Linux on z Systems

How to Set up a Terminal Server Environment on z/VM

Development stream (Kernel 4.0)

SC34-2596-01

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Note

Before using this document, be sure to read the information in "Notices" on page 69.

This edition applies to the Linux on z Systems Development stream for kernel 4.0, s390-tools version 1.30, and to all subsequent releases and modifications until otherwise indicated in new editions.

Contents

Summary of changes

This edition contains changes related to the 4.0 kernel release (s390-tools 1.30) and to current z/VM® versions.

New information

- With s390-tools 1.9 (kernel 2.6.34) the ttyrun program has been introduced. This program can be used to prevent respawns through the system startup procedures if a terminal is not available. See "Prevention of recurrent respawns for non-operational terminals" on page 3.
- As of kernel 3.14, you can use a generic terminal ID for connecting to a HVC terminal device. See "iucvconn - start terminal connection" on page 49 and "ts-shell: connect - establish a terminal session" on page 54.
- As of s390-tools 1.25 (kernel 3.14), s390-tools includes systemd units for iucvtty and ttyrun. See systemd examples for iucvtty instances and systemd examples for HVC terminal devices.
- As of s390-tools 1.30 (kernel 4.0), you can use a simple wildcard for regulating access to HVC terminal devices. See "Setting an initial z/VM user ID filter" on page 24 and "Creating a z/VM user ID filter file" on page 25.

Changed Information

- None.

This revision also includes maintenance and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Deleted Information

- None.

About this publication

This publication describes how to set up an instance of Linux on z/VM as a terminal server for a virtual Linux server farm on z/VM.

The terminal server uses Inter-User Communications Vehicle (IUCV) communications to access terminals on other instances of Linux on z/VM in the environment. Through the terminal server, you can access terminals on Linux instances that are not connected to an Internet Protocol (IP) network.

As of January 2015, IBM® System z® is re-branded to IBM z Systems™. In this document, *Linux on z Systems* and *Linux on System z* are used synonymously to refer to Linux running on an IBM mainframe, including zSeries in 64- and 31-bit mode.

Unless stated otherwise, all z/VM related information in this document assumes a current z/VM version, see www.ibm.com/vm/techinfo.

You can find the latest version of this document on developerWorks® at www.ibm.com/developerworks/linux/linux390/documentation_dev.html

Audience

This document is intended for Linux administrators and system programmers in charge of a virtual Linux server farm that runs under the z/VM hypervisor.

How this document is organized

There are sections for general concepts, setup sections for different components of a terminal server environment, a command reference, and a section with scenarios.

Chapter 1, “Introduction,” on page 1 provides an overview of the elements of a terminal server environment.

Chapter 2, “Requirements,” on page 5 tells you what you need to set up a terminal server environment.

Chapter 3, “Security,” on page 7 explains the control points you can use to protect your terminal server environment.

Chapter 4, “Setting up a terminal server,” on page 13 gives step-by-step instructions for setup tasks on the terminal server.

Chapter 5, “Setting up the target systems,” on page 21 gives step-by-step instructions for setup tasks on target systems.

Chapter 6, “Working with the terminal server,” on page 31 shows how to establish terminal sessions through the terminal server.

Chapter 7, “Scenarios,” on page 37 illustrates how the different elements of a terminal server environment interact in a particular context.

Appendix A, “Command and program reference,” on page 45 provides a reference for the most important commands used to set up, start, and access terminal devices.

Appendix B, “ts-shell user authorization file syntax,” on page 61 explains the syntax of a configuration file that authorizes Linux users on the terminal server to connect to specific target systems.

Appendix C, “Creating files with lists of z/VM user IDs,” on page 63 describes a convenient method you might want to use to create lists of z/VM user IDs.

Where to get more information

You can find more information about z/VM guest virtual machine definitions, z/VM IUCV, and the z/VM IUCV HVC device driver in other IBM publications.

For information about z/VM guest virtual machine definitions, see *z/VM CP Planning and Administration*, SC24-6178.

For information about z/VM IUCV, see *z/VM CP Planning and Administration*, SC24-6178 and *z/VM CP Programming Services*, SC24-6179.

For information about the z/VM IUCV HVC device driver, see the chapter about console and terminal devices in *Device Drivers, Features, and Commands*, SC33-8411. You can obtain the latest version of this publication on developerWorks at www.ibm.com/developerworks/linux/linux390/documentation_dev.html

See also the man pages for iucvtty, iucvconn, hvc_iucv, chiucvallow, and ts-shell.

Other publications for Linux on z Systems

You can find publications for Linux on z Systems on IBM Knowledge Center and on developerWorks.

These publications are available on IBM Knowledge Center at

ibm.com/support/knowledgecenter/linuxonibm/liaaf/lnz_r_lib.html

- *Device Drivers, Features, and Commands* (distribution-specific editions)
- *Using the Dump Tools* (distribution-specific editions)
- *How to use FC-attached SCSI devices with Linux on z Systems*, SC33-8413
- *libica Programmer's Reference*, SC34-2602
- *Exploiting Enterprise PKCS #11 using openCryptoki*, SC34-2713
- *Secure Key Solution with the Common Cryptographic Architecture Application Programmer's Guide*, SC33-8294
- *Linux on z Systems Troubleshooting*, SC34-2612
- *Linux Health Checker User's Guide*, SC34-2609
- *Kernel Messages*, SC34-2599
- *How to Set up a Terminal Server Environment on z/VM*, SC34-2596

These publications are available on developerWorks at

www.ibm.com/developerworks/linux/linux390/documentation_dev.html

- *Device Drivers, Features, and Commands*, SC33-8411

- *Using the Dump Tools*, SC33-8412
- *How to Improve Performance with PAV*, SC33-8414
- *How to use FC-attached SCSI devices with Linux on z Systems*, SC33-8413
- *How to use Execute-in-Place Technology with Linux on z/VM*, SC34-2594
- *How to Set up a Terminal Server Environment on z/VM*, SC34-2596
- *Kernel Messages*, SC34-2599
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- *Linux Health Checker User's Guide*, SC34-2609

Chapter 1. Introduction

A *terminal server* is a Linux instance that provides access to terminal devices on other Linux instances, called *target systems* in this document.

The terminal server and all target systems run as guests of the same z/VM instance. Terminal server and target systems are connected through the z/VM Inter-User Communication Vehicle (IUCV). From the terminal server, administrators can access terminal devices on target systems without requiring direct TCP/IP connections to the target systems.

| You can use a terminal server to achieve these goals:

- Increase availability by providing emergency access to target systems if the primary network for these systems fails.
- Heighten security by separating user networks from administrator networks or by isolating sensitive Linux instances from IP networks.
- Simplify systems administration by providing a central access point to target systems.

The terminal server environment

A terminal server environment includes a terminal server and multiple target systems.

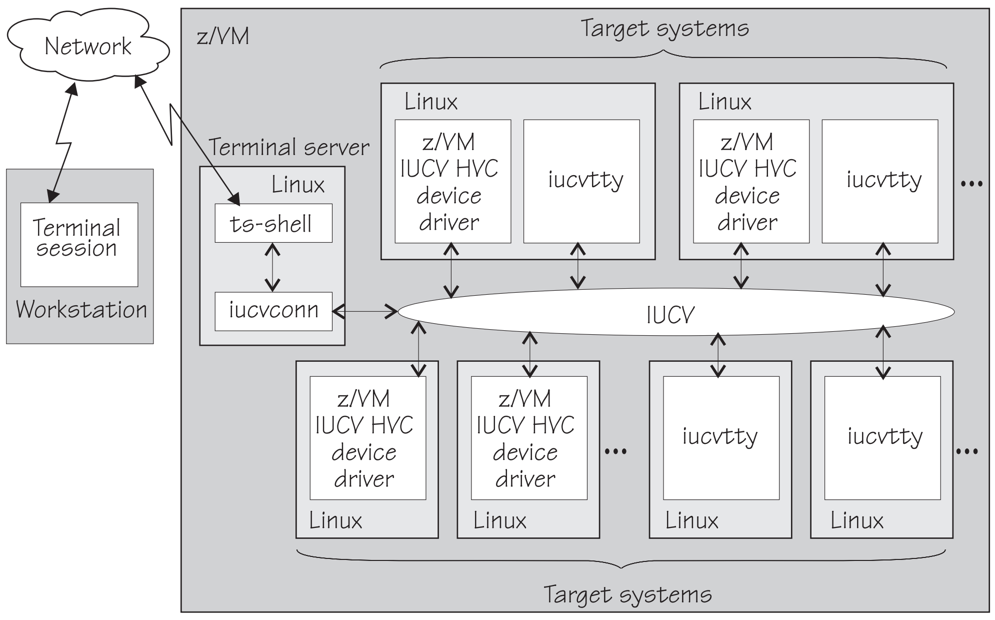


Figure 1. Terminal server environment

To access a terminal device on a target system, administrators first open a terminal session on a workstation. They then log in to a special terminal server shell, the ts-shell, on the terminal server. The terminal shell uses the iucvconn program that can access terminal devices on target systems through z/VM IUCV connections.

Linux on z Systems supports two types of terminal devices that can be accessed through z/VM IUCV.

- Terminal devices that are provided by the iucvtty program.

  For simplicity, these terminal devices are referred to as *iucvtty instances* in this document.
- Terminal devices that are provided by the z/VM IUCV hypervisor console (HVC) device driver.

  For simplicity, these terminal devices are referred to as *HVC terminal devices* in this document.

Both types of devices can be present on the same Linux instance and there can be multiple instances of each type. Each instance of a terminal device is accessed through a separate z/VM IUCV connection.

iucvtty instances

Several iucvtty instances can run to provide multiple terminal devices.

The instances are distinguished by a terminal ID that is set when an iucvtty instance is started.

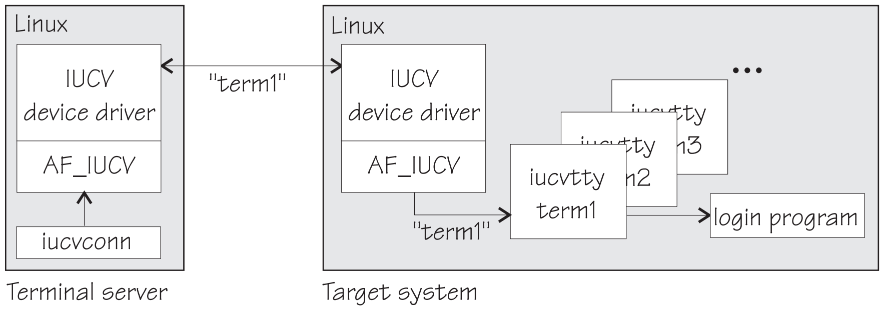


Figure 2. Login through iucvtty instances

Connection requests are created with the iucvconn program on the terminal server. A request includes the z/VM user ID of the target z/VM guest virtual machine and a terminal ID. After successfully connecting to the target system, a communication path is established to the iucvtty instance with the specified terminal ID.

A systemd instance unit, an inittab entry, or an Upstart job file starts the iucvtty instance which, typically, runs a login program.

HVC terminal devices

The z/VM IUCV HVC device driver is a kernel module that uses device nodes to enable HVC terminal devices to communicate with getty and login programs.

There can be up to 8 HVC terminal devices, hvc0 to hvc7. hvc0 can be activated to receive Linux kernel messages. The terminal IDs for HVC terminal devices match the device names with a leading “lnx”. For example, the terminal ID for `hvc0` is `lnxhvc0`.

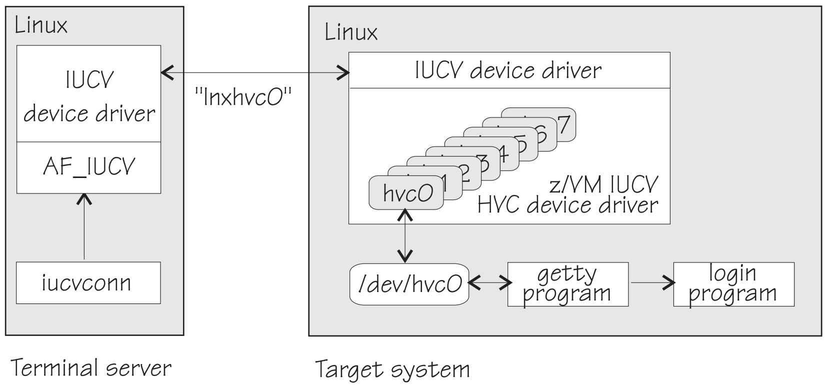


Figure 3. Login through HVC terminal devices

Connection requests are created with the iucvconn program on the terminal server. A request includes the z/VM user ID of the target z/VM guest virtual machine and the terminal ID of an HVC terminal device.

The z/VM IUCV HVC device driver maps the terminal ID to the corresponding terminal device. As of kernel 3.14, `lnxhvc` can be used as a generic terminal ID that maps to any free HVC terminal device.

A systemd instance unit, an inittab entry, or an Upstart job file associates the HVC terminal device with a login program.

The iucvconn_on_login script

You can configure Linux to start the iucvconn_on_login script when a user establishes an SSH session with the terminal server.

The iucvconn_on_login script immediately calls iucvconn and connects the user to a target system. The iucvconn_on_login user cannot access ts-shell or any other shell on the terminal server. After a successful login to the terminal server, the user is redirected to the target system. With a suitable setup of the addressed terminal device on the target system, a login prompt for the target system follows.

For each target system to be reached through iucvconn_on_login, you must create a specific Linux user on the terminal server. The user name of this Linux user must match the z/VM user ID that identifies the target system. The terminal ID on the target system is specified as a parameter when you establish the SSH session to the terminal server.

See "Basic iucvconn_on_login scenario" on page 43 for an example.

Prevention of recurrent respawns for non-operational terminals

As of s390-tools 1.9 (kernel 2.6.34), you can use ttyrun to prevent recurrent respawns.

If you set up user logins on a terminal that is not available or not operational, the system startup procedures might keep respawning the getty program. Failing respawns increase unproductive system and logging activities.

Whether a particular terminal is available can depend:

- On the platform where the Linux instance runs, LPAR or z/VM

- On the `conmode=` and `hvc_iucv=` kernel parameters

You can use ttyrun to provide entries for terminals that might or might not be present. The ttyrun program prevents respawns if the specified terminal is not available or not operational. For example:

- You can freely change kernel parameters that affect the presence of terminals.
- You can use a superset of terminal definitions for multiple Linux instances with different terminal configurations.

See the section about consoles and terminals in *Device Drivers, Features, and Commands*, SC33-8411 for more details about ttyrun, and the `conmode=` and `hvc_iucv=` kernel parameters.

For more information about the ttyrun program, see "ttyrun - start a program if a specified terminal device is available" on page 59.

Chapter 2. Requirements

Specific components are required for terminal servers and for target systems.

Terminal server

Requirements for your terminal server include Perl and, depending on your setup, items from other packages.

For the terminal server you, need a Linux instance with:

- The IUCV device driver and AF_IUCV address family support (as separate modules or compiled into the kernel)
- The iucvconn program (from s390-tools)
- The ts-shell program (from s390-tools)
- Perl (version 5 or later)

Optional additions:

- iucvconn_on_login (from s390-tools)
- scriptreplay (from the util-linux package)
- Command completion (Perl CPAN module `Term::ReadLine::Perl or Term::ReadLine::Gnu`)

If the s390-tools package is not included in your distribution, you can obtain it from www.ibm.com/developerworks/linux/linux390/s390-tools.html. Version 1.30 corresponds to kernel 4.0.

You need s390-tools 1.8.1 and kernel 2.6.29 or later, or a distribution that supports the terminal server function of s390-tools 1.8.1.

If the util-linux package is not included in your distribution, you can obtain it from www.kernel.org/pub/linux/utils/util-linux.

If Perl is not included in your distribution, you can obtain it from www.perl.org.

If the Comprehensive Perl Archive Network (CPAN) modules are not provided with your Perl installation with your distribution, you can obtain them from www.cpan.org.

Target systems

Requirements for your target systems depend on the setup and might include specific Linux kernel modules and s390-tools components.

As a minimum requirement, you need s390-tools 1.8.1 and kernel 2.6.29 or later, or a distribution that supports the terminal server function of s390-tools 1.8.1. The following table shows which features you can use for different kernel levels.

Table 1. Terminal server functions by kernel level

Function	**Component**	**Required kernel and s390-tools level**
Base functions	• The IUCV device driver (as a separate module or compiled into the kernel) • To support iucvtty instances – The AF_IUCV address family support (as a separate module or compiled into the kernel) – The iucvtty program (from s390-tools) • To support HVC terminal devices – The z/VM IUCV HVC device driver (compiled into the kernel) – The chiucvallow program (from s390-tools)	2.6.29 / 1.8.1
Respawn prevention for unavailable terminals	The ttyrun program (from s390-tools)	2.6.34 / 1.9
Automatic selection of free HVC terminal devices	z/VM IUCV HVC device driver	3.14 / 1.25
Wildcard for z/VM user ID filter for HVC terminal devices	• z/VM IUCV HVC device driver • The iucvallow program (from s390-tools)	4.0 / 1.30

If the s390-tools package is not included in your distribution, you can obtain it from www.ibm.com/developerworks/linux/linux390/s390-tools.html. Version 1.30 corresponds to kernel 4.0.

Chapter 3. Security

In addition to Linux authentication and authorization, you can use z/VM IUCV authorizations, and restrictions on your terminal server and target systems to protect your environment.

Access to Linux is typically controlled by an authentication program, for example, a login program. In a terminal server setup, you can also use additional security mechanisms:

- z/VM IUCV authorizations to control which IUCV connections are possible
- Restrictions on the terminal server to only allow connections to specific target systems
- Restrictions for the terminal devices on the target systems to only allow access from specific z/VM guest virtual machines

How you set up security depends on the specific needs of your installation. This section describes the available control points. Chapter 7, "Scenarios," on page 37 illustrates how you can combine the various possibilities into a working environment.

IUCV permissions on z/VM

You configure the IUCV connection between the terminal server and the target systems through IUCV statements in the z/VM user directory.

An IUCV statement for one of the communication peers is sufficient to permit a particular connection. Depending on your needs, you can use different strategies.

General permission to connect to a specific target system

Use the `IUCV ALLOW` statement if you want to permit any z/VM guest virtual machine to access a target system.

The following statement in the user entry for a target system permits any other z/VM guest virtual machine to establish an IUCV connection to this particular target system:

```
IUCV ALLOW
```

This permission also applies to z/VM guest virtual machines without IUCV statements in their own z/VM directory entry. Omit this statement from the z/VM directory entry of your target systems unless you want to grant a general permission to all other z/VM guest virtual machines.

Specific permissions for connections from a terminal server

Use IUCV statements to individually specify each target system to which the terminal server can establish an IUCV connection.

Through IUCV statements in the z/VM directory entry of the terminal server, you can explicitly specify the target systems to which the terminal server can establish an IUCV connection.

Example: These statements allow connections to the z/VM guest virtual machines with the z/VM user IDs LXGUEST1, LXGUEST2, LXGUEST7, and LXGUEST9.

```
IUCV LXGUEST1
IUCV LXGUEST2
IUCV LXGUEST7
IUCV LXGUEST9
```

With such explicit statements, you can avoid granting permissions for IUCV connections that are not required or not intended.

General permission for IUCV connections from a terminal server

Use the `IUCV ANY` statement if you want to permit the terminal server to connect to any target system.

You might consider the z/VM guest virtual machine of your terminal server as a trusted system. If so, you can permit it to connect to all other z/VM guest virtual machines on the z/VM instance.

Use this statement in the z/VM user directory entry for the z/VM guest virtual machine of the terminal server:

```
IUCV ANY
```

With this statement, a user on the terminal server can connect to all z/VM guest virtual machines on the same z/VM instance, including all target systems.

This general permission for the terminal server relieves you from updating the z/VM directory each time a new target system is added. The disadvantage is that general users on the terminal server can establish IUCV connections to all other z/VM guest virtual machines, not just target systems.

These concerns are addressed by a special shell that limits user actions on the terminal server, see “ts-shell” on page 9.

Security on the terminal server

In addition to general security measures for your terminal server, there are specific programs to limit user actions on the terminal server.

Both the ts-shell program and the iucvconn_on_login script limit user actions to connecting to target systems.

Access to the terminal server

You can make a terminals server more secure by minimizing physical and remote access and by hardening the Linux instance.

Workload and users
: It is good practice to use a dedicated system as the terminal server with no unnecessary users defined.

Physical access
: Physical access to mainframe systems is tightly restricted in most installations. You can also use physical access restrictions to protect your terminal server. Consider configuring a private network for connections to the terminal server with access only from workstations within a controlled physical area.

Hardening Linux

It is good practice to limit access to the Linux instance to what is required. Do not install or load any modules that you do not need and switch off all daemons and processes that you do not need. To find out which processes are accessible at network sockets enter:

```
[root]# netstat -lptu
```

Firewall
Consider protecting your terminal server through a firewall.

Linux Security Modules
Consider strengthening security through a Linux security module like SELinux or AppArmor.

ts-shell

You can set up the terminal server such that particular users always log in to ts-shell, which limits what the user can do.

The only functions available on ts-shell are commands that directly relate to establishing connections to target systems. Other functions on the terminal server are fenced from ts-shell users.

ts-shell can be configured to permit connections to only specific target systems, for ts-shell itself and for individual users.

The iucvconn_on_login script

You can set up the terminal server such that particular users always log in to the iucvconn_on_login script.

An iucvconn_on_login user logs in to Linux on the terminal server with a user ID that matches the z/VM user ID of a target system. After a successful login to the terminal server, the user is immediately prompted to log in to the target system. No action is possible on the terminal server.

Auditing

You can set up ts-shell to create transcripts of terminal sessions with target systems and store the transcripts on the terminal server.

The iucvconn_on_login script as included in the s390-tools package does not create session transcripts. If needed, you can modify the script to create session transcripts.

Logging

The **iucvconn** command logs all connection requests to syslog.

The ts-shell program and the iucvconn_on_login script both use the **iucvconn** command to connect to target systems.

Security on the target system

You can limit access to terminals on the target systems, control root logins, and log logon activities.

Limiting access to terminal devices

You can configure which z/VM guest virtual machines can connect to your terminal devices. You can specify a separate set of permitted z/VM guest virtual machines for each iucvtty instance. You can specify one more set of permitted z/VM guest virtual machines that applies to all HVC terminal devices on the target system.

Controlling root logins

Whether direct root logins are permitted on terminal devices depends on the login program.

For example, the default login program for iucvtty instances and HVC terminal devices, `/bin/login`, restricts root logins. With `/bin/login`, root logins are allowed only on devices for which a device node is listed in `/etc/securetty`.

To enable direct root logins on HVC terminal devices that use `/bin/login`, you can add the respective device nodes to `/etc/securetty`.

Because iucvtty instances use pseudo terminal devices with dynamically assigned device nodes, enabling root logins on iucvtty instances that use `/bin/login` constitutes a potential security exposure. If you need root access through an iucvtty instance, log in as a general user and then change to root, for example, with the **`su`** command.

For security risks associated with other login programs, see the documentation for the login program.

| Depending on the Linux setup, `pam_securetty` might further restrict root logins on
| particular terminal devices.

Logging

All requests to access an iucvtty instance are logged to syslog.

All refused attempts to access an iucvtty instance or an HVC terminal device are logged to syslog.

Security summary

The security barriers that a user must negotiate in a terminal server environment include barriers on the terminal server, the z/VM system, and the target system.

Figure 4 on page 11 provides an overview.

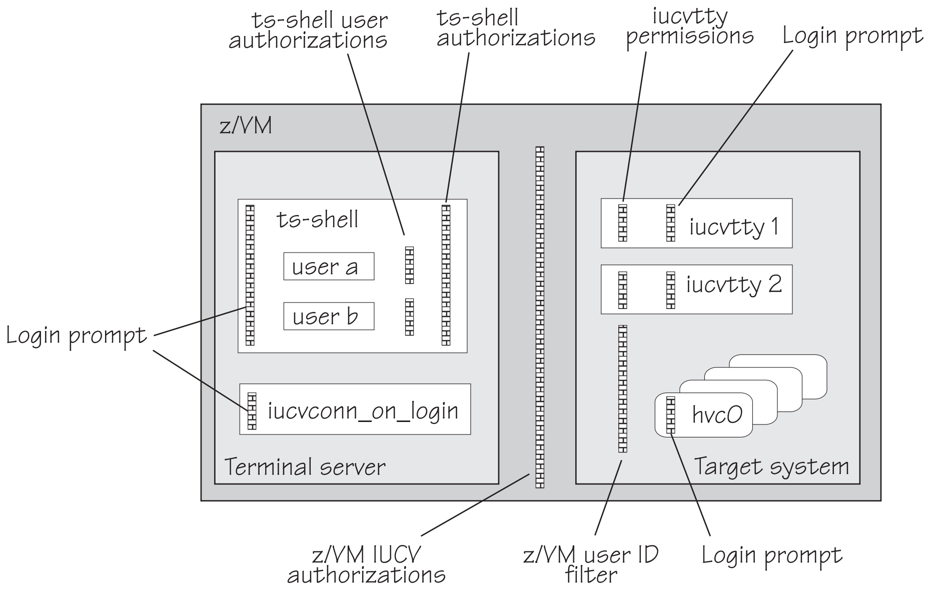


Figure 4. Security barriers in a terminal server environment - overview

For example, a ts-shell user first must log in to the terminal server and pass an SSH authentication. A connection request to an iucvtty instance is granted only if all the following apply:

- The user is authorized to connect to the target system.
- ts-shell is authorized to connect to the target system.
- The z/VM IUCV authorizations of the terminal server and the target system allow the IUCV connection between the two z/VM guest virtual machines.
- The iucvtty instance permits connections from the terminal server.

After the connection is established, the user is prompted to log in and authenticate at the target system.

For connecting to an HVC terminal device, the only difference is that there are no individual permissions. All HVC terminal devices use the same z/VM user ID filter to accept or reject a connection request.

For iucvconn_on_login users, the only security check on the terminal server is the authentication when a user logs in. The IUCV authorization and the checks on the target system are the same as for ts-shell users.

Chapter 4. Setting up a terminal server

You must set up a z/VM guest virtual machine and various terminal server components on your Linux instance.

z/VM guest virtual machine setup for a terminal server

There are some minimum requirements that the z/VM guest virtual machine for the terminal server must meet.

The z/VM guest virtual machine for the terminal server has these requirements:

- Sufficient storage (memory) for your Linux distribution.
- A network connection.
- Optional: Persistent disk space for session transcripts.

Figure 5 shows a typical directory entry for the z/VM virtual machine of a terminal server.

```
USER LXTS     XSECRETX 768M 1G G
* General statements
   IPL 0150
   CPU 00 BASE
   CPU 01
   MACH ESA 8
* IUCV authorization
   IUCV ANY
   OPTION MAXCONN 128
* Generic device statements
   CONSOLE 0009 3215 T
   SPOOL 000C 2540 READER *
   SPOOL 000D 2540 PUNCH A
   SPOOL 000E 1403 A
* Network connection
   NICDEF 7000 TYPE QDIO LAN SYSTEM VSWITCH1
* MiniDisks for Linux system and CMS A-disk
   MDISK 0150 3390 0001 3318 LXDASD1 MR
   MDISK 0151 3390 0001 1000 LXDASD2 MR
   MDISK 0191 3390 3000 0032 MDDASD  MR
```

Figure 5. Sample directory entry for a terminal server

The statements in this sample have the following meaning:

USER
: defines a z/VM user ID (LXTS) with an initial password (XSECRETX). It also assigns 768 MB storage (memory) that, if required, can be expanded to 1 GB, and grants general user privileges (G).

IPL
: specifies the boot device for Linux.

CPU
: defines one or more virtual CPUs.

`MACH ESA 8`
: specifies the machine architecture and the maximum number of CPUs that can be defined.

`IUCV`
: allows the z/VM guest virtual machine to start an IUCV connection to any other z/VM guest virtual machine. See "IUCV permissions on z/VM" on page 7 for alternatives.

  For more information about z/VM IUCV, see *z/VM CP Programming Services*, SC24-6179 and *z/VM CP Planning and Administration*, SC24-6178.

`OPTION MAXCONN 128`
: limits the number of concurrent IUCV connections to 128. If omitted, the limit defaults to 64, the maximum value for MAXCONN is 65,535.

`CONSOLE`
: defines the z/VM console device.

`SPOOL`
: defines the z/VM spool file queues.

`NICDEF`
: defines a virtual network device that is to be connected to a virtual switch. The network device that you use depends on your installation. For example, you can also use appropriate statements to specify HiperSockets™ or Open System Adapter (OSA) devices. See *z/VM Connectivity*, SC24-6174 for more information.

`MDISK`
: Assigns read/write disk space for Linux and other data. The amount of disk space you require depends chiefly on the extent to which you want to create session transcripts.

For more information about z/VM user directory entries, see the chapter about the z/VM user directory in *z/VM CP Planning and Administration*, SC24-6178.

Setup of the s390-tools package

For the Linux instance of the terminal server, you need several components from the s390-tools package.

If the s390-tools package is not included in your distribution, you can obtain it from www.ibm.com/developerworks/linux/linux390/s390-tools.html. Version 1.30 corresponds to kernel 4.0.

Installing the s390-tools package:
- Creates a directory `/etc/iucvterm` with configuration files for ts-shell
- Installs the iucvconn program
- Installs ts-shell
- Makes a copy of the iucvconn_on_login script available to you

If you install the s390-tools package as an RPM, the installation process might also:
- Make ts-shell an eligible login shell by adding it to `/etc/shells`
- Create a user group `ts-shell`
- Make the configuration files in `/etc/iucvterm` writable for user root and readable for the `ts-shell` user group

- Create a directory `/var/log/ts-shell` for session transcripts
- Make `/var/log/ts-shell` writable for the `ts-shell` user group and for user root

Setting up ts-shell

The ts-shell program observes general and user-specific authorizations for connecting to target systems.

You can create session transcripts for sessions that are established with ts-shell.

Making ts-shell an eligible login shell

To make ts-shell an eligible login shell, you must add it to `/etc/shells`.

Before you begin

If you install the s390-tools package as an RPM, the installation process might perform this task for you.

Procedure

To make ts-shell an eligible login shell add it to `/etc/shells`. For example, issue the following command:

```
[root]# echo "/usr/bin/ts-shell" >> /etc/shells
```

Creating a user group

You must set the permissions for the ts-shell configuration files.

Before you begin

If you install the s390-tools package as an RPM, the installation process might perform this task for you.

Procedure

1. Create a user group for all ts-shell users.

   ```
   [root]# groupadd -r ts-shell
   ```

2. Make `ts-shell` the group for the configuration files.

   ```
   [root]# chgrp -R ts-shell /etc/iucvterm
   ```

3. Set the access permissions for the directory with the configuration files.

   ```
   [root]# chmod 0750 /etc/iucvterm
   ```

   This command makes the `/etc/iucvterm` directory writable for user root and readable for the `ts-shell` user group.

Restricting target system connections for ts-shell

By default, ts-shell is permitted to connect to all target systems.

Before you begin

Skip this task if you do not want to restrict ts-shell permissions to specific target systems.

Procedure

1. Use your preferred editor to open `/etc/iucvterm/ts-shell.conf`.
2. Find this line:

   ```
   ts-systems = /etc/iucvterm/unrestricted.conf
   ```

   Change the line to:

   ```
   ts-systems = /etc/iucvterm/ts-systems.conf
   ```
3. Use your preferred editor to open `/etc/iucvterm/ts-systems.conf`.
4. List the z/VM user IDs, each on a separate line, of all target systems to which you want to permit connections.

   Example: A file to permit connections to LXGUEST1, LXGUEST3, LXGUEST5, LXGUEST7, and LXGUEST9 might read:

   ```
   LXGUEST1
   LXGUEST3
   LXGUEST5
   LXGUEST7
   LXGUEST9
   ```

   Tips:
   - Lists of z/VM user IDs can be extensive. If you have access to the z/VM user directory, see Appendix C, "Creating files with lists of z/VM user IDs," on page 63 for a convenient method of obtaining a list.
   - You can permit connections to any target system by keeping the default configuration file `unrestricted.conf` or with a single entry, `[*ALL*]` in `ts-systems.conf`.
5. Save and close the configuration file.

Creating a user for ts-shell

You must create one or more users for ts-shell.

Procedure

1. Create a user with ts-shell as the login shell and user group ts-shell.

   Example:

   ```
   [root]# useradd -s /usr/bin/ts-shell -G ts-shell alice
   ```

   Note: Ensure that the new user does not acquire any unintended authorizations from being added to default user groups. Adding the new user to the `ts-shell` group does not affect membership of such groups.

   You can change an existing user ID to use ts-shell as the login shell and add the user to the ts-shell group by issuing a command of this form:

   ```
   [root]# usermod -a /usr/bin/ts-shell -G ts-shell <id>
   ```

   where *<id>* is the existing ID.

2. Optional: You might want to add the user to additional user groups to manage access to target systems (see Appendix B, “ts-shell user authorization file syntax,” on page 61).
3. Set an initial password for the new user and force the new user to change the password at the initial login.

   Example:

   ```
   [root]# passwd alice
   ...
   [root]# chage alice
   ```

Granting authorizations to ts-shell users

You can authorize each ts-shell user to connect to specific target systems.

About this task

A user can connect to a target system for which both the user and ts-shell itself is authorized (see “Restricting target system connections for ts-shell” on page 15).

Procedure

Perform the following steps to specify the target systems to which specific ts-shell users are authorized to connect:

1. With your preferred editor, open `/etc/iucvterm/ts-authorization.conf`.
2. Specify the authorization statements for your users and user groups (see Appendix B, “ts-shell user authorization file syntax,” on page 61).

   Tip: The s390-tools package includes a sample user authorization file. The location is similar to `/usr/share/doc/packages/s390-tools-<`*version*`>/ts-shell/authorization-sample.conf`. The value of <*version*> and whether `/packages` is present or absent in the path depend on your distribution.
3. Save and close the configuration file.

Configuring session transcripts for ts-shell

You can configure session transcripts for specific target systems.

Before you begin

- Skip this task if you do not want to create session transcripts.
- If you install the s390-tools package as an RPM, the installation process might set up the `/var/log/ts-shell` directory for you.

Procedure

Perform the following steps to configure session transcripts:

1. Create a directory, `/var/log/ts-shell`, for the session transcripts.

   ```
   [root]# mkdir /var/log/ts-shell
   ```

2. Change the group for the new directory to the `ts-shell` group:

   ```
   [root]# chown root:ts-shell /var/log/ts-shell
   ```

3. Set the access permissions for the directory, and future subdirectories, to which the session transcripts are written:

```
[root]# chmod 2770  /var/log/ts-shell
```

4. With your preferred editor, open `/etc/iucvterm/ts-audit-systems.conf`.
5. List the z/VM user IDs, each on a separate line, of all target systems for which session transcripts are to be created. The list entries are interpreted as uppercase and, therefore, not case-sensitive.

   Example: A file that configures session transcripts for the target systems LXGUEST0 through LXGUEST4 might read:

   ```
   lxguest0
   lxguest1
   lxguest2
   lxguest3
   lxguest4
   ```

   Tips:
   - Lists of z/VM user IDs can be extensive. If you have access to the z/VM user directory, see Appendix C, "Creating files with lists of z/VM user IDs," on page 63 for a convenient method of obtaining a list.
   - You can configure session transcripts for all target system with a single entry, `[*ALL*]`.
6. Save and close the configuration file.

What to do next

Ensure that there is always sufficient disk space for new transcripts. For example, use a cron job to monitor the available disk space and purge obsolete transcripts at regular intervals according to your audit policies. If disk space runs out, no further transcripts are written.

Installing scriptreplay

You need scriptreplay if you want to replay terminal sessions from session transcripts.

About this task

The scriptreplay utility is included in the util-linux package.

Procedure

To find out whether scriptreplay is already installed on your Linux instance enter:

```
[root]# which scriptreplay
```

If scriptreplay is not included in your Linux distribution, you can obtain it from www.kernel.org/pub/linux/utils/util-linux.

Setting up iucvconn_on_login

The iucvconn_on_login script connects each user to one specific target system. You can set up the iucvconn_on_login script as an alternative to or in addition to ts-shell.

Setting up the script

To set up the iucvconn_on_login script you must copy it to a suitable directory, make it executable, and add it to `/etc/shells`.

Procedure

1. Copy the script from the s390-tools package documentation to `/usr/bin`. The path depends on your distribution and might or might not include a packages directory or version information for the s390-tools package. For example, enter:

```
[root]# cp /usr/share/doc/packages/s390-tools-1.9.0/ts-shell/iucvconn_on_login /usr/bin
```

2. Make the script executable.

```
[root]# chmod +x /usr/bin/iucvconn_on_login
```

3. Add the script to `/etc/shells`.

```
[root]# echo "/usr/bin/iucvconn_on_login" >> /etc/shells
```

Creating a user for iucvconn_on_login

You must create users for iucvconn_on_login.

About this task

Each target system to which you want to connect with iucvconn_on_login requires a separate Linux user on the terminal server. The user ID must match the z/VM user ID of the target system.

Procedure

1. Create a user with iucvconn_on_login as the login shell. For example, to add a user for accessing a terminal device on `lxguest1`, enter:

```
[root]# useradd -s /usr/bin/iucvconn_on_login lxguest1
```

2. Set an initial password for the new user and force the new user to change the password at the initial login.

Example:

```
[root]# passwd lxguest1
...
[root]# chage lxguest1
```

Results

You might be using an external security manager for your z/VM system, for example, Resource Access Control Facility (RACF®). If so, you can set up Linux to use the external security manager for authentication. See *Security on z/VM*, SG24-7471 for more information.

Modifying iucvconn_on_login for session transcripts

By default, no session transcripts are created for sessions that are established with the iucvconn_on_login script.

About this task

If you require session transcripts, modify the iucvconn_on_login script. See "iucvconn - start terminal connection" on page 49 for the required **`iucvconn`** options.

The iucvconn_on_login user must have write access to the directory to which session logs are written.

Chapter 5. Setting up the target systems

Perform the setup tasks for each target system.

About this task

A typical approach for handling numerous target systems is to first configure a few systems that serve as templates. Cloning and other techniques for propagating configuration actions from templates to target systems are not covered in this document.

The descriptions in the following sections describe how to configure a target system through an SSH session. It is assumed that a TCP/IP connection is available when the target system is configured. After the configuration is completed, the target system can be accessed without an active TCP/IP connection.

z/VM guest virtual machine setup for a target system

Unless you use IUCV authorizations for the terminal server, you must add the `IUCV ALLOW` statement to the z/VM directory entry for your target system.

Note: The `IUCV ALLOW` statement allows all z/VM guest virtual machines in the same z/VM instance to establish an IUCV connection to your target system.

If the necessary permissions for allowing an IUCV connection are in place for the terminal server, no additional statements are required for the target system (see "z/VM guest virtual machine setup for a terminal server" on page 13).

Other specifications for the z/VM guest virtual machine entirely depend on the Linux instance and the applications that run on it.

Setting up iucvtty instances

Set up one or more iucvtty instances, as required.

Installing iucvtty

The iucvtty program is part of the s390-tools package.

If the s390-tools package is not included in your distribution, you can obtain it from www.ibm.com/developerworks/linux/linux390/s390-tools.html. The ttyrun program is included as of version 1.9.0.

Enabling user logins

| Depending on your distribution, you need a systemd instance unit, an Upstart job
| file, or an entry in `/etc/inittab` to facilitate user logins.

About this task

A full discussion of systemd instance units, inittab entries, or Upstart job files for starting login programs is beyond the scope of this publication. You can use the examples that follow as a starting point. For more information, see the systemd, events, init, or inittab man pages.

For the syntax of the iucvtty program, see "iucvtty - allow remote logins over z/VM IUCV" on page 51.

systemd examples for logins

On distributions that use systemd, you can set up login programs for iucvtty instances through a systemd instance unit.

For corresponding inittab or Upstart examples, see "inittab examples for logins" or "Upstart examples for logins."

To enable a login on an iucvtty instance with terminal ID `lxterm1`, issue:

```
# systemctl enable iucvtty-login@lxterm1.service
```

At the next system start, systemd starts the iucvtty service for `lxterm1`.

To start the service without a system restart, issue:

```
# systemctl start iucvtty-login@lxterm1.service
```

Note: How to set up systemd instance can vary by distribution. See the *Device Drivers, Features, and Commands* that is specific to your distribution. You can find different version of this publication at ibm.com/support/knowledgecenter/linuxonibm/liaaf/lnz_r_dd.html.

inittab examples for logins

On distributions that use inittab, you can specify terminal IDs and login programs through inittab entries.

For corresponding systemd or Upstart examples, see "systemd examples for logins" or "Upstart examples for logins."

Each inittab entry starts with an identifier that is unique within inittab. For more information, see the man page for the inittab file.

- This inittab entry enables user logins on the iucvtty instance with terminal ID `lxterm1` with `/bin/login`.
  ```
  i1:2345:respawn:/usr/bin/iucvtty lxterm1
  ```
- This inittab entry enables user logins on the iucvtty instance with terminal ID `slnxterm` in single user mode. Instead of `/bin/login`, the default login program, the `/sbin/sulogin` login program is used.
  ```
  i3:S:once:/usr/bin/iucvtty slnxterm -- /sbin/sulogin
  ```

Upstart examples for logins

On distributions that use Upstart, you can specify terminal IDs and login programs through Upstart job files.

For corresponding systemd or inittab examples, see "systemd examples for logins" or "inittab examples for logins."

You can use names of your choice for the file names of your Upstart job files. The directory where you must place the file depends on your distribution.

- This Upstart job file enables user logins on the iucvtty instance with terminal ID `lxterm1` with `/bin/login`:

  ```
  start on runlevel [2345]
  stop on runlevel [01]
  respawn
  exec /usr/bin/iucvtty lxterm1
  ```

- This Upstart job file enables user logins on the iucvtty instance with terminal ID `slnxterm` in single user mode. Instead of `/bin/login`, the default login program, the `/sbin/sulogin` login program is used.

  ```
  start on runlevel S
  stop on runlevel
  exec /usr/bin/iucvtty slnxterm -- /sbin/sulogin
  ```

Note:

- The `/sbin/sulogin` login program requires a login by user root (see "Permitting root logins" on page 27).
- The runlevel specification for single user mode and for emergency mode depends on your distribution.

Setting up HVC terminal devices

Set up 1 - 8 HVC terminal devices, as required.

You use kernel parameters to set up HVC terminal devices. See *Device Drivers, Features, and Commands* about how to include kernel parameters in a boot configuration. You can find different version of this publication at ibm.com/support/knowledgecenter/linuxonibm/liaaf/lnz_r_dd.html.

Specifying the number of HVC terminal devices

Use the `hvc_iucv` kernel parameter to specify the number of HVC terminal devices to be operational.

hvc_iucv kernel parameter syntax

```
►►──hvc_iucv=<n>──────────────────────────────────────────────►◄
```

<*n*> is an integer in the range 1 - 8 and specifies the number of terminal devices. The default for `hvc_iucv` depends on your distribution.

Activating hvc0 to receive Linux kernel messages

Use the `console` kernel parameter to also activate `hvc0` to receive Linux kernel messages.

By default, the line-mode terminal device `ttyS0` is activated to receive Linux kernel messages and also is used as the preferred console. Of the HVC terminal devices, only `hvc0` can receive Linux kernel messages.

console kernel parameter syntax

```
►►──console=hvc0──────────────────────────────────────────────────►◄
```

You can specify multiple console statements, each activating a terminal device to receive Linux kernel messages. The last console statement specifies the preferred console. If the following is the only console statement in the Linux kernel parameter string, `hvc0` is activated to receive Linux kernel messages and also becomes the preferred console.

Examples

```
console=hvc0
```

If you want to keep `ttyS0` as the preferred console, you need a second console statement:

```
console=hvc0 console=ttyS0
```

For more information about the console kernel parameter see *Device Drivers, Features, and Commands*, SC33-8411.

Restricting access to HVC terminal devices

You can set a filter that restricts which z/VM guest virtual machines can connect to the z/VM IUCV HVC device driver and access HVC terminal devices.

The same filter applies to all HVC terminal devices. If no filter is active, there are no restrictions for accessing the HVC terminal devices.

The filter specifies the z/VM user IDs that are allowed to access the HVC terminal devices. Requests from all other z/VM user IDs are rejected.

Note: The filter also applies to local connections. If an active filter does not include the z/VM user ID of the target system itself, local connections are refused.

Setting an initial z/VM user ID filter

You set the initial filter through the `hvc_iucv_allow` kernel parameter.

Specify the z/VM user IDs that are allowed to connect to your HVC terminal devices as a comma-separated list of IDs or, as of s390-tools 1.30 (kernel 4.0), patterns.

Valid patterns are character strings with a trailing asterisk (*) as a wildcard. A pattern matches the string and any succeeding characters. For example, TSERV* matches TSERV and any IDs that begin with TSERV, such as TSERV1, TSERVA, TSERVXX1, and so on.

With a naming convention for terminal servers and a suitable pattern, you can introduce new terminal servers without having to update the kernel parameter line.

hvc_iucv_allow kernel parameter syntax

```
                          ┌─,──────────────┐
                          ▼                │
►►──hvc_iucv_allow=───────<id_or_pattern>──┴──────────────────────────────►◄
```

Examples

- To accept requests from TSERVER, TERMSRV1, and TERMSRV2 specify:

  `hvc_iucv_allow=tserver,termsrv1,termsrv2`

- To accept requests from TSERVER, TERMSRV and any user ID that begins with TERMSRV specify:

  `hvc_iucv_allow=tserver,termsrv*`

Displaying the current z/VM user ID filter

Use the **`lsiucvallow`** command to display the current z/VM user ID filter.

Example

```
$ lsiucvallow
TERMSRV1
TERMSRV2
```

Creating a z/VM user ID filter file

You can specify a z/VM user ID filter as a filter file.

Use your preferred text editor to create the filter file. The file lists the z/VM user IDs to be allowed to access the HVC terminal devices.

A valid filter file:

- Specifies a z/VM user ID or, as of s390-tools 1.30 (kernel 4.0), pattern on a separate line, with no leading or trailing white space.
  - The z/VM user IDs consist of up to eight alphanumeric characters or underscores (_).
  - Valid patterns consist of a part of a z/VM user ID with a trailing asterisk (*) as a wildcard. The pattern matches the ID part and any succeeding characters. For example, TSERV* matches TSERV and any IDs that begin with TSERV, such as TSERV1, TSERVA, TSERVXX1, and so on.
- Contains no more than 500 z/VM user IDs and patterns in total.
- Can include empty lines and comment lines that start with a number sign (#).
- Does not exceed 4096 bytes.

A filter file `/etc/iucvterm/ts-filters/filterb` might have the following content:

```
# Primary terminal server
termsrv1
# Backup terminal server
# termsrv2
# Replacement for backup terminal server termsrv2
termsrv3
```

By using the wildcard, you could authorize TERMSRV1, TERMSRV2, and TERMSRV3 with a single line:

```
# All terminal servers that start with TERMSRV
termsrv*
```

"Changing the z/VM user ID filter with an editor" describes how to make the filter in a file the current filter.

Tip: You might want to list numerous z/VM user IDs in a filter file. If you have access to the z/VM user directory, see Appendix C, "Creating files with lists of z/VM user IDs," on page 63 for a convenient method of obtaining a list.

Changing the z/VM user ID filter with an editor

Use the **chiucvallow** command to edit the z/VM user ID filter.

About this task

You can base the new z/VM user ID filter on the current filter or on specifications from a filter file.

Procedure

1. Open a filter with the **chiucvallow** command.
   - Open the current filter:
     ```
     [root]# chiucvallow -e
     ```
   - Alternatively, open a filter file:
     ```
     [root]# chiucvallow -e <filter>
     ```

   where <*filter*> is the file path.
2. Use the editor to change the filter. **chiucvallow** opens the filter with **vi** unless you specify an alternative editor with the EDITOR environment variable.
3. Save your changes and close the editor. **chiucvallow** validates the new filter and replaces the current filter.

Replacing the current z/VM user ID filter

Use the **chiucvallow** command to replace the current z/VM user ID filter with a filter defined by a filter file.

```
[root]# chiucvallow -s <filter>
```

where <*filter*> specifies the filter file. **chiucvallow** first validates the new filter and then replaces the current filter. If necessary, use **chiucvallow** *-e* <*filter*> to correct verification errors. You can use **chiucvallow** *-V* <*filter*> to validate the specifications in the filter file without replacing the current filter.

```
[root]# chiucvallow -s /etc/ts-filters/filterb
```

Tip: You can replace the filter as part of the boot process, for example as part of an init script (for example, rc.local or boot.local). Replacing the filter can be a useful alternative to specifying a filter with the kernel parameters, especially if the filter is extensive.

Revoking access restrictions

You can revoke access restrictions to the HVC terminal devices by clearing the z/VM user ID filter.

To clear the filter enter:

```
[root]# chiucvallow -c
```

Permitting root logins

The default login program for HVC terminal devices, `/bin/login`, restricts root logins.

Root logins are allowed only on devices that are listed in `/etc/securetty`.

To permit root logins on an HVC terminal device add a separate line that specifies the device node for the device, omitting the leading `/dev/`. For example, to include `/dev/hvc0` specify `hvc0`.

For more information, see the securetty man page. For other login programs, see the respective documentation.

Enabling user logins

Depending on your distribution, you need an Upstart job file or an entry in `/etc/inittab` to facilitate user logins on a terminal device.

A full discussion of inittab entries or Upstart job files for starting login programs is beyond the scope of this publication. You can use the examples that follow as a starting point.

Setting the terminal capabilities

You must set the terminal name of the HVC terminal devices to a suitable value to obtain correct terminal output on the terminal emulator of your workstation.

The terminal name indicates the capabilities of the terminal device. Examples for terminal names are `linux`, `dumb`, `xterm`, or `vt220`. You set the terminal name with the `TERM` environment variable.

Some getty programs accept the terminal name as a parameter and set the TERM environment variable accordingly at startup. For other getty programs, you must explicitly set the variable after the terminal session is established, for example by entering the following command:

```
# export TERM=xterm
```

The value of the TERM variable is specific for each established terminal session and different sessions can use different values.

If `xterm` does not result in properly displayed terminal output, find out the setting for the terminal emulator on your workstation. Then set the `TERM` environment variable on the target system to match this setting.

| ### systemd examples for logins

| On distributions that use systemd, you can set up login programs for HVC
| terminal devices through a systemd instance unit.

For corresponding inittab or Upstart examples, see "inittab examples for logins" or "Upstart examples for logins."

Enable a getty service for `hvc1` by issuing a command of this form:

```
# systemctl enable ttyrun-getty@hvc1.service
```

At the next system start, systemd starts the ttyrun service for `hvc1`. The ttyrun service starts a getty only if this terminal is available.

To start the service without a system restart, issue:

```
# systemctl start ttyrun-getty@hvc1.service
```

Note: How to set up systemd instance can vary by distribution. See the *Device Drivers, Features, and Commands* that is specific to your distribution. You can find different version of this publication at ibm.com/support/knowledgecenter/linuxonibm/liaaf/lnz_r_dd.html.

inittab examples for logins

On distributions that use inittab, you can set up login programs for HVC terminal devices through inittab entries.

For corresponding systemd or Upstart examples, see "systemd examples for logins" on page 27 "Upstart examples for logins."

Each inittab entry starts with an identifier that is unique within inittab. For more information, see the man page for the inittab file.

- This inittab entry enables user logins on terminal device `hvc1` with mingetty.

  ```
  h1:2345:respawn:/sbin/mingetty --noclear hvc1
  ```

  With mingetty, you must explicitly export the TERM environment variable as explained in "Setting the terminal capabilities" on page 27.
- This inittab entry enables user logins on terminal device `hvc2` with agetty and sets the TERM environment variable to `xterm` at startup.

  ```
  h2:2345:respawn:/sbin/agetty -L 9600 hvc2 xterm
  ```

  With agetty, you can specify the value to be set for the TERM environment variable as a parameter.
- This inittab entry enables user logins on terminal device `hvc3` with agetty and sets the TERM environment variable to `xterm` at startup. The ttyrun program prevents recurrent respawns if the terminal is not operational.

  ```
  h2:2345:respawn:/sbin/ttyrun hvc3 /sbin/agetty -L 9600 %t xterm
  ```

  With agetty, you can specify the value to be set for the TERM environment variable as a parameter.
- This inittab entry enables user logins in single user mode on terminal device `hvc0`. Instead of `/bin/login`, the default login program, the `/sbin/sulogin` login program is used.

  ```
  h0:S:once:/sbin/sulogin hvc0
  ```

  The `/sbin/sulogin` login program requires a login by user root (see "Permitting root logins" on page 27).

Upstart examples for logins

On distributions that use Upstart, you can set up login programs for HVC terminal devices through Upstart job files.

For corresponding systemd or inittab examples, see "systemd examples for logins" on page 27 or "inittab examples for logins" on page 28.

You can use names of your choice for the file names of your Upstart job files. The directory where you must place the file depends on your distribution.

- This Upstart job file enables user logins on terminal device `hvc1` with mingetty.

  ```
  start on runlevel [2345]
  stop on runlevel [01]
  respawn
  exec /sbin/mingetty --noclear hvc1
  ```

  With mingetty, you must explicitly export the TERM environment variable as explained in "Setting the terminal capabilities" on page 27.
- This Upstart job file enables user logins on terminal device `hvc2` with agetty and sets the TERM environment variable to `xterm` at startup.

  ```
  start on runlevel [2345]
  stop on runlevel [01]
  respawn
  exec /sbin/agetty -L 9600 hvc2 xterm
  ```

  With agetty, you can specify the value to be set for the TERM environment variable as a parameter.
- This Upstart job file enables user logins on terminal device `hvc3` with agetty and sets the TERM environment variable to `xterm` at startup. The ttyrun program prevents recurrent respawns by stopping with return code 123 if the terminal is not operational.

  ```
  start on runlevel [2345]
  stop on runlevel [01]
  respawn
  normal exit 123
  exec /sbin/ttyrun -e 123 hvc3 /sbin/agetty -L 9600 %t xterm
  ```
- This Upstart job file enables user logins in single user mode on terminal device `hvc0`. Instead of `/bin/login`, the default login program, the `/sbin/sulogin` login program is used.

  ```
  start on runlevel S
  stop on runlevel
  exec /sbin/sulogin hvc0
  ```

  Note:
  - The `/sbin/sulogin` login program requires a login by user root (see "Permitting root logins" on page 27).
  - The runlevel specification for single user mode and for emergency mode depends on your distribution.

Chapter 6. Working with the terminal server

From a terminal server, you can access terminal devices on target systems. You can also work with session transcripts and inspect log entries that pertain to terminal server activities.

The methods that are available to a particular user depend on the user setup.

- A ts-shell user (see "Creating a user for ts-shell" on page 16) uses the **`connect`** command on ts-shell.
- An iucvconn_on_login user (see "Creating a user for iucvconn_on_login" on page 19) logs on to the terminal server and is automatically connected to the target system.
- A general Linux user on the terminal server uses the **`iucvconn`** command.

Accessing a terminal device from ts-shell

If you are a ts-shell user, use the shell commands to access a terminal device.

About this task

This task applies to users who log in to ts-shell on the terminal server (see "Creating a user for ts-shell" on page 16).

Tip: If you have Perl ReadLine installed, you can press the Tab key to complete command names, terminal IDs, and z/VM guest IDs.

Procedure

Perform the following steps to access a terminal device:

1. Log in to ts-shell on the terminal server.
2. Optional: Confirm that you are authorized to connect to the intended target system by entering the **`list`** command. The command lists all target systems for which you are authorized with a pager. Close the pager to return to ts-shell.

   Example:

   ```
   alice@ts-shell> list
   LXGUEST1
   LXGUEST3
   LXGUEST5
   LXGUEST7
   LXGUEST9
   ```

3. Connect to the target system and access the terminal device by entering a command of this form:

   ```
   alice@ts-shell> connect <vm_guest> <terminal_id>
   ```

   where:

   `<vm_guest>`
      specifies the z/VM user ID where the target Linux instance runs.

<terminal_id>
optionally identifies the terminal device.

For HVC terminal devices, the terminal IDs are `lnxhvc<n>`, where *<n>* is an integer in the range 0 - 7. As of kernel 3.14, you can specify the generic terminal ID `lnxhvc` to automatically match the ID of any free HVC terminal device.

The terminal ID for an iucvtty instance is set with the **`iucvtty`** command that starts the instance. See "iucvtty - allow remote logins over z/VM IUCV" on page 51.

If omitted, a default terminal ID is used. Initially, the default is lnxhvc0. You can change the default for the duration of the ts-shell session by entering a command of this form:

```
alice@ts-shell> terminal <terminal_id>
```

where *<terminal_id>* is the new default. To display the current default, enter:

```
alice@ts-shell> terminal
```

Example:

```
alice@ts-shell> connect lxguest1 lnxterm1
```

Results

Depending on how the terminal device on the target system setup, you are prompted to log in to the terminal. You might have to press Enter to obtain the prompt.

Hint: Output that is written by Linux while the terminal window is closed is not displayed. Therefore, a newly opened terminal window is always blank. For most applications, like login or shell prompts, it is sufficient to press Enter to obtain a new prompt.

Accessing a terminal device through iucvconn_on_login

If you are an iucvconn_on_login user, you are automatically redirected and connected to the target system when you log in to iucvconn_on_login on the terminal server.

For more information, see "Creating a user for iucvconn_on_login" on page 19.

The iucvconn_on_login program is designed to connect a specific terminal server user to a terminal device on a specific target system. Use the z/VM user ID of the target system as the user ID for opening an SSH session with the terminal server. Depending on the terminal device setup on the target system, you are then prompted to log in.

To establish a connection, enter a command of this form from a command prompt on your workstation:

```
$ ssh -t <guest_id>@<terminal_server> <terminal_id>
```

where:

<guest_id>
: is the z/VM user ID that identifies the target system.

<terminal_server>
: is the host name or IP address of the terminal server.

<terminal_id>
: identifies the terminal device on the target system. If omitted, `lnxhvc0` is used.

Example

```
$ ssh -t lxguest1@termsrv.example.net
...
lxguest1@termsrv.example.net's password:
iucvconn_on_login: Connecting to lxguest1 (terminal ID: lxterm1)

login: ...
...
[lxguest1]$ exit
logout
Connection to lxguest1 closed.$
```

See "Basic iucvconn_on_login scenario" on page 43 for more details of this example.

Accessing a terminal device with iucvconn

Linux users with access to a regular shell (for example, bash) on the terminal server can use the **iucvconn** command to establish a terminal session with a target system.

The **iucvconn** command is not directly available to ts-shell users or iucvconn_on_login users.

See "iucvconn - start terminal connection" on page 49 or the **iucvconn** man page for details.

Working with HVC terminal devices

There are some characteristics of HVC terminal devices you should know.

Output that is written by Linux while the terminal session for an HVC terminal device is closed is not displayed. Therefore, a newly opened terminal window is always blank. For most applications, like login or shell prompts, it is sufficient to press Enter to obtain a new prompt.

You can also call magic sysrequest functions from the hvc0 terminal device if it is present and activated to receive Linux kernel messages. To call the magic sysrequest functions from hvc0, enter the single character Ctrl+o followed by the character for the particular function. See `Documentation/sysrq.txt` in the Linux source tree for the available magic sysrequest functions.

Your distribution might not have enabled all of the listed functions. For information about enabling magic sysrequest functions see *Device Drivers, Features, and Commands*, SC33-8411 and the hvc_iucv man page.

Security hint

Always end sessions with HVC terminal devices by explicitly logging off (for example, type `exit` and press Enter). If a logoff results in a new login prompt, press Control and Underscore (Ctrl+_) then press d to close the terminal session. Simply closing the terminal window for a hvc0 terminal device that was activated for Linux kernel messages leaves the device active. The terminal session can then be reopened without a login.

Working with session transcripts

A session transcript comprises several files.

Before you begin:

- You must be a regular user on the terminal server. ts-shell users and iucvconn_on_login users cannot work with session transcripts.
- You need read access to `/var/log/ts-shell` where ts-shell creates the session transcripts.

Within `/var/log/ts-shell` there is a subdirectory for each user who conducted a terminal session for which a transcript was created.

The raw terminal data stream is written to a file within the directory for the respective user with a name of the format:

```
<vm_guest>_<YY-MM-DD-hhmmss>
```

where *<vm_guest>* is the z/VM user ID that identifies the target system and *<YY-MM-DD-hhmmss>* is a time stamp that indicates when the session was started.

The complete transcript includes two more files:

*<vm_guest>*_*<YY-MM-DD-hhmmss>***.timing**
with timing information about the session.

*<vm_guest>*_*<YY-MM-DD-hhmmss>***.info**
with more terminal session information.

The file with extension `.info` is a human readable text file. The transcript file without an extension and the file with extension `.timing` are intended for replaying a session. See the scriptreplay man page for details.

Consider a cron job to purge obsolete transcripts according to your audit policies.

Inspecting the logs

You can view events that are related to the terminal server in the syslog on both the terminal server itself and on the target systems.

In particular, the iucvtty program and the z/VM IUCV HVC device driver log refused IUCV connection attempts.

In addition, unsuccessful login attempts are logged to `/var/log/secure` by the login program. These log records include the involved terminal IDs.

To find relevant entries on the terminal server examine `/var/log/secure`. For example, enter:

```
[root]# grep "iucvconn" /var/log/secure
May 25 10:42:42 termsrv1 iucvconn[27340]: Established connection to lxguest1/lxterm1 for user alice (uid=503)
May 25 10:44:13 termsrv1 iucvconn[27342]: Established connection to lxguest1/lnxhvc0 for user alice (uid=503)
May 25 10:52:42 termsrv1 iucvconn[27358]: Established connection to lxguest3/lxterm1 for user alice (uid=503)
May 25 11:38:09 termsrv1 iucvconn[27522]: Established connection to linux00/lnxhvc0 for user bob (uid=505)
May 25 12:01:34 termsrv1 iucvconn[27589]: Established connection to lxguest1/lxterm1 for user lxguest1 (uid=507)
```

To find relevant entries on a target system examine `/var/log/secure` for iucvtty instances. For example, enter:

```
[root]# grep "iucvtty" /var/log/secure
May 25 10:38:57 lxguest3 iucvtty[23618]: Listening on terminal ID: lxterm1, using pts device: /dev/pts/10
May 25 10:52:42 lxguest3 iucvtty[23618]: Accepted client connection from termsrv1
May 25 11:13:19 lxguest3 iucvtty[23621]: Listening on terminal ID: lxterm1, using pts device: /dev/pts/10
[root]# grep "login: LOGIN ON pts" /var/log/secure
May 25 10:53:08 lxguest3 login: LOGIN ON pts/10 BY alice FROM termsrv1
```

To find relevant entries on a target system examine `/var/log/secure` and `/var/log/messages` for HVC terminal devices. For example, enter:

```
[root]# grep "LOGIN ON hvc" /var/log/secure
May 25 10:44:22 lxguest1 login: ROOT LOGIN ON hvc0
[root]# grep "hvc_iucv" /var/log/messages
May 25 13:44:16 lxguest1 kernel: hvc_iucv.09cae6: A connection request from z/VM user ID LXGUEST7 was refused
```

Chapter 7. Scenarios

The scenarios show how the different components of a terminal server environment work together.

Basic scenario

The basic scenario shows how to set up a ts-shell user on the terminal server with access to three terminal devices on the target system.

This basic scenario assumes:

- A z/VM guest virtual machine TERMSRV1 is set up as a terminal server. In particular:
  - Linux with the s390-tools package is installed.
  - `ts-shell` is listed in `/etc/shells`.
  - A user group `ts-shell` is in place.
  - The directory entry for the terminal server includes the IUCV ANY statement that permits IUCV connections to any other z/VM virtual machine within the z/VM instance.
- A z/VM guest virtual machine LXGUEST1 is set up on the same z/VM instance. In particular:
  - Linux with the s390-tools package is installed
  - The Linux distribution uses inittab.

The steps in the scenario show how to set up a `ts-shell` user `alice` on the terminal server. This user is to have access to three terminal devices on the target system: an iucvtty instance `lxterm1` and two HVC terminal devices `hvc0` and `hvc1` (see Figure 6).

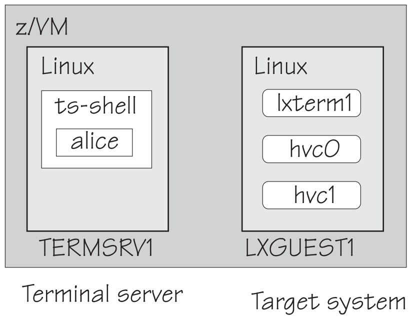


Figure 6. Basic scenario

Setting up the terminal server

On the terminal server, set up the user with the required permissions.

Procedure

1. As user root, log in to Linux on the terminal server.
2. Add and set up user `alice`.

```
[root]# useradd -s /usr/bin/ts-shell -G ts-shell alice
[root]# passwd alice
...
[root]# chage alice
```

3. Permit user `alice` to connect to LXGUEST1 by opening `/etc/iucvterm/ts-authorization.conf` with an editor and adding the following line:

   ```
   alice = list:lxguest1
   ```

Setting up the target system

On the target system, set up the terminals and the required permissions.

Procedure

1. As user root, establish an SSH session with the target system.
2. Change the kernel parameter line to include `hvc_iucv=2` and `hvc_iucv_allow=termsrv1` to obtain two HVC terminal devices and to allow connections from TERMSRV1 only.
3. Reboot the target system.
4. As user root, establish an SSH session with the target system.
5. Confirm that the HVC terminal devices are accessible only through connections from TERMSRV1.

   ```
   [root]# lsiucvallow
   TERMSRV1
   ```

6. Configure logins for the three terminal devices. See "Enabling user logins" on page 21 and "Enabling user logins" on page 27.

Establishing terminal sessions

In the basic scenario, the `ts-shell` user connects to the target system by issuing `ts-shell` commands.

User `alice` can now log in to `ts-shell` on the terminal server and access the terminal devices on LXGUEST1.

Accessing `lxterm1`:

```
alice@ts-shell> connect lxguest1 lxterm1
ts-shell: Connecting to lxguest1 (terminal identifier: lxterm1)...
login as:
...
[LXGUEST1]$
...
[LXGUEST1]$ exit
ts-shell: Connection ended
alice@ts-shell>
```

Accessing `hvc0` with the default setting for the terminal ID:

```
alice@ts-shell> terminal
lnxhvc0
alice@ts-shell> connect lxguest1
ts-shell: Connecting to lxguest1 (terminal identifier: lnxhvc0)...
login as:
...
[LXGUEST1]$ export TERM=xterm
...
[LXGUEST1]$ exit
ts-shell: Connection ended
alice@ts-shell>
```

Exiting the terminal session at the target system might result in a renewed login prompt to the target system. If so, you might have to press Control and underscore (Ctrl+_), and then press d to disconnect and return to the `ts-shell` (see also “Security hint” on page 34).

Extended scenario

The extended scenario extends the basic scenario with a second user, a second terminal server, and numerous target systems.

For information about the basic scenario, see “Basic scenario” on page 37. This scenario extends the basic scenario as follows:

- There is now a backup terminal server TERMSRV2. TERMSRV1 and TERMSRV2 must both be permitted to connect to all target systems.
- In addition to LXGUEST1, there are more target systems: LXGUEST0, LXGUEST2 through LXGUEST9, and LINUX00 through LINUX99.
- User `alice` is responsible for LXGUEST1, LXGUEST3, LXGUEST5, LXGUEST7, and LXGUEST9.
- There is another `ts-shell` user, `bob`, who is responsible for LINUX00 through LINUX99, LXGUEST0, LXGUEST2, LXGUEST4, LXGUEST6, and LXGUEST8.
- `ts-shell` is to be permitted to connect to the target systems only.
- Session transcripts are to be created for LXGUEST0 through LXGUEST4.

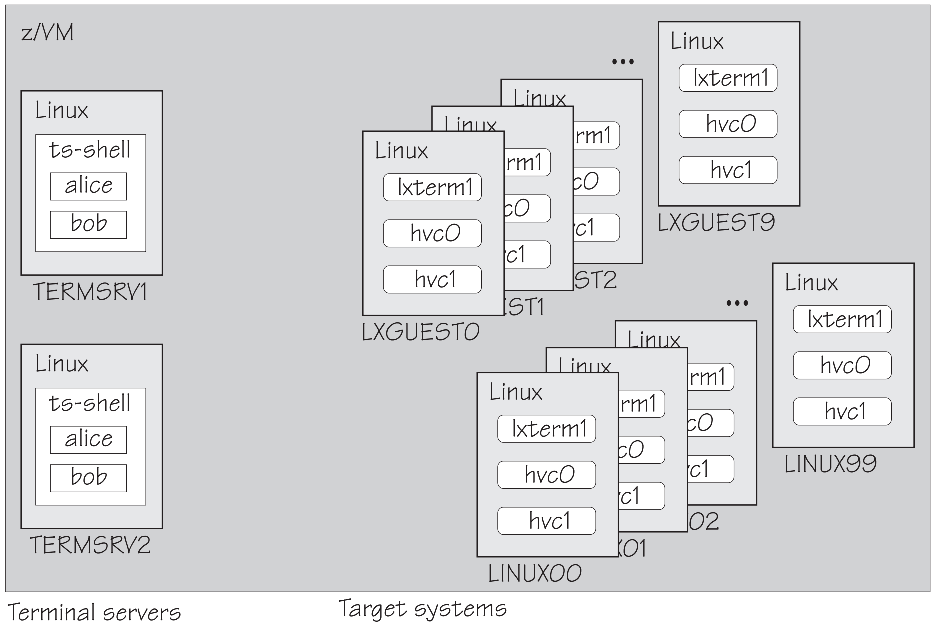


Figure 7. Extended scenario

This scenario assumes that the terminal servers and target systems are set up as described in "Basic scenario" on page 37.

Extending the terminal server configuration

On each terminal server, add another user and adapt the user permissions to cover the requirements for the extended scenario.

Procedure

1. As user root, log in to Linux on the terminal server.
2. Add and set up user `bob`.

```
[root]# useradd -s /usr/bin/ts-shell -G ts-shell bob
[root]# passwd bob
...
[root]# chage bob
```

3. Grant user permissions by changing the content of `/etc/iucvterm/ts-authorization.conf` to:

```
alice = list:lxguest1,lxguest3,lxguest5,lxguest7,lxguest9
bob = regex:lxguest[02468]
bob = regex:^linux[0-9]{2}$
```

4. Use your preferred editor to open `/etc/iucvterm/ts-shell.conf`.
5. Find the line

```
ts-systems = /etc/iucvterm/unrestricted.conf
```

and change it to

```
ts-systems = /etc/iucvterm/ts-systems.conf
```

6. In `/etc/iucvterm/ts-systems.conf`, list the z/VM user IDs of all target systems. List each z/VM user ID on a separate line.

```
[root]# echo lxguest{0..9}|tr ' ' '\n' > /etc/iucvterm/ts-systems.conf
[root]# echo linux0{0..9}|tr ' ' '\n' >> /etc/iucvterm/ts-systems.conf
[root]# echo linux{10..99}|tr ' ' '\n' >> /etc/iucvterm/ts-systems.conf
```

7. Ensure that `/etc/iucvterm/ts-systems.conf` is readable by members of the `ts-shell` user group.
8. If not already present as a result of installing s390-tools, set up a directory, `/var/log/ts-shell`, for the session transcripts.

```
[root]# mkdir /var/log/ts-shell
[root]# chown root:ts-shell /var/log/ts-shell
[root]# chmod 2770  /var/log/ts-shell
```

9. Configure session transcripts for LXGUEST0 through LXGUEST4 by adding the following lines to `/etc/iucvterm/ts-audit-systems.conf`:

```
lxguest0
lxguest1
lxguest2
lxguest3
lxguest4
```

Extending the target system configuration

On each target system, set up the required terminals and grant access to both terminal servers.

Procedure

1. As user root, establish an SSH session with the target system.
2. Change the kernel parameter line to include `hvc_iucv=2` and `hvc_iucv_allow=termsrv1,termsrv2` to obtain two HVC terminal devices and to allow connections from TERMSRV1 and TERMSRV2.
3. Reboot the target system.
4. Log in to Linux as user root.
5. Confirm that the HVC terminal devices are accessible through connections from TERMSRV1 and TERMSRV2.

```
[root]# lsiucvallow
TERMSRV1
TERMSRV2
```

6. Change the systemd, inittab or Upstart configuration to permit logins from both terminal servers to the three terminal devices. See "Enabling user logins" on page 21 and "Enabling user logins" on page 27.

Establishing terminal sessions

According to the user permissions, users of `ts-shell` on the terminal servers can access terminal devices through `ts-shell` commands.

User `alice` can now log in to `ts-shell` on the terminal servers and access the terminal devices on LXGUEST1, LXGUEST3, LXGUEST5, LXGUEST7, and LXGUEST9.

User `bob` can now log in to `ts-shell` on the terminal servers and access the terminal devices on LINUX00 through LINUX99, LXGUEST0, LXGUEST2, LXGUEST4, LXGUEST6, and LXGUEST8.

Examples

User `alice` accessing `lxterm1` on LXGUEST3:

```
alice@ts-shell> connect lxguest3 lxterm1
ts-shell: Connecting to lxguest3 (terminal identifier: lxterm1)...
login as:
...
[LXGUEST3]$
...
[LXGUEST3]$ exit
ts-shell: Connection endedalice@ts-shell>
```

An attempt by user `bob` to access `lxterm1` on LXGUEST3 is rejected:

```
bob@ts-shell> connect lxguest3 lxterm1
ts-shell: You are not authorized to connect to lxguest3
bob@ts-shell>
```

User `bob` accessing `hvc0` on LINUX00:

```
bob@ts-shell> connect linux00 lnxhvc0
ts-shell: Connecting to linux00 (terminal identifier: lnxhvc0)...
login as:
...
[LINUX00]$ export TERM=xterm
...

[LINUX00]$ exit
ts-shell: Connection ended
bob@ts-shell>
```

Exiting the terminal session at the target system might results in a renewed login prompt to the target system. You might have to press Control and underscore (Ctrl+_), and then press d to disconnect and return to the `ts-shell` (see also "Security hint" on page 34).

Locating the session transcripts

You can find the session transcripts in subdirectories of `/var/log/ts-shell`.

Session transcripts are configured for terminal sessions with LXGUEST0 through LXGUEST4.

To show who has established terminal sessions with these systems, enter:

```
$ ls /var/log/ts-shell
alice
```

To show the transcripts for the sessions that have been established by user `alice` enter:

```
$ ls /var/log/ts-shell/alice
lxguest3_09-05-25-105242
lxguest3_09-05-25-105242.info
lxguest3_09-05-25-105242.timing
```

Basic iucvconn_on_login scenario

This simple scenario illustrates the use of iucvconn_on_login and extends the basic scenario.

In addition to the connections through `ts-shell`, there is to be a connection through the iucvconn_on_login script.

The setup of the terminal server and target server are assumed to be as described in "Basic scenario" on page 37. The fully qualified host name of the terminal server is assumed to be `termserv1.example.net` and the fully qualified host name of the target system `lxguest1.example.net`.

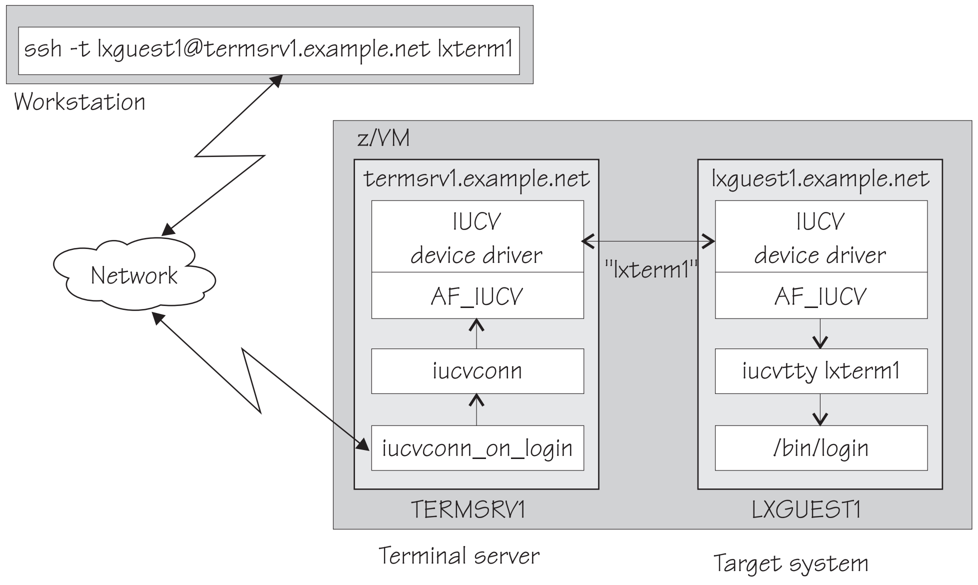


Figure 8. Accessing a terminal device with the iucvconn_on_login script

Extending the configuration

On the terminal server, set up the iucvconn_on_login script and create a user with the name of the target system. No changes are required on the target system.

Procedure

1. As user root, log in to Linux on the terminal server.
2. Copy the iucvconn_on_login script from the s390-tools package documentation to `/usr/bin`. The path depends on your distribution and might or might not include a packages directory or version information for the s390-tools package. For example, enter:

```
[root]# cp /usr/share/doc/packages/s390-tools-1.9.0/ts-shell/iucvconn_on_login /usr/bin
```

3. Make the script executable.

```
[root]# chmod +x /usr/bin/iucvconn_on_login
```

4. Add the script to `/etc/shells`.

```
[root]# echo "/usr/bin/iucvconn_on_login" >> /etc/shells
```

5. Add `lxguest1` as a new user with iucvconn_on_login as the login shell:

   ```
   [root]# useradd -s /usr/bin/iucvconn_on_login lxguest1
   ```

6. Set an initial password for the new user and force the new user to change the password at the initial login.

   Example:

   ```
   [root]# passwd lxguest1
   ...
   [root]# chage lxguest1
   ```

Establishing terminal sessions

You can connect to a target system by logging on to the matching user on the terminal server.

Accessing `lxterm1` on `lxguest1`:

```
$ ssh -t lxguest1@termsrv1.example.net lxterm1
..
lxguest1@termsrv.example.net's password:
iucvconn_on_login: Connecting to lxguest1 (terminal ID: lxterm1)

login: ...
...
[lxguest1]$ exit
logout
Connection to termsrv1.example.net closed.
$
```

Appendix A. Command and program reference

Some commands are used directly from `ts-shell`, other commands and programs are used in configuration files.

chiucvallow - work with z/VM user ID filters

Runs on target systems to list, verify, and change the z/VM user ID filter of the z/VM IUCV HVC device driver.

The filter specifies the z/VM user IDs that are allowed to access HVC terminal devices.

chiucvallow requires root authority.

Format

chiucvallow syntax

```
►►──chiucvallow──┬─ -l──────────────────┬──────────────────────────────────────────►◄
                 ├─ -e──┬─────────────┬─┤
                 │      └─ <filter>───┘ │
                 ├─ -V── <filter>───────┤
                 ├─ -s── <filter>───────┤
                 └─ -c──────────────────┘
```

where:

-l or --list
: displays the z/VM user IDs contained in the current filter.

  chiucvallow with the `-l` option is equivalent to **lsiucvallow** (see "lsiucvallow - display the z/VM user ID filter" on page 53).

<filter>
: specifies a z/VM user ID filter file.

  z/VM user ID filter files list z/VM user IDs to be allowed to access the HVC terminal devices. Each z/VM user ID is specified on a separate line. There can also be blank lines and comment lines, which start with a number sign (#).

-e or --edit
: edit the current z/VM user ID filter.

  If *<filter>* is specified, the z/VM user ID filter in *<filter>* is opened in an editor; otherwise the current z/VM user ID filter is imported into the editor.

  When the editor is closed, the edited filter is verified (see `-V` or `--verify`). If verified successfully, the edited z/VM user ID filter becomes the current filter. If the verification fails, the edited z/VM user ID filter is saved to a backup copy that can then be corrected.

  By default, vi is used as the editor. You can specify an alternative editor with the EDITOR environment variable.

-V or --verify
: verifies that the z/VM user ID filter specified by *<filter>*:

  - Contains only z/VM user IDs or patterns that consist of up to eight alphanumeric characters or underscores (_), where the last character of a pattern is an asterisk (*).
  - Contains no more than 500 z/VM user IDs and patterns in total.

- Does not exceed 4096 bytes

-s or --set
replaces the current z/VM user ID filter with the filter specified by <*filter*>. The current z/VM user ID filter can be replaced only after <*filter*> has been successfully verified.

-c or --clear
clears the current z/VM user ID filter. After clearing the filter, any z/VM user ID is allowed to connect to the z/VM IUCV HVC device driver.

-v or --version
displays the version of **chiucvallow** and exits.

-h or --help
displays a short help text and exits. For more information, see the **chiucvallow** man page.

Examples

The examples that follow assume a filter file, /etc/ts-filters/filterb, with this content:

```
# Primary terminal server
termsrv1
# Backup terminal server
# termsrv2
# Replacement for backup terminal server termsrv2
termsrv3
```

- To make /etc/ts-filters/filterb the current filter:

```
[root]# chiucvallow -V /etc/ts-filters/filterb
Verify z/VM user ID: termsrv1 : OK
Verify z/VM user ID: termsrv3 : OK

chiucvallow: Verification summary: verified=2 failed=0 size=18 bytes
[root]# chiucvallow -s /etc/ts-filters/filterb
```

- To list the current filter:

```
[root]# chiucvallow -l
TERMSRV1
TERMSRV3
```

- To clear the filter:

```
[root]# chiucvallow -c
```

The examples that follow assume a filter file, /etc/ts-filters/wildfilter, with this content:

```
# Primary terminal server
termsrv1
# Backup terminal servers
bkptsrv*
```

- To make /etc/ts-filters/wildfilter the current filter:

```
[root]# chiucvallow -V /etc/ts-filters/wildfilter
Verify z/VM user ID: termsrv1 : OK
Verify z/VM user ID: bkptsrv* : OK

chiucvallow: Verification summary: verified=2 failed=0 size=18 bytes
[root]# chiucvallow -s /etc/ts-filters/wildfilter
```

- To list the current filter:

```
[root]# chiucvallow -l
BKPTSRV*
TERMSRV1
```

iucvconn - start terminal connection

Runs on the terminal server to access a terminal device on a target system. This command is used by `ts-shell` and by the iucvconn_on_login script.

The **`iucvconn`** command is not used directly by `ts-shell` and by the iucvconn_on_login users.

Format

iucvconn syntax

```
              ┌─ -e _ ──────────────┐
►►──iucvconn──┼─────────────────────┼──┬──────────────────┬── <vm_guest>── <terminal_id>──────►◄
              ├─ -e <escape_char>───┤  └─ -s <log_file>───┘
              └─ -e none────────────┘
```

where:

`-e or --escape-char` *`<escape_char>`*
: sets an escape character for the terminal session. You need an escape character to access special **`iucvconn`** functions. The default escape character is the underscore (_) character. If *<escape_char>* is set to “none”, escaping is not possible. The escape character can be the closing bracket (]), the caret (^), the underscore (_), or any alphabetic character except C, D, Q, S, and Z. The escape character is not case-sensitive.

To call a special function press *<escape_char>* while you hold down Ctrl, then press the key for the function:

Table 2. Special functions that can be accessed through the escape character

Function character	Function
d	Close the terminal session.
period (.)	Close the terminal session (same as d).
r	Force resizing of the connected terminal.

`-s or --sessionlog` *`<log_file>`*
: creates a transcript of the terminal session and writes session data to three different files.

<log_file>
: contains the raw terminal data stream.

*<log_file>***`.timing`**
: contains timing data that can be used for replaying the raw terminal data stream with realistic output delays.

*<log_file>***`.info`**
: contains more terminal session information.

If any of these files exist, the **`iucvconn`** program exits with an error. To proceed either delete the files or choose another file name for *<log_file>*.

`<vm_guest>`
: specifies the z/VM user ID where the target Linux instance runs.

`<terminal_id>`
: identifies a running iucvtty instance, or an HVC terminal device. The *<terminal_id>* is like a port number in TCP/IP communications. *<terminal_id>* is case-sensitive and consists of up to eight alphanumeric characters.

  The terminal ID for an iucvtty instance is set in the start command for the instance.

  For HVC terminal devices, the terminal IDs are lnxhvc<*n*>, where <*n*> is an integer in the range 0 - 7. If you do not need a specific HVC terminal device or if you are not sure which device is free, you can omit the trailing integer.

  As of kernel 3.14, you can specify the generic terminal ID `lnxhvc` to automatically assign the next free terminal device.

`-v or --version`
: prints the version number of the **`iucvconn`** program and exits.

`-h or --help`
: prints a short help text and exits. For more detail, see the **`iucvconn`** man page.

Examples

- To access the `lxterm1` terminal on the Linux instance in z/VM guest virtual machine LXGUEST1:

```
$ iucvconn lxguest1 lxterm1
```

- To access the `lxterm1` terminal on the Linux instance in z/VM guest virtual machine LXGUEST1 and setting the escape character to `X`:

```
$ iucvconn -e x lxguest1 lxterm1
```

- To access the first z/VM IUCV HVC terminal device on the Linux instance in z/VM guest virtual machine LXGUEST2:

```
$ iucvconn lxguest2 lnxhvc0
```

- To access any free z/VM IUCV HVC terminal device on the Linux instance in z/VM guest virtual machine LXGUEST2:

```
$ iucvconn lxguest2 lnxhvc
```

- To access the first z/VM IUCV HVC terminal device on the Linux instance in z/VM guest virtual machine LINUX99 and create a set of session transcript files `~/transcripts/linux99`, `~/transcripts/linux99.timing`, and `~/transcripts/linux99.info`:

```
$ iucvconn -s ~/transcripts/linux99 linux99 lnxhvc0
```

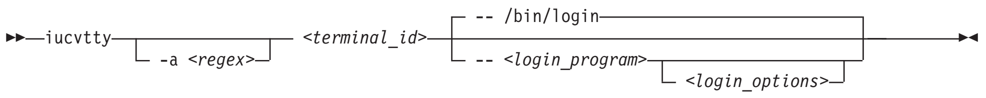
iucvtty - allow remote logins over z/VM IUCV

The **iucvtty** application provides full-screen terminal access to an instance of Linux on z/VM.

Runs on target systems to start iucvtty instances. Typically, the **iucvtty** command is called through systemd instance units, inittab entries, or Upstart job files.

Format

iucvtty syntax



where:

-a or --allow-from *<regex>*
: is a regular expression that limits permissions for incoming connections to matching z/VM user IDs. The connection is refused if the z/VM user ID does not match. If this parameter is omitted, connections are permitted from any z/VM user ID.

<terminal_id>
: identifies the z/VM IUCV connection. *<terminal_id>* is case-sensitive and consists of up to eight alphanumeric characters. The *<terminal_id>* must be specified as a parameter in access requests against an iucvtty instance. The *<terminal_id>* is like a port number in TCP/IP communications.

<login_program>
: specifies the absolute path to the login program to be started when a connection is established. The default is `/bin/login`.

<login_options>
: specifies further options that depend on the particular login program used.

-v or --version
: displays the version number of **iucvtty** and exits.

-h or --help
: displays a short help text and exits. For more detail, see the **iucvtty** man page.

Examples

- To allow remote logins for terminal ID `lxterm1`:

```
[root]# iucvtty lxterm1
```

- To allow only users from LXGUEST1 to access `lxterm1`:

```
[root]# iucvtty -a lxguest1 lxterm1
```

- To allow only users from LINUX10 through LINUX19 to access `lxterm1`:

```
[root]# iucvtty -a "linux1[0-9]" lxterm1
```

- To use `/sbin/sulogin` instead of `/bin/login` for `suterm`:

```
[root]# iucvtty suterm -- /sbin/sulogin
```

lsiucvallow - display the z/VM user ID filter

Runs on target systems to display the current z/VM user ID filter of the z/VM IUCV HVC device driver.

The filter specifies the z/VM user IDs that are allowed to connect to the z/VM IUCV HVC device driver.

lsiucvallow requires root authority.

Format

lsiucvallow syntax

```
►►──lsiucvallow──────────────────────────────────────────────────────────►◄
```

Example

In this example, access from TERMSRV1 and TERMSRV2 is allowed.

```
$ lsiucvallow
TERMSRV1
TERMSRV2
```

ts-shell: connect - establish a terminal session

Runs within `ts-shell` on the terminal server to connect to a target system and accesses a terminal device on the target system.

Format

connect syntax

```
►►──connect── <vm_guest>──┬───────────────┬──────────────────────────────►◄
                          └─ <terminal_id>─┘
```

where:

<vm_guest>
: specifies the target system.

<terminal_id>
: specifies the terminal ID of the terminal to be accessed.

  The terminal ID for an iucvtty instance is set in the start command for the instance (see "iucvtty - allow remote logins over z/VM IUCV" on page 51).

  For HVC terminal devices, the terminal IDs are lnxhvc<*n*>, where <*n*> is an integer in the range 0 - 7. If you do not need a specific HVC terminal device or if you are not sure which device is free, you can omit the trailing integer.

  As of kernel 3.14, you can specify the generic terminal ID `lnxhvc` to automatically assign the next free terminal device.

  If omitted, a default terminal ID is used. Initially, the default is lnxhvc0. You can change the default with the `ts-shell` **`terminal`** command. The modified default applies for the duration of the `ts-shell` session.

Examples

To connect to an iucvtty terminal with terminal ID `lxterm1` on LXGUEST1:

```
alice@ts-shell> connect lxguest1 lxterm1
```

To connect to HVC terminal device with terminal ID `lnxhvc0` on LXGUEST1:

```
alice@ts-shell> connect lxguest1 lnxhvc0
```

Unless the default terminal has been changed, this command is equivalent to:

```
alice@ts-shell> connect lxguest1
```

To connect to any free HVC terminal device on LXGUEST1:

```
alice@ts-shell> connect lxguest1 lnxhvc
```

ts-shell: list - list authorized target systems

Runs within `ts-shell` on the terminal server to list all target systems for which a `ts-shell` user is authorized.

Lists are displayed with a pager. Close the pager to return to `ts-shell`.

The default pager is **`less`** in secure mode (set with the LESSSECURE environment variable).

You can use the PAGER environment variable to specify the full path to an alternative pager. Because `ts-shell` is a login shell, you might have to use a security module to set environment variables. For example, you might have to use the `pam_env` module.

Format

list syntax

```
►►──list──────────────────────────────────────────────────────────►◄
```

Examples

- Listing authorizations that are defined in list format:

```
alice@ts-shell> list
LXGUEST1
LXGUEST3
LXGUEST5
LXGUEST7
LXGUEST9
```

- Listing authorizations that are defined as regular expressions:

```
bob@ts-shell> list
Regular expressions for your authorization:
(?i-xsm:lxguest[02468])
(?i-xsm:^linux[0-9]{2}$)
```

- Listing authorizations that are defined as regular expressions if further restrictions exist for `ts-shell`. Those IDs in `/etc/iucvterm/ts-systems.conf` that match one of the regular expressions is appended to the user authorizations.

  If `/etc/iucvterm/ts-systems.conf` reads:

```
LXGUEST1
LXGUEST2
LXGUEST3
LXGUEST5
LINUX07
LINUX11
LINUX13
```

  the previous example becomes:

```
bob@ts-shell> list
Regular expressions for your authorization:
(?i-xsm:lxguest[02468])
(?i-xsm:^linux[0-9]{2}$)
You are authorized to connect to these z/VM guest virtual machines:
LXGUEST2
LINUX07
LINUX11
LINUX13
```

ts-shell: terminal - display and set the default terminal ID

Runs within `ts-shell` on the terminal server to display and set the default terminal ID used for the connect command.

Format

connect syntax

```
►►──terminal──┬─────────────────┬──────────────────────────────────────►◄
              └─ <terminal_id>──┘
```

where:

<terminal_id>
: is the default terminal ID to be set. If omitted, the current default terminal ID is displayed.

  The terminal ID for an iucvtty instance is set in the start command for the instance (see "iucvtty - allow remote logins over z/VM IUCV" on page 51).

  For HVC terminal devices, the terminal IDs are lnxhvc<*n*>, where <*n*> is an integer in the range 0 - 7. If the trailing integer is omitted the default ID matches the next free HVC terminal device.

Examples

- To display the current terminal ID:

```
alice@ts-shell> terminal
lnxhvc0
```

- To set `lxterm1` as the default terminal ID:

```
alice@ts-shell> terminal lxterm1
```

- To make the default ID match any free HVC terminal device:

```
alice@ts-shell> terminal lnxhvc
```

ts-shell: version, help, exit, quit

In addition to **`connect`**, **`list`**, and **`terminal`**, `ts-shell` provides commands for information about `ts-shell` and for closing the shell.

`version`
displays the version of `ts-shell`.

`help`
displays a summary of the available `ts-shell` commands.

`exit`
closes the terminal server shell session.

`quit`
closes the terminal server shell session.

ttyrun - start a program if a specified terminal device is available

As of s390-tools 1.9 (kernel 2.6.34), the ttyrun program can run on target systems to start a program on a terminal device; for example, a getty program.

ttyrun is typically started during the system startup procedures and is used to prevent a respawn through the system startup procedures when a terminal is not available. For more information, see "Prevention of recurrent respawns for non-operational terminals" on page 3.

Format

ttyrun syntax

```
►►──ttyrun──┬──────┬──┬─────────────────┬── <term>── <prog>──┬───────────────────┬──────►◄
            └─ -V──┘  └─ -e <status>────┘                    └─ <prog_options>───┘
```

where:

`-V or --verbose`
: displays syslog messages.

`-e` *`<status>`* **`or --exitstatus`** *`<status>`*
: specifies an exit status that is returned when the terminal device is not available. The exit status must be an integer in the range 1 - 255.

  You can use this status value in an Upstart job file to prevent respawning.

  - With the `-e` option, ttyrun exits with the specified return value.
  - Without the `-e` option, ttyrun sleeps until it receives a signal that causes an exit.

`<term>`
: specifies the name of the terminal device and is a path relative to the `/dev` directory; for example, specify `hvc0` for `/dev/hvc0`. If the specified terminal device can be opened, ttyrun starts the specified program.

`<prog>`
: specifies an absolute path to the program to be started by ttyrun.

`<prog_options>`
: specifies arguments for the program to be started by ttyrun. Depending on the program, some arguments might be required. In the arguments, you can use `%t` as a variable that resolves to the specified terminal device.

`-v or --version`
: displays the version number of ttyrun and exits.

`-h or --help`
: displays a short help text and exits. For more detail, see the ttyrun man page.

ttyrun return values

ttyrun exits with one of the following return values to report an error condition:

1 ttyrun was called with an argument that is not valid or required but missing.

2 the <*term*> variable specifies a device that is not a terminal device.

3 ttyrun failed to start the specified program.

Do not inadvertently override these return values with the `-e` option.

4 - 255 The terminal device is not available and the `-e` option specifies an exit status in this range.

systemd example

- Enable a getty service for `hvc1` by issuing a command of this form:

  ```
  # systemctl enable ttyrun-getty@hvc1.service
  ```

  At the next system start, systemd starts the ttyrun service for `hvc1`. The ttyrun service starts a getty only if this terminal is available.
- To start the service without a system restart, issue:

  ```
  # systemctl start ttyrun-getty@hvc1.service
  ```

inittab example

- This inittab entry starts `/sbin/agetty` on terminal device `hvc1`, if available:

  ```
  h1:2345:respawn:/sbin/ttyrun hvc1 /sbin/agetty -L 9600 %t linux
  ```

  ttyrun prevents the agetty program from respawning if `hvc1` is not available.

Upstart example

- An Upstart job file with the following content starts `/sbin/agetty` on terminal device `hvc1`, if available:

  ```
  respawn
  normal exit 42
  exec /sbin/ttyrun -e 42 hvc1 /sbin/agetty -L 9600 %t linux
  ```

  With the normal exit statement, you specify an exit status that prevents Upstart from respawning the program. To prevent respawning with ttyrun, you must specify the same value for the `-e` option and for the exit status. The example uses 42.

Appendix B. ts-shell user authorization file syntax

Authorizations for `ts-shell` users to connect to target systems are granted through a user authorization file.

This file can include:
- Authorization statements
- Comment lines, which start with a number sign (#)
- Blank lines

An authorization statement has the general form:

```
<users> = <list_type>:<targets>
```

where:

<users>
: specifies who is authorized to establish connections. *<users>* can be an individual Linux user ID or a Linux user group. To distinguish users from groups, groups are prefixed with an at sign (@).

<list_type>:*<targets>*
: specifies the target systems to which connections are authorized. Target systems can be specified as a comma-separated list, in a list file, or as a regular expression.

`list:`
is followed by a comma-separated list of individual z/VM user IDs. Consider this method for specifying a few individual target systems.

`file:`
is followed by a file path to a configuration file that contains a list of z/VM user IDs, each on a separate line. Consider this method to specify numerous target systems.

Tip: Lists of z/VM user IDs can be extensive. If you have access to the z/VM user directory, see Appendix C, “Creating files with lists of z/VM user IDs,” on page 63 for a convenient method of obtaining a list.

`regex:`
is followed by a regular expression that matches z/VM user IDs. Consider this method to specify target systems that follow a naming convention.

Examples

- The following authorization statement permits user `alice` to connect to target systems LXGUEST1, LXGUEST3, LXGUEST5, LXGUEST7, and LXGUEST9.
  ```
  alice = list:lxguest1,lxguest3,lxguest5,lxguest7,lxguest9
  ```
- The following authorization statement permits all users in group `testgrp` to connect to the target systems listed in a file `/etc/iucvterm/auth/test-systems.list`.
  ```
  @testgrp = file:/etc/iucvterm/auth/test-systems.list
  ```
- The following authorization statement permits user `bob` to connect to the target systems: LXGUEST0, LXGUEST2, LXGUEST4, LXGUEST6, and LXGUEST8.
  ```
  bob = regex:lxguest[02468]
  ```

You can have multiple authorizations for the same user. Multiple authorizations can result from multiple authorization statements for the same user. Multiple authorizations can also result from authorization statements for groups of which the user is a member.

For a particular user, you can mix explicit authorizations of types list or file but you cannot mix either of these explicit authorizations with regular expressions. The first type of authorization that is found for a user, explicit or regular expression, sets the authorization type for this user. Further authorizations of the same type are accumulated. Authorizations of the other type are ignored.

The following example assumes that both user `alice` and user `bob` are members of group `users`:

```
@users = list:lxguest0,lxguest1,lxguest2
alice = list:lxguest1,lxguest3,lxguest5,lxguest7,lxguest9
bob = regex:lxguest[02468]
```

For user `alice`, the group and individual authorizations accumulate to LXGUEST0, LXGUEST1, LXGUEST2, LXGUEST3, LXGUEST5, LXGUEST7, and LXGUEST9.

For user `bob`, the regular expression is ignored and the authorizations are for LXGUEST0, LXGUEST1, and LXGUEST2 as defined for the group.

Appendix C. Creating files with lists of z/VM user IDs

You can use Linux commands to obtain lists of z/VM user IDs.

You might need lists of z/VM user IDs to specify:

- Target systems that `ts-shell` can connect to
- Target systems a particular user can connect to
- Target systems for which session logs are to be created
- A z/VM filter file

Such lists can be extensive and writing them manually is both tedious and error prone. If you have access to the z/VM user directory, and your z/VM user IDs follow a naming convention, you can use the **vmur**, **grep**, and **cut** commands to create a list from the z/VM user directory.

The **grep** and **cut** commands are core Linux commands. The **vmur** command is included in the s390-tools package.

Example: This example is based on the following assumptions:

- The z/VM user directory has been sent to the reader of your z/VM guest virtual machine.
- You want to list all z/VM user IDs that begin with LINUX and end with one or more numerals.

```
[root]# vmur receive -H -t 1234 -O |grep -E "^USER LINUX[0-9]+" |cut -d" " -f2 > userlist
```

The individual parts of this command perform these tasks:

- The **vmur** command reads out the file with spool ID 1234 from the reader.
- The **grep** command extracts all lines that specify z/VM user IDs according to the pattern.
- The **cut** command reduces the line to just the z/VM user ID.
- The greater than symbol (>) directs the output to a file, `userlist`.

You can find out the spool IDs of the files in your z/VM reader with the command:

```
[root]# vmur list -q rdr
```

Tip: Another convenient way to create lists of IDs that follow a pattern is bash brace expansion. For example, to create a list of IDs including `lnxa34` through `lnxa46`, `lnxb34` through `lnxb46`, and `lnxc34` through `lnxc46` enter:

```
$ echo lnx{a..c}{34..46} | tr ' ' '\n'
```

Appendix D. Known issues

Avoid problems that can arise from known issues.

Obtain a command prompt on a newly opened HCV terminal device

Output that is written by Linux while the terminal window is closed is not displayed. Therefore, a newly opened terminal window is always blank. For most applications, like login or shell prompts, it is sufficient to press Enter to obtain a new prompt.

Securely end sessions with HVC terminal devices

Always end sessions with HVC terminal devices by explicitly logging off (for example, type exit and press Enter).

If a logoff results in a new login prompt, press Control and Underscore (Ctrl+_) then press d to close the terminal session. Simply closing the terminal window for a hvc0 terminal device that was activated for Linux kernel messages leaves the device active. The terminal session can then be reopened without a login.

Assure sufficient space for session transcripts

If you want to create session transcripts for one or more terminals, ensure that there is always sufficient disk space for new transcripts. For example, use a cron job to monitor the available disk space and purge obsolete transcripts at regular intervals according to your audit policies. If disk space runs out, no further transcripts are written.

Do not assign reserved terminal IDs to iucvtty instances

The following terminal IDs are reserved for the z/VM IUCV HVC device driver: `lnxhvc0` - `lnxhvc7` and `lnxhvc`. Do not assign any of these terminal IDs when setting up iucvtty instances.

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