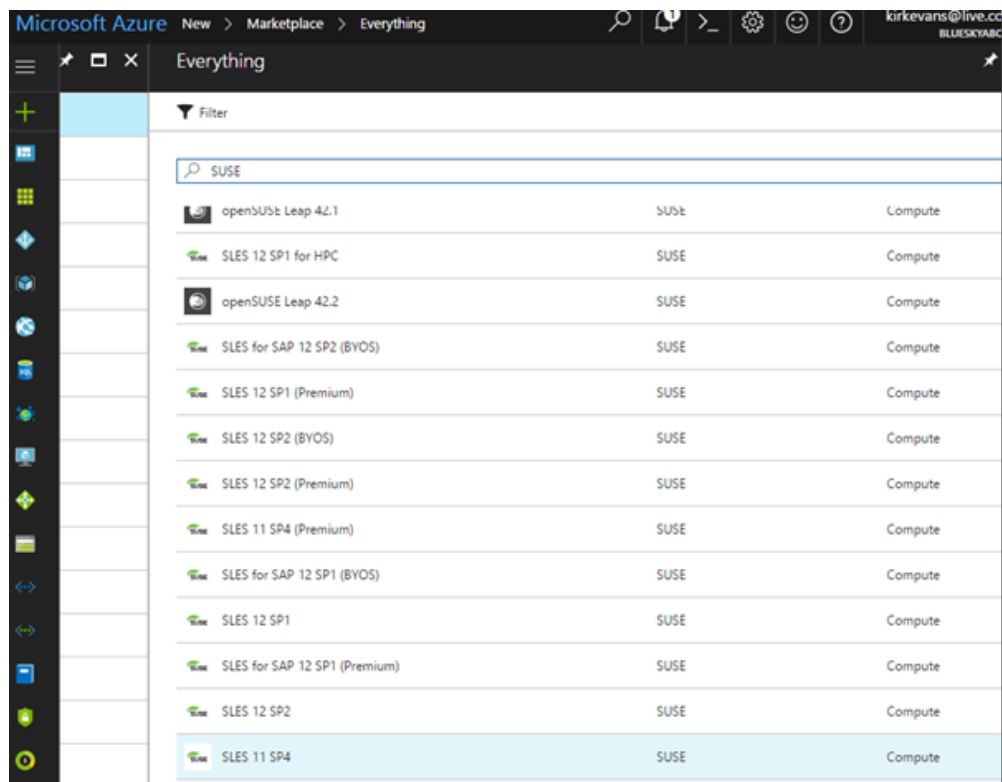


FIGURE 7: SELECT SUSE LINUX ENTERPRISE SERVER ISO IMAGE

! Important: Classic Deployment

Make sure to create a VM using the “Classic” deployment model so that it can be placed in the same Vnet!

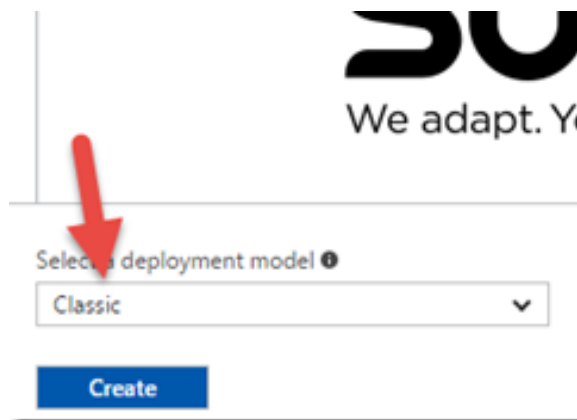


FIGURE 8: SELECT DEPLOYMENT MODEL

The next step enables you to provide your SSH login information and SSH public key. For more information about SSH keys, refer to the article “How to create and use an SSH public and private key pair for Linux VMs in Azure” at <https://docs.microsoft.com/en-us/azure/virtual-machines/linux/mac-create-ssh-keys> ↗.

The screenshot shows the 'Create virtual machine' wizard in the Azure portal. The left sidebar contains a navigation pane with four steps: 1. Basics (Configure basic settings), 2. Size (Choose virtual machine size), 3. Settings (Configure optional features), and 4. Summary (SLES 11 SP4). The 'Basics' tab is selected. The main area displays the 'Basics' configuration form. A red arrow points to the 'SSH public key' field, which is currently empty. The form includes the following fields: Name (kirke-suse-aad), User name (myadmin), Authentication type (SSH public key), SSH public key (empty text box), Subscription (MSDN), Resource group (aad), and Location (Central US).

FIGURE 9: ADD SSH PUBLIC KEY

Choose a size for the Virtual Machine. For the example at hand, a DS1_v2 machine is big enough.

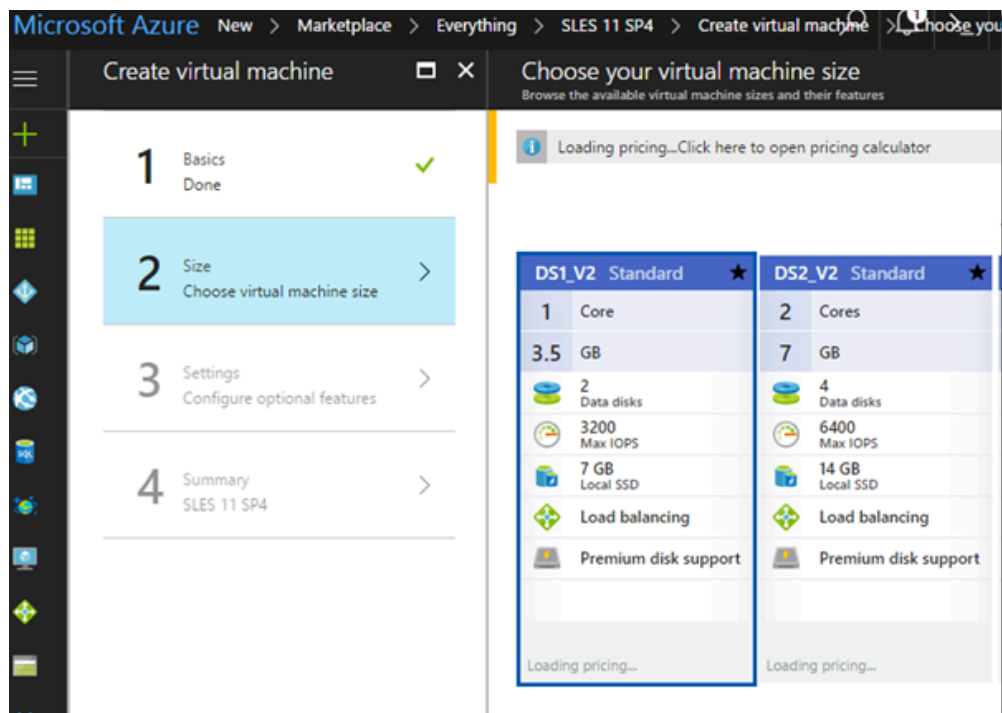


FIGURE 10: VIRTUAL MACHINE SIZE

Now create or choose a storage account and cloud service. For the example at hand, the same cloud service is used as with the Windows Virtual machine above.

! Important: Virtual Network

Use the same virtual network that is configured for Azure AD Domain Services.

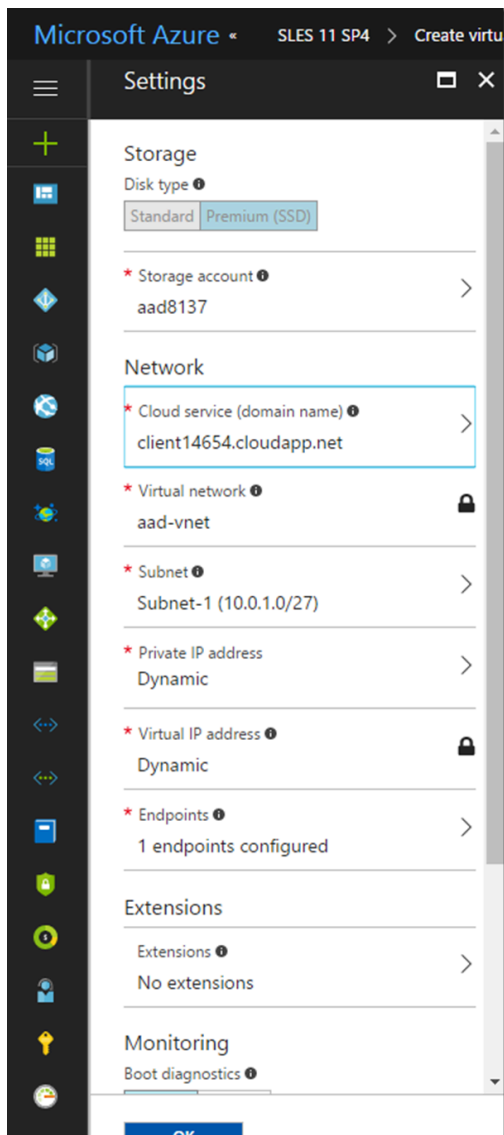


FIGURE 11: STORAGE AND NETWORK SETTINGS

After a few minutes, the VM is created and you can connect to it via SSH. Use the Windows Subsystem for Linux, open a command prompt and type **bash** to open the bash shell. Then you can run your SSH commands.

5 Connect Via SSH Using Your Certificate

You have not yet joined the new SUSE Linux Enterprise Server VM to the domain. To do so, connect to it via SSH using the details you provided when creating the Azure VM.

When the VM is created, open the VM to see its public IP address.

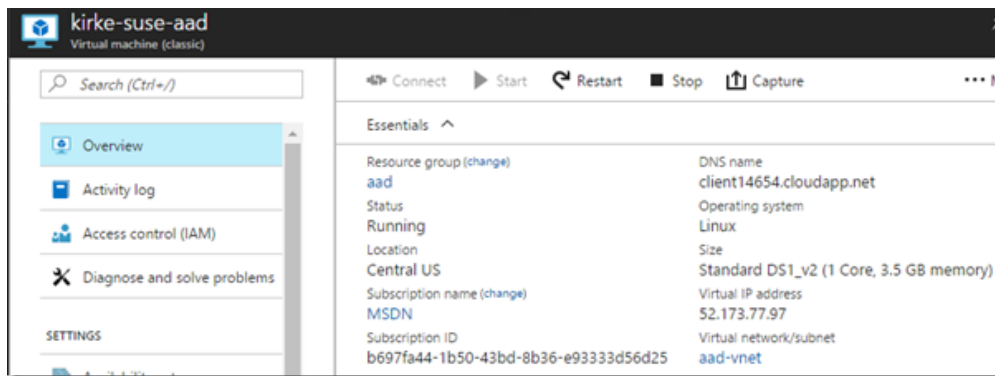


FIGURE 12: VIRTUAL MACHINE OVERVIEW



Note: Public IP

The public IP can change if you restart the Azure virtual machine.

Go to the “Endpoints” property of the VM to see which port to use for SSH.

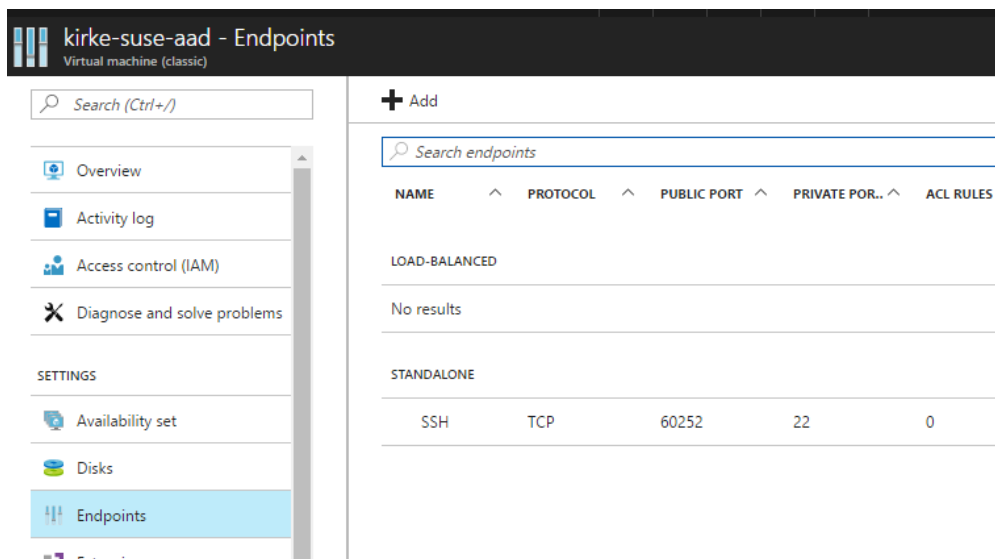
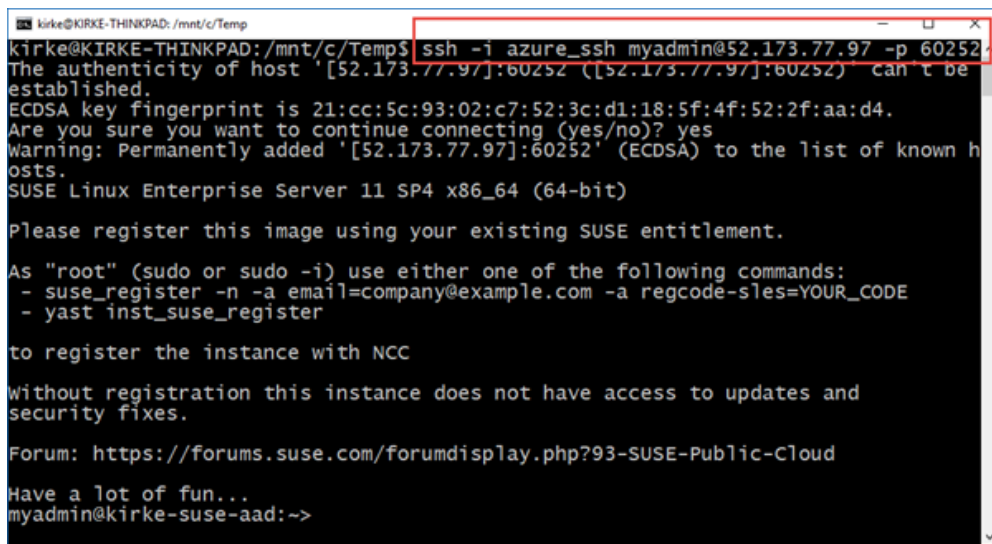


FIGURE 13: VIRTUAL MACHINE ENDPOINTS

Now type the following SSH command to access your virtual machine:

```
ssh -i azure_ssh myadmin@52.173.77.97 -p 60252
```



```
kirke@KIRKE-THINKPAD: /mnt/c/Temp
kirke@KIRKE-THINKPAD:/mnt/c/Temp$ ssh -i azure_ssh myadmin@52.173.77.97 -p 60252
The authenticity of host '[52.173.77.97]:60252 ([52.173.77.97]:60252)' can't be
established.
ECDSA key fingerprint is 21:cc:5c:93:02:c7:52:3c:d1:18:5f:4f:52:2f:aa:d4.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '[52.173.77.97]:60252' (ECDSA) to the list of known h
osts.
SUSE Linux Enterprise Server 11 SP4 x86_64 (64-bit)

Please register this image using your existing SUSE entitlement.

As "root" (sudo or sudo -i) use either one of the following commands:
- suse_register -n -a email=company@example.com -a regcode-sles=YOUR_CODE
- yast inst_suse_register

to register the instance with NCC

Without registration this instance does not have access to updates and
security fixes.

Forum: https://forums.suse.com/forumdisplay.php?93-SUSE-Public-Cloud

Have a lot of fun...
myadmin@kirke-suse-aad:~>
```

FIGURE 14: CONNECT VIA SSH

6 Domain Join SUSE Linux Enterprise Server Using YaST

Now that you can access the SUSE Linux Enterprise Server virtual machine, you need to join to the domain controller that Azure AD Domain Services provides. Since the VM is in the same VNet and you have updated the DNS settings for the VNet, the new Linux machine can locate the domain controller by name without any further configuration with the command **sudo /sbin/yast**:

```
myadmin@kirke-suse-aad:~> sudo /sbin/yast
```

This command opens the YaST Control Center. Choose “Network Services” and “Windows Domain Membership”.

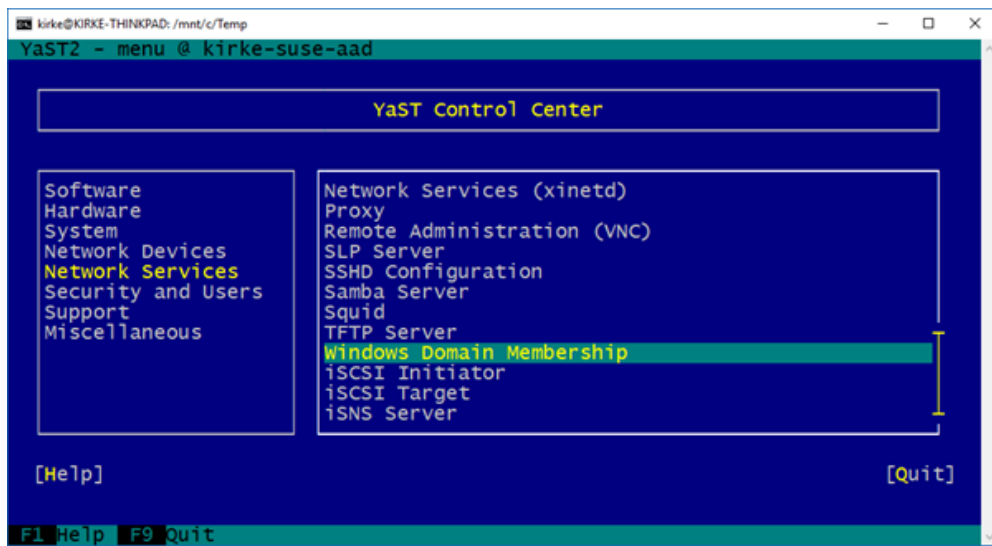


FIGURE 15: YAST CONTROL CENTER - OVERVIEW

You are prompted to install the Samba client packages.

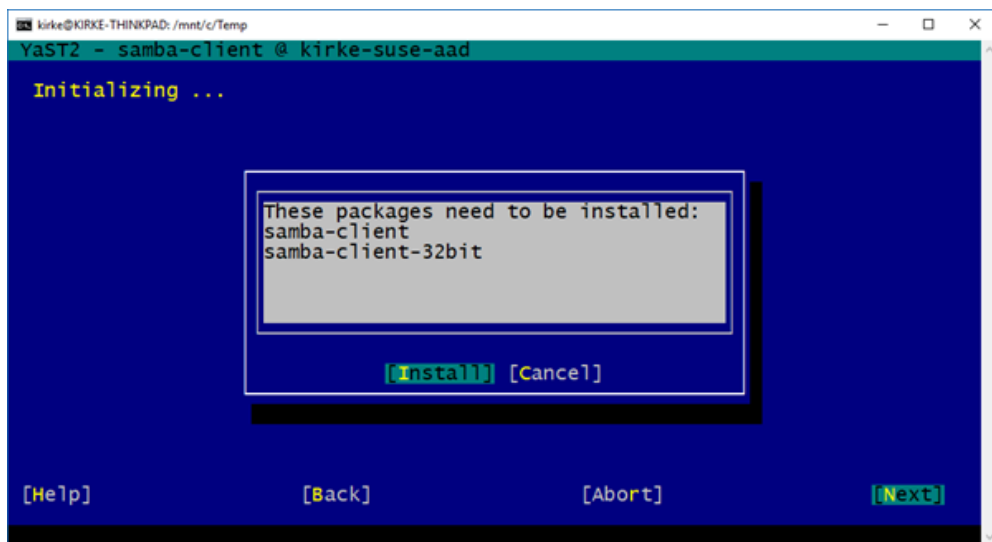


FIGURE 16: YAST CONTROL CENTER - SAMBA CLIENT PACKAGES

Next, provide your domain as all capital letters, and enable the settings in the top section to enable users to SSH to the machine using their credentials from Azure AD.



Note: Custom Domain

For the example at hand, a cloud-only directory without a custom domain is used. If you added and verified a custom domain, and have users from that custom domain in your AAD directory from a synchronization, then you should use your custom domain.

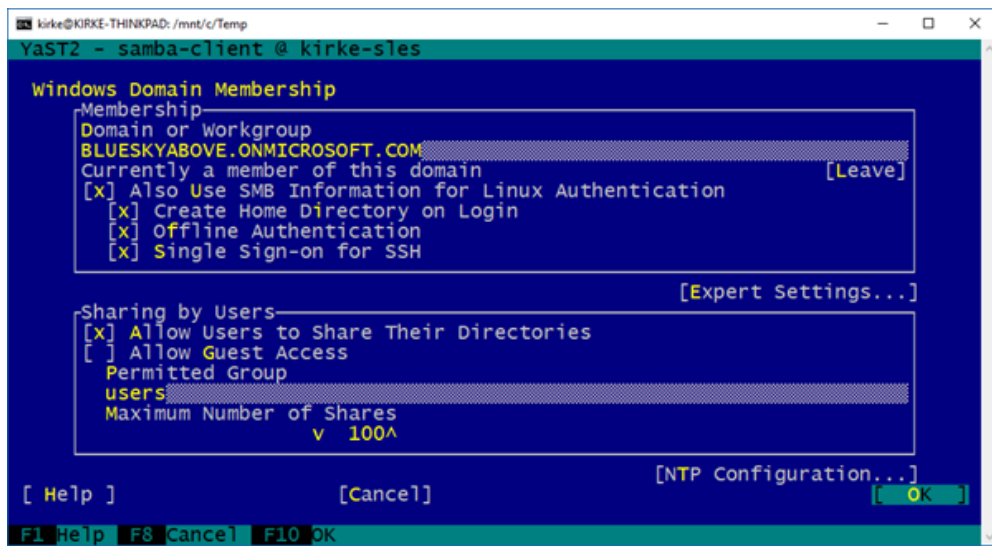


FIGURE 17: YAST CONTROL CENTER - WINDOWS DOMAIN MEMBERSHIP



Note: Backspace

If “Backspace” does not work, use **CTRL + H** to backspace.

When you are done, exit and reboot the VM.



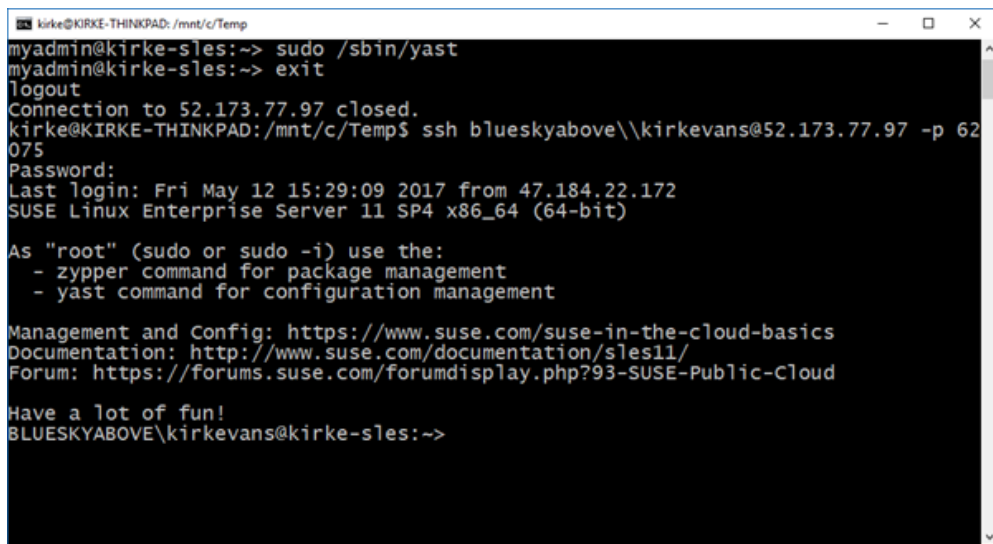
Note: YaST

If you want to understand in detail what the YaST tool did in the background, read the article “How to integrate SUSE Linux Enterprise 11 with Windows Active Directory” at <https://jreypo.wordpress.com/2012/02/01/how-to-integrate-suse-linux-enterprise-11-with-windows-active-directory/> />. This article provides a comprehensive look at the files it edited and the values it used.

You can now log in using the same credentials that you use to log in to Azure AD:

```
ssh blueskyabove\\kirkevans@52.173.77.97 -p 62075
```

Connect via SSH using your credentials from Azure AD. A home directory has been created for the user.



```
kirke@KIRKE-THINKPAD: /mnt/c/Temp
myadmin@kirke-sles:~> sudo /sbin/yast
myadmin@kirke-sles:~> exit
logout
Connection to 52.173.77.97 closed.
kirke@KIRKE-THINKPAD: /mnt/c/Temp$ ssh blueskyabove\\kirkevans@52.173.77.97 -p 62075
Password:
Last login: Fri May 12 15:29:09 2017 from 47.184.22.172
SUSE Linux Enterprise Server 11 SP4 x86_64 (64-bit)

As "root" (sudo or sudo -i) use the:
- zypper command for package management
- yast command for configuration management

Management and Config: https://www.suse.com/suse-in-the-cloud-basics
Documentation: http://www.suse.com/documentation/sles11/
Forum: https://forums.suse.com/forumdisplay.php?93-SUSE-Public-Cloud

Have a lot of fun!
BLUESKYABOVE\\kirkevans@kirke-sles:~>
```

FIGURE 18: CONNECT FROM AZURE AD VIA SSH

The user is not contained in the “sudo-ers” group. It is possible to enable users from a particular Active Directory group to use sudo. For more information regarding this topic, read the article “Adding AD domain groups to /etc/sudoers” at <https://derflounder.wordpress.com/2012/12/14/adding-ad-domain-groups-to-etcsudoers/> .

7 More Information

For more detailed information, have a look at the following articles:


- Enable Azure Active Directory Domain Services Using the Azure Portal (<https://docs.microsoft.com/en-us/azure/active-directory-domain-services/active-directory-ds-getting-started>)
- How to create and use an SSH public and private key pair for Linux VMs in Azure (<https://docs.microsoft.com/en-us/azure/virtual-machines/linux/mac-create-ssh-keys>)
- Join a Red Hat Enterprise Linux 7 virtual machine to a managed domain (<https://docs.microsoft.com/en-us/azure/active-directory-domain-services/active-directory-ds-admin-guide-join-rhel-linux-vm>)

- How to integrate SUSE Linux Enterprise 11 with Windows Active Directory (<https://jreypo.wordpress.com/2012/02/01/how-to-integrate-suse-linux-enterprise-11-with-windows-active-directory/>) ↗
- Adding AD Domain Groups to /etc/sudoers (<https://derflounder.wordpress.com/2012/12/14/adding-ad-domain-groups-to-etcsudoers/>) ↗

8 Legal notice

Copyright ©2006-2025 SUSE LLC and contributors. All rights reserved.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or (at your option) version 1.3; with the Invariant Section being this copyright notice and license. A copy of the license version 1.2 is included in the section entitled “GNU Free Documentation License”.

SUSE, the SUSE logo and YaST are registered trademarks of SUSE LLC in the United States and other countries. For SUSE trademarks, see <http://www.suse.com/company/legal/> . Linux is a registered trademark of Linus Torvalds. All other names or trademarks mentioned in this document may be trademarks or registered trademarks of their respective owners.

Documents published as part of the **SUSE Best Practices** series have been contributed voluntarily by SUSE employees and third parties. They are meant to serve as examples of how particular actions can be performed. They have been compiled with utmost attention to detail. However, this does not guarantee complete accuracy. SUSE cannot verify that actions described in these documents do what is claimed or whether actions described have unintended consequences. SUSE LLC, its affiliates, the authors, and the translators may not be held liable for possible errors or the consequences thereof.

Below we draw your attention to the license under which the articles are published.

GNU Free Documentation License

Copyright (C) 2000, 2001, 2002 Free Software Foundation, Inc. 51 Franklin St, Fifth Floor, Boston, MA 02110-1301 USA. Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or non-commercially. Secondly, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

A section "Entitled XYZ" means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as "Acknowledgements", "Dedications", "Endorsements", or "History".) To "Preserve the Title" of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects. If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

- A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
- B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.
- C. State on the Title page the name of the publisher of the Modified Version, as the publisher.
- D. Preserve all the copyright notices of the Document.
- E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
- F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.
- G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.
- H. Include an unaltered copy of this License.
- I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.
- J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
- K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.
- L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
- M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.
- N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.
- O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties--for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements".

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See <http://www.gnu.org/copyleft/>.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

ADDENDUM: How to use this License for your documents

```
Copyright (c) YEAR YOUR NAME.
Permission is granted to copy, distribute and/or modify this document
under the terms of the GNU Free Documentation License, Version 1.2
or any later version published by the Free Software Foundation;
with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.
A copy of the license is included in the section entitled "GNU
Free Documentation License".
```

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the "with...Texts". line with this:

```
with the Invariant Sections being LIST THEIR TITLES, with the
Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.
```

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.