

Redirecting the Direct Console to Serial Over LAN (SOL) with VMware vSphere

Planning / Implementation

Serial over LAN (SOL) is the name of the redirection of baseboard serial controller traffic over an IPMI session. The following figure presents an example block diagram for the purposes of illustrating the concept of SOL. The lines represent the flow of the serial port data. BMC (Baseboard Management Controller) redirects the serial traffic over LAN, then the remote server or PC can interact with BIOS or OS via IPMI LAN session.

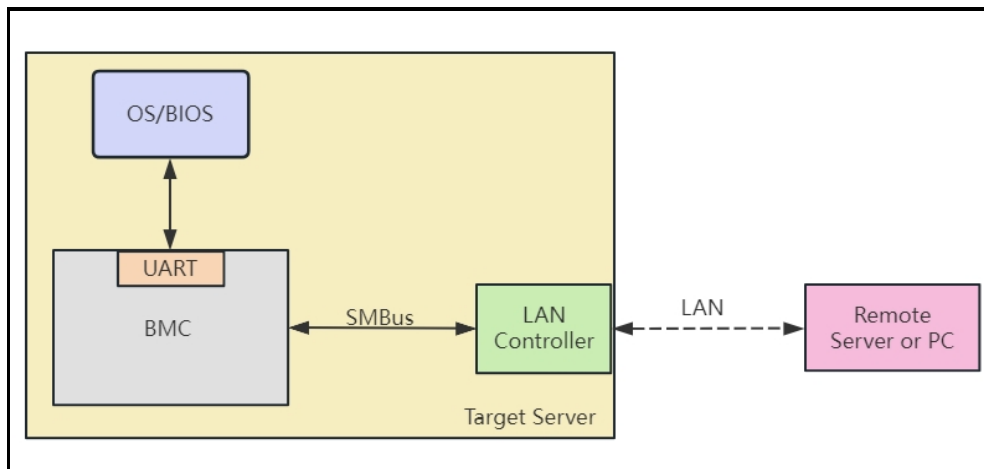


Figure 1. Serial over LAN concept

SOL can be used to enable asynchronous serial-based OS and pre-OS communication over a connection to the BMC. SOL provides users with a method to interact with serial text interfaces at remote consoles, such as operating system command-line, serial redirected BIOS interfaces, and serial text-based application over an IPMI LAN session. A single remote console application can use SOL to simultaneously provide LAN access to IPMI platform management and serial text redirection under a unified user interface. Access privileges for SOL are managed under the same user configuration interfaces that are used for IPMI management. This simplifies the creation of configuration software, remote management applications, and cross-platform configuration utilities.

Prerequisites for using SOL

The prerequisites for using SOL are listed below and these requirements are necessary for SOL to work properly.

The target server:

- [Check IPMI over LAN](#): make sure that IPMI over LAN is enabled in XClarity Controller.
- [Configure Serial Port Setting in UEFI](#): ensure the serial port settings are correct.
- [Configure console redirection in vSphere](#): redirect OS direct log to the serial port.

The remote server of PC:

- [ipmitool with IPMI v2.0 support](#): ipmitool v1.8.18 is recommended.

The following sections cover each of these items in detail. Click the above links to jump to each section.

Check IPMI over LAN status

Before configuring SOL, make sure that IPMI over LAN is enabled. On ThinkSystem servers, IPMI via the Ethernet port (IPMI over LAN) is supported, however it is disabled by default. You can configure it in XClarity Controller via **BMC Configuration** → **Network** → **IPMI over LAN** as shown in Figure 2.

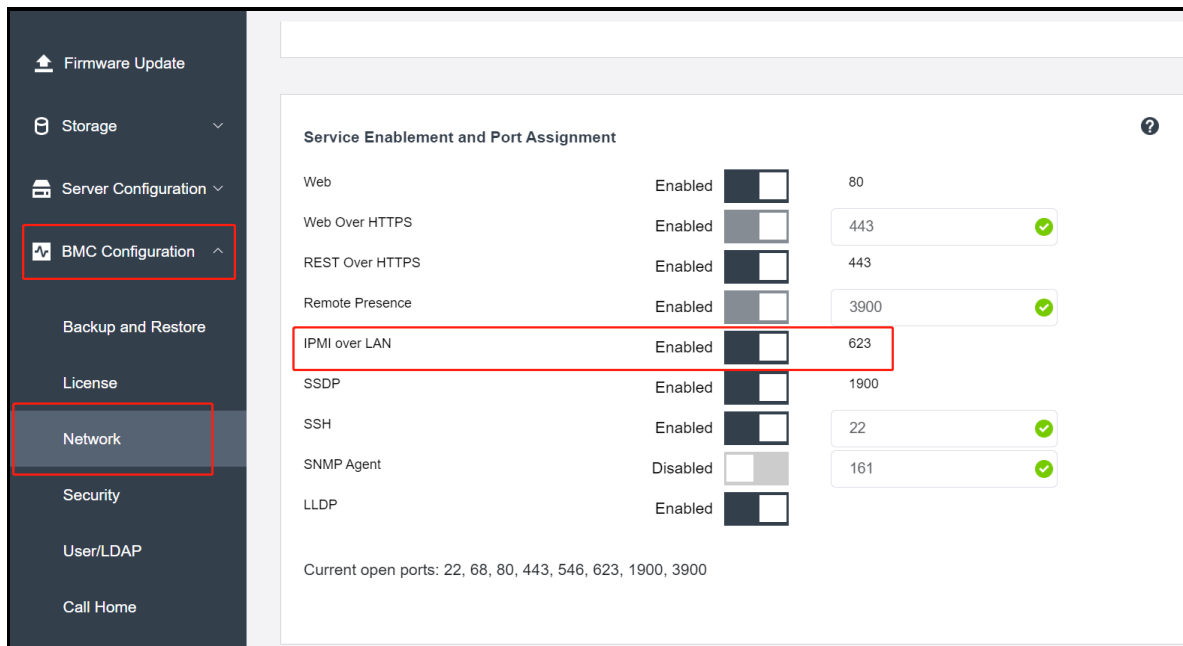


Figure 2. The IPMI over LAN setting of XCC

Besides enabling IPMI over LAN, it is necessary to confirm your BMC users have IPMI over LAN access if the User Accessible Interface option is available in XClarity Controller. Navigate to **BMC Configuration** → **User/LDAP**, select your user to edit. If it has the **User Accessible Interface** option, make sure the **IPMI over Lan** option is selected as shown in Figure 3.

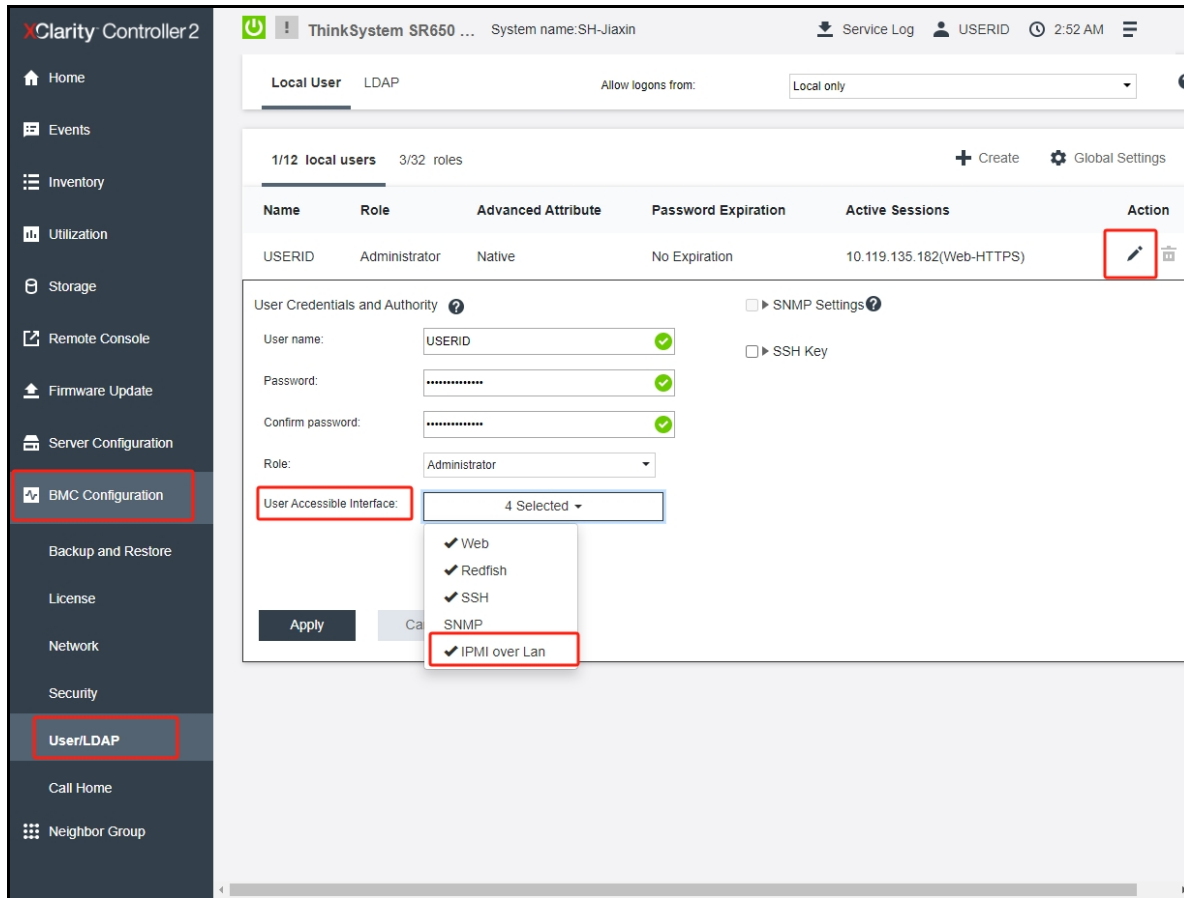


Figure 3. The User Accessible Interface setting of XCC

Configure Serial Port Settings in UEFI

To communicate normally, it is necessary to enable Serial Port Console Redirection and ensure that the parameters of the serial port are correct. You can configure Serial Port Console Redirection in Lenovo UEFI.

Power on the Lenovo ThinkSystem server and then press F1 to enter System Setup.

Select **System Settings** → **Devices and I/O Ports** → **Console Redirection Settings** where you can configure the settings of the server serial port as shown in Figure 4 and set the Console Redirection Settings accordingly.



Figure 4. Server serial port settings in UEFI setting

These are mandatory items to be set for Console Redirection Settings

- **COM Port 1:** [Enabled], to enable COM1 device. On Lenovo ThinkSystem server, SOL is related to Console Redirection via COM 1, so enabled COM1 is essential to using SOL.
- **Console Redirection:** [Auto] or [Enabled], to enable console redirection. When [Auto] is selected, Console Redirection is enabled automatically if IPMI Serial over LAN status is active.
- **Serial Port Sharing:** [Disabled], the serial port is assigned to BMC unless “Serial Port Access Mode” is set to [Disabled].
- **Serial Port Access Mode:** [Disabled]. When Serial Port Access Mode set to disabled, the setting of Serial Port Sharing will not affect the use of SOL. When Serial Port Access Mode is not disabled and Serial Port Sharing is disabled, COM1 will be disabled. This will make SOL no output, so we suggest disabling both Serial Port Sharing and Serial Port Access Mode.
- **COM Port Active After Boot:** [Enabled]
- **COM1 Baud Rate:** [115200]
- **COM1 Data Bits:** [8]
- **COM1 Parity:** [None]
- **COM1 Stop Bits:** [1]
- **COM1 Terminal Emulation:** [VT100]. vSphere supports the VT100 terminal type and the PuTTY terminal emulator to view the direct console over the serial port.

ThinkSystem SR635 and SR655

For ThinkSystem SR635 and SR655, the Console Redirection for Windows Emergency Management Services (EMS) needs to be enabled as shown in Figure 5 and configure the Console Redirection Settings of EMS correctly as shown in Figure 6, to make COM1 work properly. In general, the default mapping between I/O ports and serial ports in OS is COM1→ 0x3F8, COM2→ 0x2F8. However, the I/O port 0x3F8 on ThinkSystem SR635 and SR655 cannot work. If EMS is enabled, UEFI will notify the OS through the SPCR table to set the port of COM1 to 0x2F8, so that COM1 can work normally.

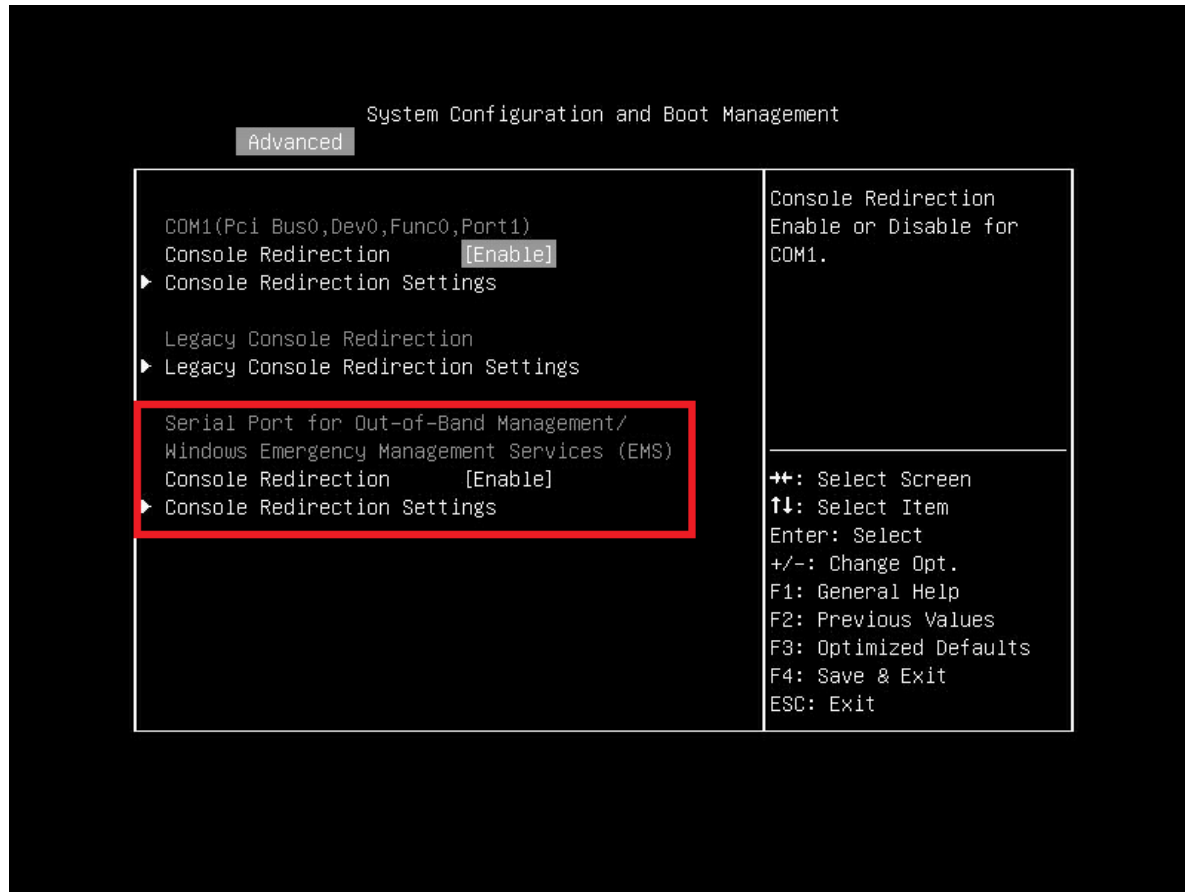


Figure 5. The Windows Emergency Management Services (EMS) settings on SR655

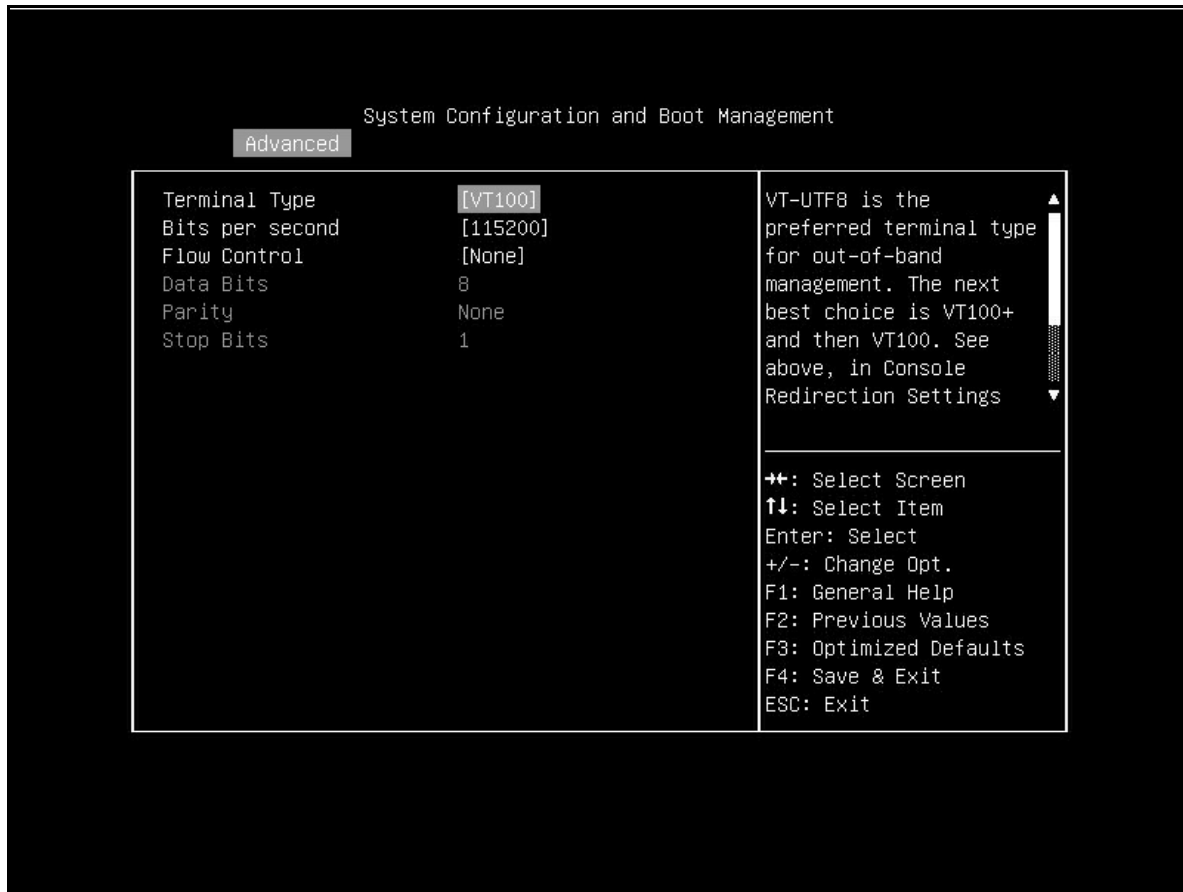


Figure 6. The sub-menu of EMS settings on SR655

Configure console redirection in vSphere

After ensuring that the UEFI settings are configured, we also need to redirect the direct console in vSphere to manage vSphere remotely via SOL. SOL binding with COM 1 on ThinkSystem servers, so we need to redirect the direct console to COM1.

vSphere supports three ways to redirect the direct console to a serial port, as described in the following sections:

- [Redirect the Console by Setting the Boot Options Manually](#)
- [Redirect the console from the ESXi host client](#)
- [Redirect the Console from the vCenter](#)

Redirect the Console by Setting the Boot Options Manually

The following are steps for redirecting the direct console to a serial port by setting the boot options.

1. Start the host.
2. When loading the VMware Hypervisor window appears, you can see the prompt "<SHIFT+O: Edit boot options>" in the bottom right as shown in Figure 7. Press Shift + O to edit boot options.

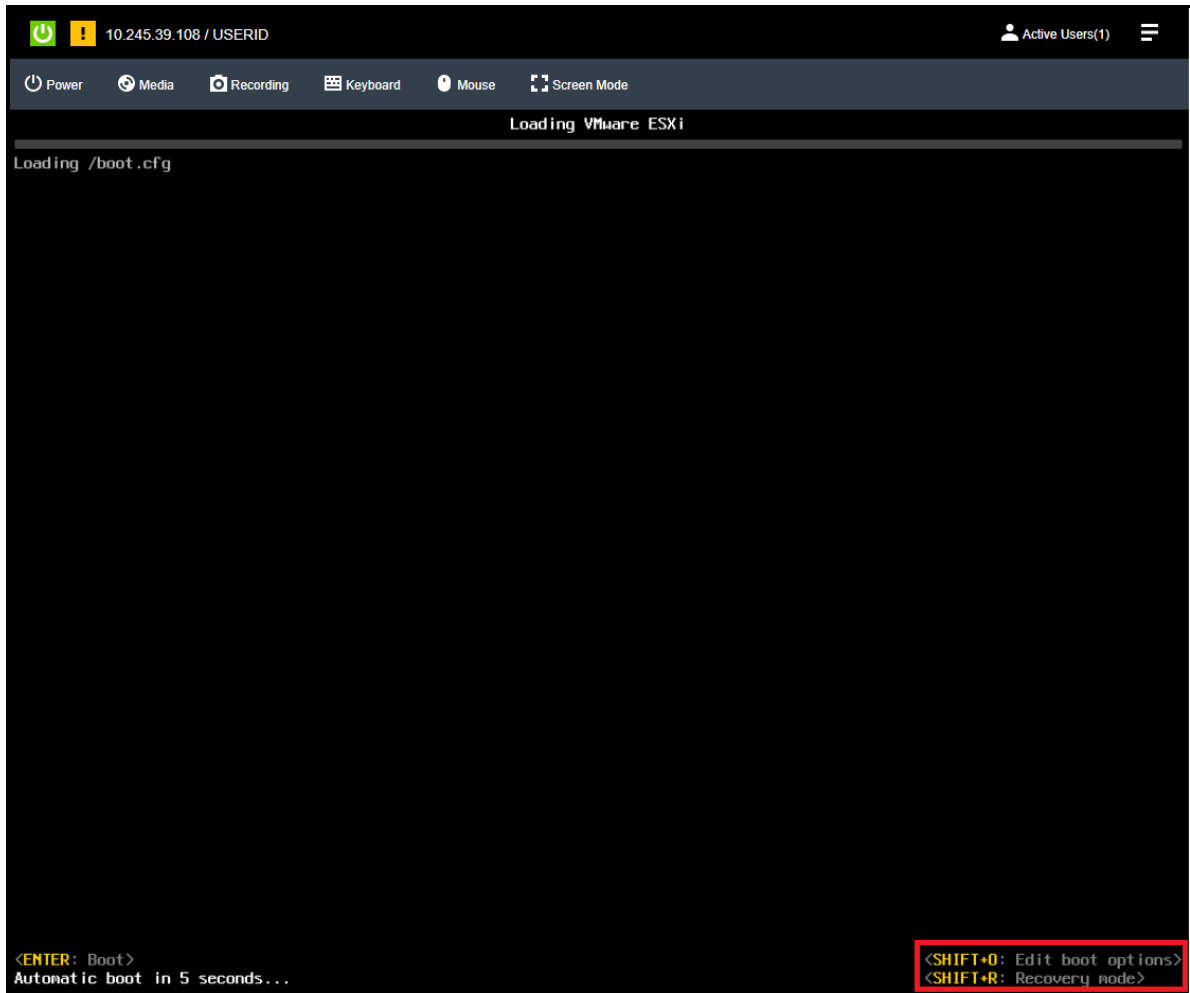


Figure 7. VMware ESXi with the Shift+O message (ESXi 7.0 U3)

3. Deactivate the logPort and gdbPort on com1 and set tty2Port to com1 by entering the following boot options, and add the following options after the original boot options as shown in Figure 8.

```
gdbPort=none logPort=none tty2Port=com1
```

4. After adding these boot options, press the Enter key to boot ESXi with new boot options.



Figure 8. Add boot options in ESXi 7.0 U3

Tip: Redirecting to the serial port by setting the boot options manually only works once at first boot. To redirect the direct console for subsequent boots, please use other methods.

Redirect the console from the ESXi host client

VMware vSphere supports setting the direct console redirection from the ESXi host Client. Different from setting via boot options, when you use the ESXi host Client to redirect the direct console to a serial port, the boot option that you set persists after subsequent reboots.

The following are steps for redirecting the direct console to a serial port from the ESXi host Client.

1. Make sure ESXi boots up, and you can access the host from ESXi Host Client.
2. In the ESXi Host Client, select **Manage** → **System** → **Advanced settings** as shown in Figure 9.

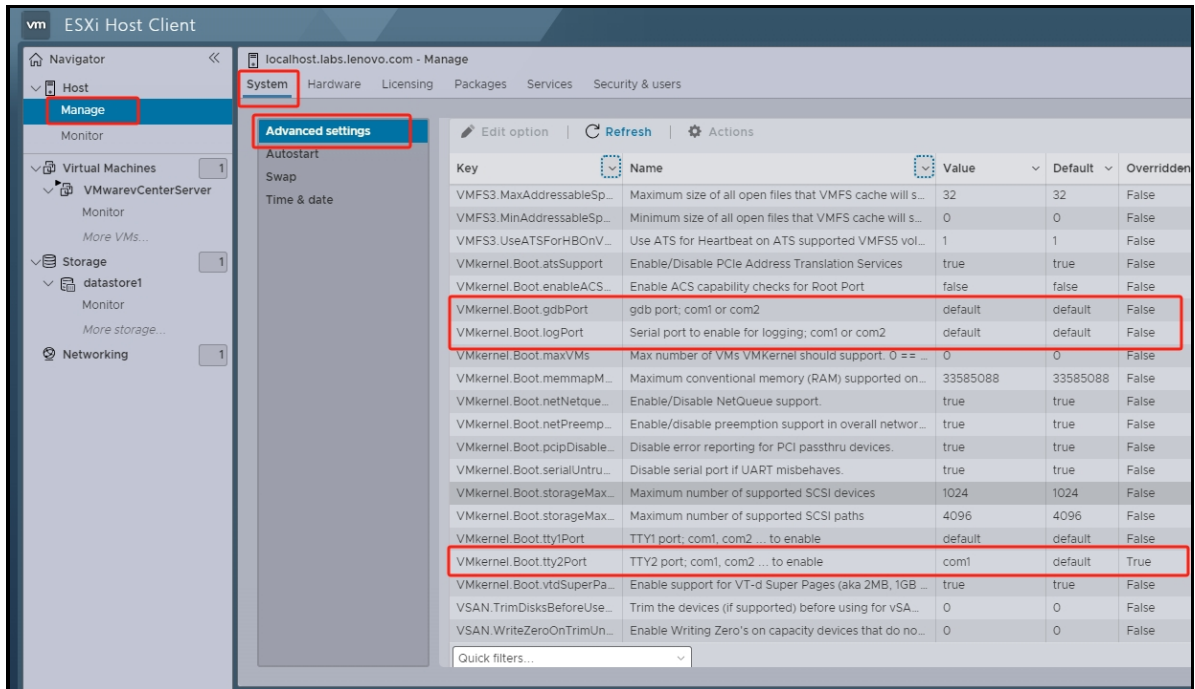


Figure 9. The settings of the direct console redirection in ESXi host client

3. As shown in Figure 9, make sure that the **Boot.logPort** and **VMkernel.Boot.gdbPort** fields are not set to use the com port that you want to redirect the direct console to. Set **VMkernel.Boot.tty2Port** to the serial port to redirect the direct console to: com1.
4. Reboot the host to make the settings to take effect.

Or you can set these settings with ESXi command.

1. Run the following CLI command to set the direct console redirection settings.

```
~# esxcfg-advcfg -k none gdbPort
~# esxcfg-advcfg -k none logPort
~# esxcfg-advcfg -k com1 tty2Port
```

2. Run the command to check the configuration. The output of the command is shown in Figure 10.

```
~# esxcfg-advcfg -j gdbPort
~# esxcfg-advcfg -j logPort
~# esxcfg-advcfg -j tty2Port
```

```
[root@localhost:~] esxcfg-advcfg -k none gdbPort
[root@localhost:~] esxcfg-advcfg -k none logPort
[root@localhost:~] esxcfg-advcfg -k com1 tty2Port
[root@localhost:~] esxcfg-advcfg -j gdbPort
gdbPort = none
[root@localhost:~] esxcfg-advcfg -j logPort
logPort = none
[root@localhost:~] esxcfg-advcfg -j tty2Port
tty2Port = com1
[root@localhost:~] █
```

Figure 10. Set the direct console redirection with the CLI

Redirect the Console from the vCenter

VMware vSphere supports setting the direct console redirection from the vCenter. When you use the ESXi host Client to redirect the direct console to a serial port, the boot option that you set persists after subsequent reboots just like setting from the ESXi host client does. And you can make that setting part of the host profile that persists when you reprovision the host with Auto Deploy.

The following are steps for redirecting the direct console to a serial port from the vCenter.

1. Make sure you can access the host from the vCenter. Then, from the vSphere Client, connect to the vCenter Server.
2. In the vSphere Client, select **the host in the inventory** → Click the **Configure** tab → select **Advanced System Settings** under **System** as shown in Figure 11.
3. As shown in Figure 11, make sure that the **Boot.logPort** and **VMkernel.Boot.gdbPort** fields are not set to use the com port that you want to redirect the direct console to. Set **VMkernel.Boot.tty2Port** to the serial port to redirect the direct console to: com1.
4. Reboot the host to make the settings to take effect.
5. If you want the settings persist when you reprovision the host with Auto Deploy, save the host profile, and attach the host to the profile.

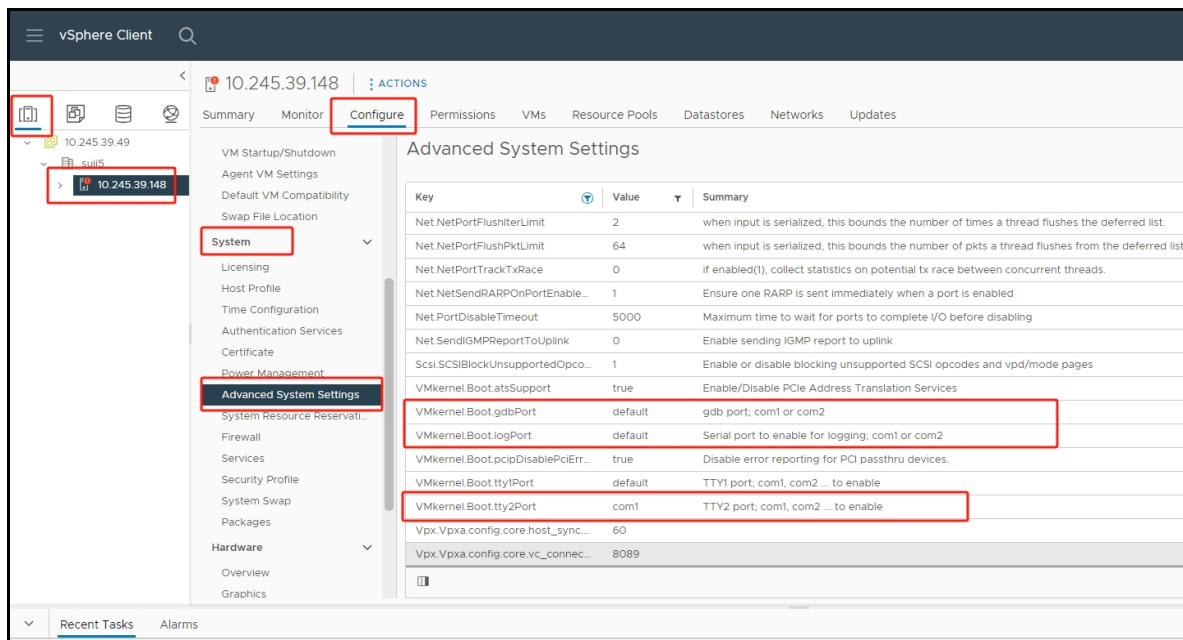


Figure 11. Settings of the direct console redirection in vSphere Client

Use ipmitool Remote Monitor Console

After setting up console redirection in UEFI and redirecting the direct console in ESXi, the direct console of ESXi output to COM1, then redirect information destined for COM1 over to the LAN. You can use ipmitool on your PC to interact with ESXi remotely.

SOL is implemented under IPMI v2.0, which requires ipmitool to support IPMI v2.0. The ipmitool v1.6.0 and later are available, and we recommend ipmitool v1.8.18.

The following are steps for using ipmitool to interact with ESXi remotely:

1. Make sure ipmitool works on your PC and that your PC is on the same local area network as the target server's BMC.
2. In order to connect to SOL use the following IPMI command from an external PC or server:

```
ipmitool -C 17 -I lanplus -H <IP address of BMC > -U ADMIN -P ADMIN sol activate
```

For example:

```
ipmitool -C 17 -I lanplus -H 10.10.10.10 -U ADMIN -P ADMIN sol activate
```

The IPMI SOL commands are listed in the following table:

Table 1. IPMI SOL commands

Function	Command	Description
Get SOL information.	ipmitool sol info ipmitool sol info 1	Get SOL configuration data
Activate SOL	ipmitool -C 17 -I lanplus -U <username> -P <password> -H <ip_address> sol activate Where: <ul style="list-style-type: none"> o -U is BMC username o -H is BMC IP address o -P is BMC password 	Activate SOL access to the ESXi console
Deactivate SOL	ipmitool -C 17 -I lanplus -U <username> -P <password> -H <ip_address> sol deactivate	Deactivate SOL access to the ESXi console

3. Reboot the ESXi then you can see the context of the ESXi direct console in the session as shown in Figure 12.

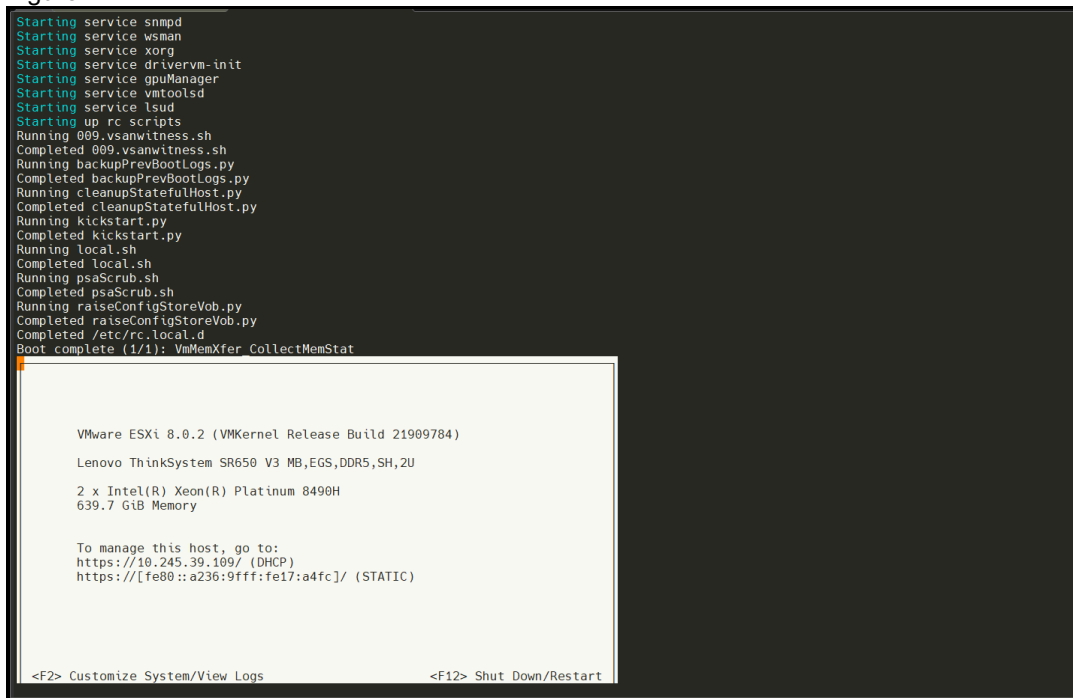


Figure 12. SOL session of ipmitool

Redirect the Guest OS Console to SOL

In addition to the serial port of the ESXi host, vSphere also supports redirecting the serial port of the guest OS to the SOL. ESXi console redirection and guest OS console redirection will conflict when used together, so use one with the other turned off.

The following steps are an example of redirecting the Linux guest OS console to SOL:

1. Power off the virtual machine and then right-click the virtual machine in the inventory and select **Edit Settings** to add a Serial port.
2. On the Virtual Hardware tab, click **Add other device** and select **Serial port** from the drop-down menu, as shown in Figure 13.

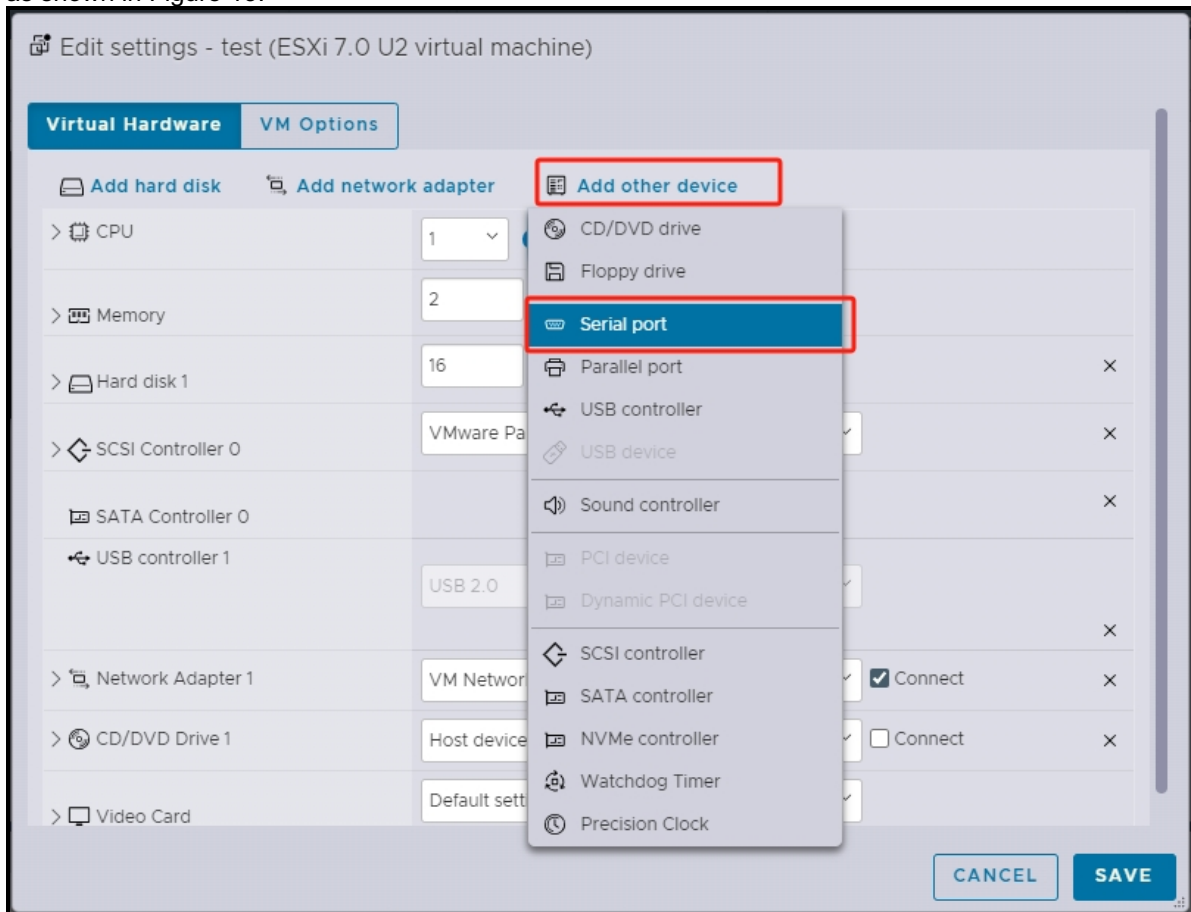


Figure 13. Add Serial port on host web client in ESXi 7.0 U3

3. In the New Serial port text box, select **Use physical serial port** and `/dev/char/serial/uart0`, as shown in Figure 14.

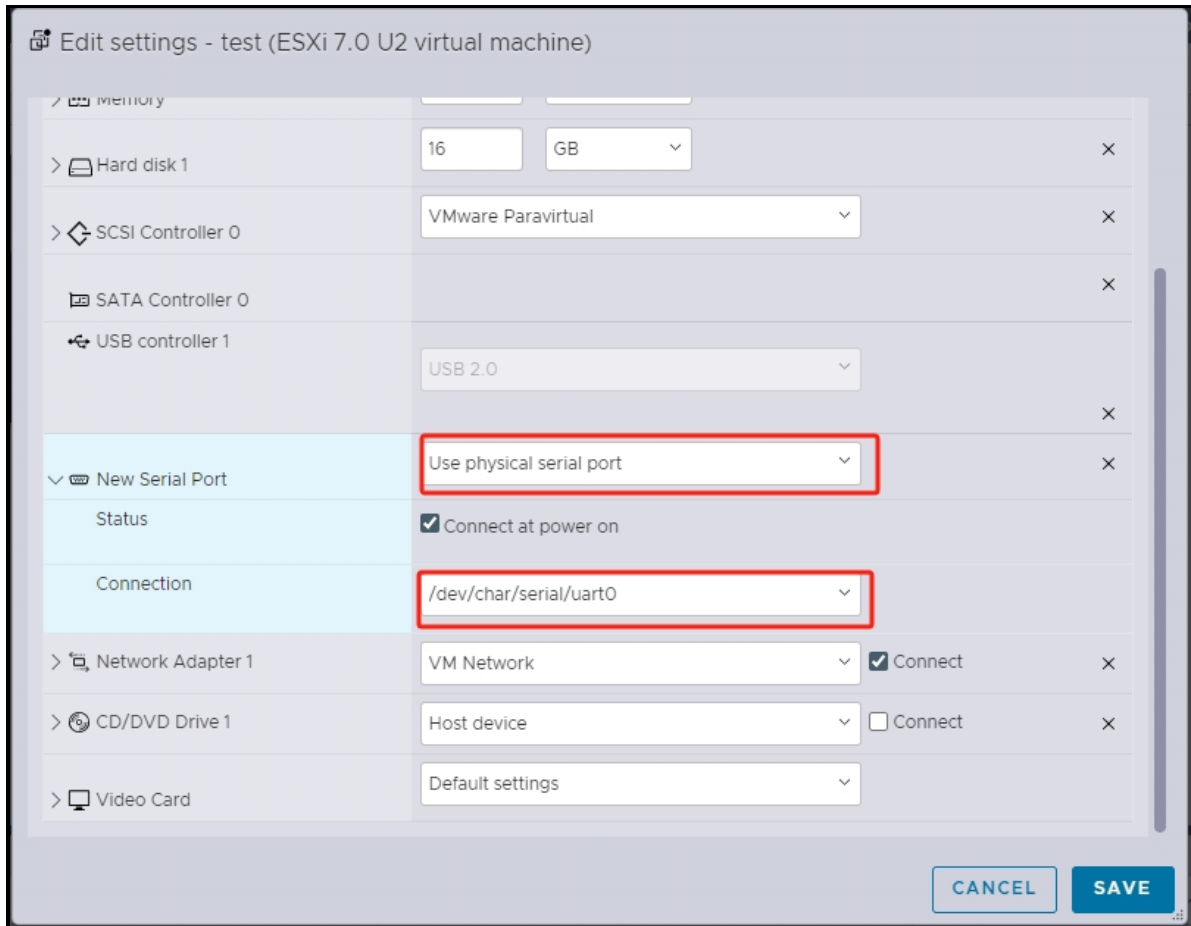


Figure 14. Configure New Serial Port on host web client in ESXi 7.0 U3

4. Power on the virtual machine, and use the following steps to set guest OS console output via serial port. For the Linux OS:

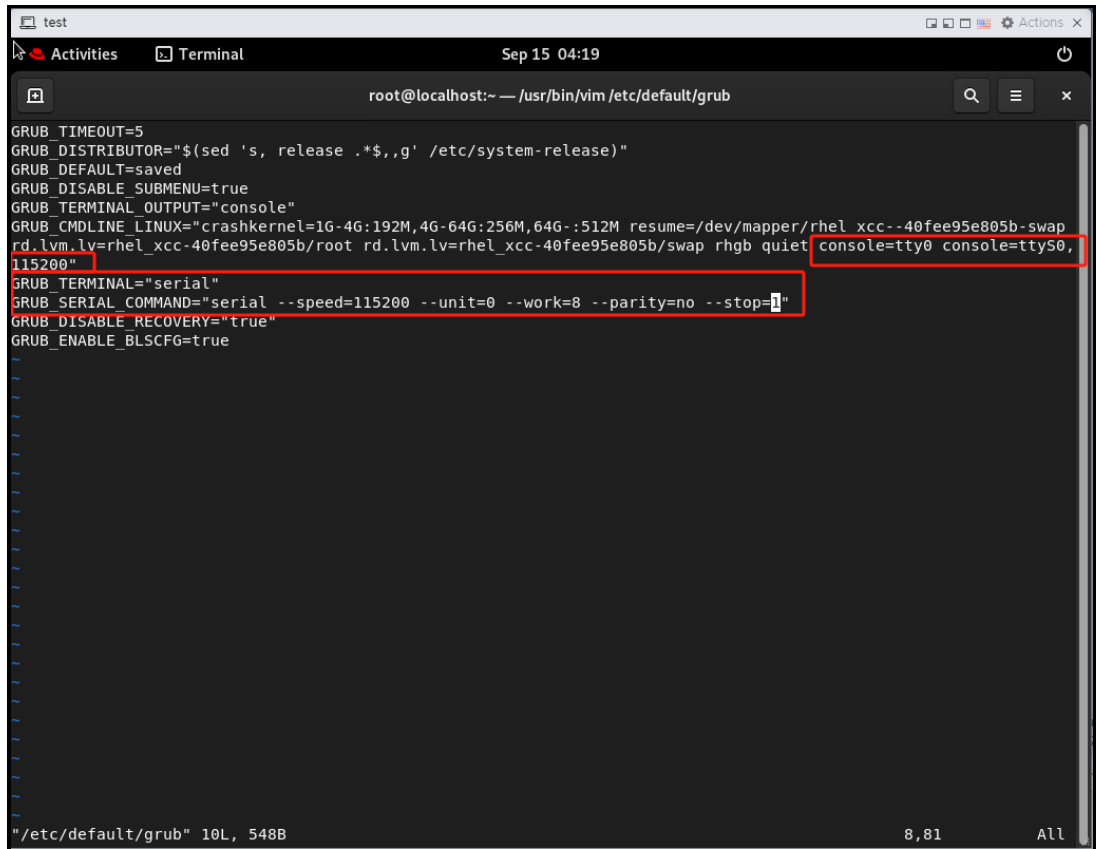
1. Edit the `/etc/default/grub` file as shown in Figure 15.
2. Add `console=tty0 console=ttyS0,115200` to the end of the `GRUB_CMDLINE_LINUX`
3. Add `GRUB_TERMINAL="serial"` to a new line.
4. Add `GRUB_SERIAL_COMMAND="serial --speed=115200 --unit=0 --word=8 --parity=no --stop=1"` to a new line.
5. Enter the following command to generate a grub config file.

UEFI mode:

```
~# grub2-mkconfig -o /boot/efi/EFI/redhat/grub.cfg
```

Legacy mode:

```
# grub2-mkconfig -o /boot/grub2/grub.cfg
```



```
GRUB_TIMEOUT=5
GRUB_DISTRIBUTOR="$(sed 's, release .*,g' /etc/system-release)"
GRUB_DEFAULT=saved
GRUB_DISABLE_SUBMENU=true
GRUB_TERMINAL_OUTPUT="console"
GRUB_CMDLINE_LINUX="crashkernel=1G-4G:192M,4G-64G:256M,64G-:512M resume=/dev/mapper/rhel_xcc--40fee95e805b-swap
rd.lvm.lv=rhel_xcc-40fee95e805b/root rd.lvm.lv=rhel_xcc-40fee95e805b/swap rhgb quiet console=tty0 console=ttyS0,
115200"
GRUB_TERMINAL="serial"
GRUB_SERIAL_COMMAND="serial --speed=115200 --unit=0 --work=8 --parity=no --stop=1"
GRUB_DISABLE_RECOVERY="true"
GRUB_ENABLE_BLSCFG=true
```

Figure 15. Edit /etc/default/grub on RHEL9.0 virtual machine

5. Reboot the virtual machine. When the virtual machine restarts, you can get the context of the virtual machine console via SOL, as shown in Figure 16.

```
Windows PowerShell
[ OK ] Starting OpenSSH server daemon...
[ OK ] Started Virtual Machine an...ontainer Registration Service.
[ OK ] Started Hostname Service...
[ OK ] Started Hostname Service.
[ OK ] Listening on Load/Save RF ...itch Status /dev/rfkill Watch.
[ OK ] Started Enable periodic up... of entitlement certificates..
[ OK ] Started Daemon for power management.
[ OK ] Started OpenSSH server daemon.
[ OK ] Started CUPS Scheduler.
[ OK ] Started GSSAPI Proxy Daemon.
[ OK ] Reached target NFS client services.
[ OK ] Started Authorization Manager.
[ OK ] Started Modem Manager...
[ OK ] Started Power Profiles daemon.
[ OK ] Started Accounts Service.
[ OK ] Started Network Manager Script Dispatcher Service...
[ OK ] Started Network Manager Script Dispatcher Service.
[ OK ] Finished Network Manager Wait Online.
[ OK ] Reached target Network is Online.
[ OK ] Reached target Preparation for Remote File Systems.
[ OK ] Reached target Remote File Systems.
[ OK ] Starting Crash recovery kernel arming...
[ OK ] Starting Performance Metrics Collector Daemon...
[ OK ] Starting /etc/rc.d/rc.local Compatibility...
[ OK ] Starting Notify NFS peers of a restart...
[ OK ] Starting Permit User Sessions...
[ OK ] Starting Virtualization qemu daemon...
[ OK ] Finished Permit User Sessions.
[ OK ] Started Deferred execution scheduler.
[ OK ] Started Command Scheduler.
[ OK ] Started Notify NFS peers of a restart.
[ OK ] Started Disk Manager.
[ OK ] Started Virtualization qemu daemon.
[ OK ] Started Modem Manager.
[ OK ] Created slice User Slice of UID 0.
[ OK ] Starting User Runtime Directory /run/user/0...
[ OK ] Finished User Runtime Directory /run/user/0.
[ OK ] Starting User Manager for UID 0...
[ OK ] Started User Manager for UID 0.
[ OK ] Started Session c1 of User root.
[ OK ] Started Performance Metrics Collector Daemon.
[ OK ] Starting Performance Metrics Inference Engine...
[ OK ] Starting Performance Metrics Archive Logger...
[ OK ] Started Performance Metrics Inference Engine.
[ OK ] Started Half-hourly check of PMIE instances.
[ OK ] Started Daily processing of PMIE logs.
[ OK ] Starting pmie farm service...
[ OK ] Started pmie farm service.
[ OK ] Started Half-hourly check of pmie farm instances.
[ OK ] Started Performance Metrics Archive Logger.
[ OK ] Started Half-hourly check of pmlogger instances.
[ OK ] Started Daily processing of archive logs.
[ OK ] Starting pmlogger farm service...
[ OK ] Started pmlogger farm service.
[ OK ] Started Half-hourly check of pmlogger farm instances.
[ OK ] Reached target Timer Units.
[ OK ] Started /etc/rc.d/rc.local Compatibility.
[ OK ] Starting GNOME Display Manager...
[ OK ] Starting Hold until boot process finishes up...
[ OK ] Started GNOME Display Manager.

Red Hat Enterprise Linux 9.0 (Plow)
Kernel 5.14.0-70.22.1.el9_0.x86_64 on an x86_64

Activate the web console with: systemctl enable --now cockpit.socket

localhost login:
```

Figure 16. Output of RHEL 9.0 console via SOL

References

Review the following web pages for more information:

- ThinkSystem server with AMD EPYC (1-socket, 1st, 2nd, 3rd Gen)
https://pubs.lenovo.com/uefi_amd_1p_1st_2nd_3rd/
- Intelligent Platform Management Interface Specification Second Generation v2.0
<https://www.intel.cn/content/dam/www/public/us/en/documents/product-briefs/ipmi-second-gen-interface-spec-v2-rev1-1.pdf#zoom=100ajor-advance-in-memory-and-storage-architecture>
- VMware vSphere Documentation
<https://docs.vmware.com/en/VMware-vSphere/7.0/com.vmware.esxi.install.doc/GUID-FB5146D3-A732-4523-8716-1B734E0250EE.html>

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- David Watts, Lenovo Press

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