Network Performance Insight
References
Before you use this information and the product it supports, read the information in "Notices" on page 27.
Contents

References ........................................ v
Intended audience ................................... v
Organization .......................................... v
Network Performance Insight overview ....... v
Service Management Connect ................... vii
Network Performance Insight technical training .. vii
Support information ................................. vii
Conventions used in this publication .......... viii
  Typeface conventions .............................. viii

Chapter 1. Database administration ....... 1
Backup data ............................................ 1
  Backing up data ................................... 2
Restoring data ........................................ 3

Chapter 2. Command line interface ...... 7
service npi command reference ................ 7
npid command reference .......................... 8
backup command reference ....................... 8
restore command reference ....................... 9
encrypt command reference ...................... 9

Chapter 3. Configuring Flow devices .... 11
Supported devices and flow formats .......... 11
Configuring NetFlow on Cisco routers ...... 11
  Cisco IOS command modes ..................... 12
Enabling NetFlow on your devices .......... 13
Configuring the Flow Exporters ............. 13
Customizing the number of entries in flow cache 15
Monitoring NetFlow information .......... 15
An example Cisco device configuration ... 16
Configuring flow on Juniper devices ......... 16
  Configuring J-Flow versions 5 and 8 ....... 17
  Configuring J-Flow version 9 ............... 18
  Configuring J-Flow version 9 for SRX-DataCenter devices ................................. 20
Using the show commands ....................... 20
Configuring NetStream traffic on Huawei devices 25
Configuring NetStream export .................. 25

Notices ............................................. 27
Trademarks .......................................... 29
Terms and conditions for product documentation .... 30
References

Provides you with additional reference information to help you work with IBM® Network Performance Insight effectively.

Intended audience

The audience who are network administrators or operations specialist responsible for installing the Network Performance Insight product suite on an enterprise network.

To install Network Performance Insight successfully, you must have a thorough understanding of the following subjects:

- Network Performance Insight 1.1.1 system
- Basic principles of network protocols and network management
- NetFlow concepts
- Administration of the Linux
- Jazz™ for Service Management
- IBM Tivoli® Network Manager
- IBM Tivoli Netcool/OMNibus

Organization

Read this summary to help you find the information that you need.

This information is organized as follows:

- Chapter 1, “Database administration,” on page 1
- Chapter 2, “Command line interface,” on page 7
- Chapter 3, “Configuring Flow devices,” on page 11

Network Performance Insight overview

IBM Network Performance Insight is a flow-based network traffic performance monitoring system.

Network Performance Insight provides comprehensive, flexible, and scalable traffic data management with visualization and reporting to support complex, multi-vendor, multi-technology networks. It offers a range of dashboard views with robust security features that are designed to meet the needs of executive management and converging network and IT operations teams.

Network Performance Insight offers near real-time and interactive view on the traffic data that helps in reduced network repair times and optimized network performance.

Network Performance Insight provides IBM Netcool® Operations Insight with network performance monitoring capabilities to address modern network management challenges around application-oriented, software-defined-networks in the enterprise data centers and intranet.
The following diagram shows how data is flowing through the various components in Network Performance Insight:

The flow records that are sent by the configured flow exporters are collected by Collector, and sent to Inventory or Analytics component based on the information that they contain.

Analytics component performs flow data aggregation. These results are then stored in Network Performance Insight database.

Additionally, you can enable or disable the processing of flow records on each flow interface on Dashboard Application Services Hub portal. The dashboards provide up-to-date actionable information to provide an insight into network problems and streamline root cause analysis.

The data from the Storage component can be queried to display the results on Network Health Dashboard or OMNibus Web GUI from Active Event List or Event Viewer.

You must integrate Network Performance Insight with IBM Tivoli Network Manager and Tivoli Netcool/OMNibus components of IBM Netcool Operations Insight to take advantage of its network topology views and fault management capabilities.

Network Performance Insight includes the following documents:

- Release summary
- Quick Start Guide
- Installing Network Performance Insight
- Configuring Network Performance Insight
- Integrating with Netcool Operations Insight
• Getting Started with Network Performance Insight
• Troubleshooting Network Performance Insight
• References
• Technical notes

Related information:

IBM Network Performance Insight on IBM Knowledge Center

Service Management Connect

Connect, learn, and share with Service Management professionals: product support technical experts who provide their perspectives and expertise.

Use Service Management Connect in the following ways:
• Become involved with transparent development, an ongoing, open engagement between other users and IBM developers of Tivoli products. You can access early designs, sprint demonstrations, product roadmaps, and prerelease code.
• Connect one-on-one with the experts to collaborate and network about Tivoli and the Network and Service Assurance community.
• Read blogs to benefit from the expertise and experience of others.
• Use wikis and forums to collaborate with the broader user community.

Related information:

IBM Network Performance Insight community on developerWorks

Network Performance Insight technical training

For Tivoli technical training information, see the following Network Performance Insight Training website at https://tnpmsupport.persistentsys.com/updated_trainings.

Support information

If you have a problem with your IBM Software, you want to resolve it quickly. IBM provides the following ways for you to obtain the support you need:

Online

IBM Support Assistant
The IBM Support Assistant is a free local software serviceability workbench that helps you resolve questions and problems with IBM Software products. The Support Assistant provides quick access to support-related information and serviceability tools for problem determination. To install the Support Assistant software, go to http://www.ibm.com/software/support/isa

Troubleshooting Guide
For more information about resolving problems, see the problem determination information for this product.
Conventions used in this publication

Several conventions are used in this publication for special terms, actions, commands, and paths that are dependent on your operating system.

Typeface conventions

This publication uses the following typeface conventions:

**Bold**
- Lowercase commands and mixed case commands that are otherwise difficult to distinguish from surrounding text
- Interface controls (check boxes, push buttons, radio buttons, spin buttons, fields, folders, icons, list boxes, items inside list boxes, multicolumn lists, containers, menu choices, menu names, tabs, property sheets), labels (such as Tip:, and Operating system considerations:)
- Keywords and parameters in text

*Italic*
- Citations (examples: titles of publications, diskettes, and CDs)
- Words defined in text (example: a nonswitched line is called a point-to-point line)
- Emphasis of words and letters (words as words example: "Use the word that to introduce a restrictive clause."); letters as letters example: "The LUN address must start with the letter L.")
- New terms in text (except in a definition list): a view is a frame in a workspace that contains data.
- Variables and values you must provide: ... where myname represents....

**Monospace**
- Examples and code examples
- File names, programming keywords, and other elements that are difficult to distinguish from surrounding text
- Message text and prompts addressed to the user
- Text that the user must type
- Values for arguments or command options

**Bold monospace**
- Command names, and names of macros and utilities that you can type as commands
- Environment variable names in text
- Keywords
- Parameter names in text: API structure parameters, command parameters and arguments, and configuration parameters
- Process names
- Registry variable names in text
- Script names
Chapter 1. Database administration

Provides information about essential administration tasks such as backing up and restoring your traffic data that is stored in a specialized, indigenously developed database in IBM Network Performance Insight.

As a part of database best practices, it is recommended that you run backup operation regularly. Backup and recovery procedures protect your database against data loss and reconstruct the data, if there is a data loss.

A backup is a safeguard against unexpected data loss and application errors. If you lose the original data, then you can reconstruct it by using a backup.

You can use Network Performance Insight backup and restore scripts.

Backup data

There are two modes of backup in Network Performance Insight.

**Full backup**

Backup of the entire database. It represents the state of the database at the time when backup procedure completes.

**Differential backup**

Backup of the changed data since the previous backup. It backs up only the changed files since the previous full or differential backup to the most recent changes to the database files.

During the backup procedure, by default the backup engine creates the backup snapshot in the `<NPI_Home>/work/backup-snapshot` directory. The backup snapshot consists of hard link to the storage files.

The backup script identifies the backup mode based on the previous backup that is done from the snapshot directory.

By default, the backup procedure maintains a total of 7 backup snapshots, which consist of 1 full snapshot and 6 differential snapshot at any time in the backup-snapshot directory. The backup snapshots count is configurable in `npi.conf` file. See *Editing default settings in a configuration file* in *Configuring Network Performance Insight*.

Consider the following scenarios:

- There are 1 full and 5 differential backup snapshots that are created in the backup-snapshot directory. When you now run the backup script, it creates the sixth differential backup snapshot in the `<NPI_Home>/work/backup-snapshot` directory that contains the files that are changed since the previous backup.

- There are 1 full and 6 differential backup snapshots that are created in the backup-snapshot directory.
When you now run the backup script, it creates a new full backup snapshot and removes all previous snapshots.

The following table describes the naming convention of the backup file directories:

<table>
<thead>
<tr>
<th>Backup mode</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td><code>yyyy.MM.dd-HH.mm.ss-full</code></td>
</tr>
<tr>
<td></td>
<td>For example: <code>2015.08.10-04.57.31-full</code></td>
</tr>
<tr>
<td>Differential</td>
<td><code>yyyy.MM.dd-HH.mm.ss-diff</code></td>
</tr>
<tr>
<td></td>
<td>For example: <code>2015.08.24-10.44.09-diff</code></td>
</tr>
</tbody>
</table>

**Backing up data**

Create a backup of your Network Performance Insight database to prevent data loss if there is a database service outage. A simple backup script is used to do this task.

**Before you begin**

Ensure that the process is up and running.

To start the npi process, run the following command as root user:

```bash
# cd <NPI_Home>/bin
# ./npid start
```

**Procedure**

1. Log in as root user.
2. Change to `/<NPI_Home>/bin` directory:
   ```bash
   # cd /<NPI_Home>/bin
   ```
3. Run the following command to start the database backup procedure:
   ```bash
   # ./backup
   ```

By default, the backup script takes the following two parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-path</td>
<td><code>&lt;NPI_Home&gt;/work/backup</code></td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong>: The default destination directory for the tar files.</td>
</tr>
<tr>
<td>-tool</td>
<td><code>&lt;NPI_Home&gt;/bin/backup-tool</code></td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong>: The backup script uses the default backup-tool script that is available in the Network Performance Insight package.</td>
</tr>
</tbody>
</table>

The backup script performs the following tasks in the background:

- Creates the backup snapshot in `/<NPI_Home>/work/backup-snapshot` directory.
  
The backup-snapshot directory consists of hard link to the `/<NPI_Home>/work/storage` files.
- Creates tar files of the `<NPI_Home>/work/backup-snapshot` folders to the backup destination directory. By default, `<NPI_Home>/work/backup`. 
For example, the contents of the work/backup directory:

```
# cd /opt/IBM/npi/work/backup
# ls -lrt
-rw-r--r-- 1 root root 14773749760 Aug 10 10:29 2015.08.10-04.57.31-full.tar
-rw-r--r-- 1 root root 11803054080 Aug 24 16:15 2015.08.24-10.44.09-diff.tar
-rw-r--r-- 1 root root 727040 Aug 26 13:14 2015.08.26-07.44.27-diff.tar
-rw-r--r-- 1 root root 440320 Aug 26 14:22 2015.08.26-08.52.02-diff.tar
```

4. Optional: Run the backup script with `-path` option to back up the tar files to a different file system or location by using the following command:

```
# cd /<NPI_Home>/bin
# ./backup -path <Destination_directory>
```

It creates tar files of the `<NPI_Home>/work/backup-snapshot` folders to the backup destination directory that is specified in `-path`.

5. Optional: Run the backup script with `-tool` option, if you want to override the default backup-tool script, by using the following command:

```
# cd <NPI_Home>/bin
# ./backup -tool <Customised_script>
```

Where, the `Customized_script` is the full path of the script.

The `Customized_script` takes the following parameters from the backup script:

a. The full path of backup-snapshot directory.

b. The full path of backup directory.

By running the `Customized_script`, it provides the user the flexibility to perform any required tasks by using both the parameters as specified in (a) and (b).

**Note:** It depends entirely to the user on how they want to customize their backup-tool script.

Most importantly, user needs to know the backup-snapshot directory as this information is needed during the restore procedure.

6. Verify the `<NPI_Home>/log/backup.log` file for any issues during the backup procedure.

All messages during backup procedure are logged in `backup.log`.

**Related reference:**

["backup command reference" on page 8](#)

**Usage for the backup command:** Run the **backup** command to back up Network Performance Insight storage database.

---

**Restoring data**

You can restore the Network Performance Insight database to a previous state by using the restore option. A backup image of the database must exist before you can use this script. The database is restored to the same state as the backup copy. A simple restore script is used to do this task.

**About this task**

Explains how to perform restore operation on Network Performance Insight database environment.

There are two typical scenarios when a restore procedure can be done.

1. Chapter 1. Database administration 3
Restore to a new Network Performance Insight installation state.

When Network Performance Insight storage and backup-snapshot folders are corrupted or deleted due to any disk or system failure.

For example, you had a disk failure in your system and Network Performance Insight storage and backup-snapshot folders are deleted. Perform restore procedure by using the backup tar files that were saved remotely to any other devices from the Network Performance Insight server.

2. Restore to an existing Network Performance Insight installation state.

You want to restore the database to any state as the last backups that are done, while Network Performance Insight is still running.

For example, you have a running Network Performance Insight system. You want to restore your database to a state of a last backup that is done, for example, yesterday.

Procedure

1. Log in as root user.

   **Important:** Steps 2 - 5 are only applicable to Restore to a new Network Performance Insight installation state scenario.

   These steps are not needed when `<NPI_Home>/work/backup-snapshot` directory exists in your system.

2. Change to the `<NPI_Home>` directory:

   ```
   # cd <NPI_Home>
   ```

3. Create the following directory to hold the previously backup tar files of your Network Performance Insight:

   ```
   # mkdir -p work/backup-snapshot
   ```

4. From your backup device, copy the last 7 backup snapshots tar files, which include the most recent full backup snapshot tar file, to the following directory of your Network Performance Insight server:

   `<NPI_Home>/work/backup-snapshot`

5. Extract all copied backup tar files. For example,

   ```
   # tar -xvf 2015.08.10-04.57.31-full.tar
   ```

6. Before you run the restore procedure, the Network Performance Insight process needs to be stopped. Run the following command to stop the process:

   ```
   # cd <NPI_Home>/bin
   # ./npid stop
   ```

7. To restore from a previous backup file, run the following command:

   ```
   # cd <NPI_Home>/bin
   # ./restore
   ```

   The restore script backs up the storage folder, `<NPI_Home>/work/storage` by renaming the folder to `<NPI_Home>/work/restore-backup`.

   After the restore procedure successfully completes:

   - The backup content is restored from `<NPI_Home>/work/backup-snapshot` to the `<NPI_Home>/work/storage` directory.
   - The restore script removes the `<NPI_Home>/work/restore-backup` directory.

8. Verify the `restore.log` file for no issues during the restore procedure.

   All messages during restore procedure are logged in `<NPI_Home>/log/restore.log`

9. Run the following command to start Network Performance Insight process:
10. Check `<NPI_Home>/log/npid.log` to ensure that process starts without any errors.

Failed to restore

11. If a restore procedure fails, you can identify the following error message from the `restore.log`:

   GYMCSB1020 - Unable to revert Storage dir

   The error message indicates that the restore procedure fails, where the restore script is unable to revert the `<NPI_Home>/work/restore-backup` to `<NPI_Home>/work/storage` directory.

12. Remove the following directory. For example,

   # rm -rf `<NPI_Home>/work/storage`

13. Rename the `<NPI_Home>/work/restore-backup` directory to `<NPI_Home>/work/storage`.

Chapter 2. Command line interface

Provide command-line interfaces that are available in IBM Network Performance Insight to support installation, configuration, administration, and other tasks.

A list of commands available for Network Performance Insight users and administrators.

service npi command reference

Usage for the service npi command. Run the service npi command to start, stop, and restart Network Performance Insight.

Location

Note: service npi command is intended to be run as root user to start Network Performance Insight at system startup. It can be run by a non-root user, but it requires the password of the user it is configured to run the system.

<NPI_Home>/service

NPI_Home is the location where Network Performance Insight is installed. For example, /opt/IBM/NPI.

Syntax

service npi {start | stop | restart | kill | status | version | help}

Parameters

start
Starts Network Performance Insight application.

stop
Stops Network Performance Insight application.

restart
Stops and starts Network Performance Insight application.

kill
Kills the Network Performance Insight application process by using the command kill -9.

status
Checks if Network Performance Insight application process ID (PID) is running when you use the command ps -eaf.

version
Shows the version of Network Performance Insight that is installed.

help
Displays the usage for npi service command.
npid command reference

Usage for the npid command. Run the npid command to start, stop, and restart Network Performance Insight.

Location

<NPI_Home>/bin

NPI_Home is the location where Network Performance Insight is installed. For example, /opt/IBM/NPI.

Syntax

npid {start | stop | restart | kill | status | version | help}

Parameters

start
Starts Network Performance Insight application.

stop
 Stops Network Performance Insight application.

restart
 Stops and starts Network Performance Insight application.

kill
Kills the Network Performance Insight application process by using the command kill -9.

status
 Checks if Network Performance Insight process is running when you use the command ps -eaf.

version
 Shows the version of Network Performance Insight that is installed.

help
 Displays the usage for npid command.

backup command reference

Usage for the backup command. Run the backup command to back up Network Performance Insight storage database.

Location

<NPI_Home>/bin

NPI_Home is the location where Network Performance Insight is installed. For example, /opt/IBM/NPI.

Syntax

backup [-path | -tool]
Parameters

-path
The directory path of where the backup tar files are stored. By default, <NPI_Home>/work/backup

-tool
By default, this option uses the <NPI_Home>/bin/backup-tool script to create tar files of the backup-snapshot folders to the path specified in -path.

restore command reference

Usage for the restore command. Run the restore command to restore Network Performance Insight storage database.

Location

<NPI_Home>/bin

NPI_Home is the location where Network Performance Insight is installed. For example, /opt/IBM/NPI.

Syntax

restore

encrypt command reference

Usage for the encrypt command. Encrypts the passwords that are created for Jazz for Service Management and for Tivoli Netcool/OMNibus components.

Location

<NPI_Home>/bin

NPI_Home is the location where Network Performance Insight is installed. For example, /opt/IBM/NPI.

Syntax

encrypt <password>

Parameters

password
Provide the password to be encrypted.

The encrypted password must be copied to the npi.conf file. The encrypted forms of some passwords are required for security reasons. For example, https.keystore.password, https.key.password, security.dash.password, and event.netcool.omnibus.rest-api.password.

Note: The encrypted form of the password is randomly generated and you might get a different output when you run the tool multiple times.
Chapter 3. Configuring Flow devices

Provides the command reference with examples for configuring the flow devices to enable them to work with IBM Network Performance Insight, Version 1.1.1.

Before Network Performance Insight can gather data, routers and other network devices must be configured to send NetFlow data. These configurations are needed to ensure that routers send NetFlow data periodically to the Collector subsystem.

For more detailed information about setting up flow devices for Network Performance Insight, see the specific vendor documentation.

CAUTION:
Only IT administrators with experience in configuring routers and switches must use this information.

Supported devices and flow formats

IBM Network Performance Insight, Version 1.1.1 supports most of the devices and their flow formats that are available in the market.

Some of devices and their flow formats that Network Performance Insight v1.1.1 supports:

<table>
<thead>
<tr>
<th>Device</th>
<th>Flow format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco</td>
<td>NetFlow (v1, v5, v9, and IPFIX versions)</td>
</tr>
<tr>
<td>Juniper</td>
<td>J-Flow (v5 and v9)</td>
</tr>
<tr>
<td>Alcatel</td>
<td>Cflow (v5 and v9)</td>
</tr>
<tr>
<td>Huawei</td>
<td>NetStream (v5 and v9)</td>
</tr>
</tbody>
</table>

Configuring NetFlow on Cisco routers

Netflow is a data collection and reporting protocol for monitoring network traffic that is supported by multiple vendors.

As a part of this configuration, network administrators must configure the devices to transmit NetFlow information actively to the network monitoring application and configure the interfaces to gather information about the traffic conversations. The configurations that you perform must be in line with the capacity of the network application. In this case, Network Performance Insight.

NetFlow also monitors layers 2-4 of Open Systems Interconnection (OSI) model and other flow technologies and provides information on network usage and port conversations activity.

Related information:

Cisco IOS Configuration Fundamentals Command Reference, Release 12.2
Cisco IOS command modes

You use the CLI to access Cisco IOS software.

Enter a question mark (?) at the CLI prompt to obtain a list of commands that are available for each command mode.

When you log in to the CLI, you are in user EXEC mode. User EXEC mode contains only a limited subset of commands. To have access to all commands, you must enter privileged EXEC mode, normally by using a password. From privileged EXEC mode, you can give any EXEC command; user or privileged mode. Or, you can enter global configuration mode.

These configuration modes are needed for you to change the running configuration. If you later save the running configuration to the start configuration, these changed commands are stored when the software is rebooted. To enter specific configuration modes, you must start at global configuration mode. From global configuration mode, you can enter interface configuration mode and various other modes, such as protocol-specific modes.

Command modes

Describes how to use various common command modes of the Cisco IOS software.

Command modes

Shows examples of the prompts displayed.

<table>
<thead>
<tr>
<th>Command mode</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Exec</td>
<td></td>
</tr>
<tr>
<td>When you log in to the CLI, you are in User Exec mode. Contains only a limited subset of commands.</td>
<td>Router&gt;</td>
</tr>
<tr>
<td>Privileged Exec</td>
<td></td>
</tr>
<tr>
<td>You can have access to all commands in this mode. Typically, require a password. Use the enable command. Your prompt changes to Router#.</td>
<td>Router&gt; enable Password &lt;password&gt; Router#</td>
</tr>
<tr>
<td>Global configuration</td>
<td></td>
</tr>
<tr>
<td>Enter the configure terminal privileged EXEC command to enter global configuration mode. Your prompt changes to Router(config)#.</td>
<td>Router# configure terminal Router(config)#</td>
</tr>
<tr>
<td>Note: Enter configuration commands, one per line. End with CTRL+Z or Exit command.</td>
<td></td>
</tr>
<tr>
<td>Interface configuration</td>
<td></td>
</tr>
<tr>
<td>From global configuration mode, specify an interface by using an interface command. Your prompt changes to Router(config_if)#. Note: Enter “?” to display what you must enter next on the command line.</td>
<td>Router(config)# interface serial ? &lt;0-6&gt; Serial interface number Router(config)# interface serial 4 ? / Router(config)# interface serial 4/ ? &lt;0-3&gt; Serial interface number Router(config)# interface serial 4/0 Router(config-if)#</td>
</tr>
</tbody>
</table>

12 Network Performance Insight References
Enabling NetFlow on your devices

To enable NetFlow, configure IP routing and use these commands in global configuration mode.

About this task

Enabling flow monitoring for an interface.

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# interface type slot/port-adapter/port</td>
<td>Enters interface configuration mode and configures the interface. For example, interface GigabitEthernet1/0/3</td>
</tr>
<tr>
<td>Router(config-if)# ip route-cache flow</td>
<td>Enables NetFlow for IP routing.</td>
</tr>
<tr>
<td>Router(config-if)# ip route-cache ingress</td>
<td>Enables NetFlow on the sub interfaces with direction.</td>
</tr>
<tr>
<td>Router(config-if)# ip route-cache egress</td>
<td></td>
</tr>
<tr>
<td>Router(config-if)# ip flow egress</td>
<td></td>
</tr>
<tr>
<td>Router(config-if)# ip flow ingress</td>
<td></td>
</tr>
</tbody>
</table>

Configuring the Flow Exporters

NetFlow information can also be exported to network management applications.

About this task

To configure a router to export NetFlow information that is maintained in the NetFlow cache to Network Performance Insight, use these commands in global configuration mode. NetFlow information is exported to Network Performance Insight when the Flow expires in NetFlow cache.

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
</table>
| Router(config)# ip flow-export ip-address udp-port | Configures a router to export NetFlow cache entries to a Collector. Where:
  - `<IP_address>`: IP address of the system to which you want to send the NetFlow information.
  - `udp-port`: UDP protocol-specific port number. |
<p>| Note: To disable IP routing, use the no IP routing command as: no ip flow-export. |</p>
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# ip flow-export version 9 [peer-as</td>
<td>origin-as</td>
</tr>
<tr>
<td>• peer-as</td>
<td>Specifies that export statistics include the originating autonomous system for the source and destination.</td>
</tr>
<tr>
<td>• origin-as</td>
<td>Specifies that export statistics include the peer autonomous system for the source and destination.</td>
</tr>
<tr>
<td>• bgp-nexthop</td>
<td>Specifies that export statistics include BGP next hop-related information.</td>
</tr>
<tr>
<td>show ip flow export</td>
<td>Displays statistics for the NetFlow data export, including statistics for the main cache and for all other enabled caches.</td>
</tr>
<tr>
<td>Router(config)# ip flow-export source &lt;interface&gt;/interface_number</td>
<td>Sets the source IP address of the NetFlow exports that are sent by the device to the specified IP address.</td>
</tr>
<tr>
<td>Router(config)# ip flow-cache timeout active 1</td>
<td>Active timeout is the frequency of active flow records that are exported from the flow cache to Network Performance Insight. Default value is 30 min. To get real-time traffic reports, set this value to 1.</td>
</tr>
<tr>
<td>Router(config)# ip flow-cache timeout inactive 15</td>
<td>Inactive timeout is the frequency of inactive flow records that are exported from the flow cache to Network Performance Insight. A flow record is inactive when the conversation between two interfaces is stopped. Default value is 15 sec.</td>
</tr>
</tbody>
</table>

Related information:
- [Configuring NetFlow and NetFlow Data Export](#)
Customizing the number of entries in flow cache

You can increase or decrease the number of entries that are maintained in the cache to meet your NetFlow traffic rates. The number of entries can be 1024 - 524288. The default is 65536.

**About this task**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# ip flow-cache entries &lt;number&gt;</td>
<td>Changes the number of entries that are maintained in the NetFlow cache.</td>
</tr>
<tr>
<td></td>
<td>CAUTION: Improper use of this feature might cause network problems. To return to the default NetFlow cache entries, use the no ip flow-cache entries in global configuration mode.</td>
</tr>
</tbody>
</table>

Monitoring NetFlow information

Use these commands to verify whether the NetFlow data export is functioning and displaying the data.

**About this task**

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router# show ip flow export</td>
<td>Displays information about NetFlow flow exporters and statistics.</td>
</tr>
<tr>
<td>Router# show flow exporter &lt;exporter_name&gt;</td>
<td>Displays the statistics of the specified Flow Exporter.</td>
</tr>
<tr>
<td>Router# show ip flow interface</td>
<td>Displays NetFlow accounting configuration on interfaces.</td>
</tr>
<tr>
<td>Router# show ip interface</td>
<td>Displays the usability status of interfaces that are configured for IP.</td>
</tr>
<tr>
<td>Router# show ip cache flow</td>
<td>Displays the NetFlow statistics such as:</td>
</tr>
<tr>
<td></td>
<td>• IP packet size distribution</td>
</tr>
<tr>
<td></td>
<td>• IP flow cache information</td>
</tr>
<tr>
<td></td>
<td>• Flow information: protocol, total flow, flows per second</td>
</tr>
<tr>
<td>Router# clear ip flow stats</td>
<td>Clears the NetFlow statistics.</td>
</tr>
</tbody>
</table>
An example Cisco device configuration

Need more information
configure terminal
interface serial 3/0/0
ip route-cache flow
exit
ip flow-export 127.1.0.0 0 version 5 peer-as
exit
clear ip flow stats
Router# show ip cache flow

The output is as shown:

| IP packet size distribution (230151 total packets): |  
|---------------------------------------------------|---
| 1-32 64 96 128 160 192 224 256 288 320 352 384 416 448 480 |  
| .999 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 |  
| 512 544 576 1024 1536 2048 2560 3072 3584 4096 4608 |  
| .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 |  

Configuring flow on Juniper devices

Provides commands and examples to configure J-Flow on an SRX Series device.

Command modes

<table>
<thead>
<tr>
<th>Command mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational mode</td>
<td>This mode displays the status of the device. In operational mode, you enter commands to monitor and troubleshoot the Junos OS, devices, and network connectivity.</td>
</tr>
<tr>
<td>When you log in to the router and type the CLI command, you are automatically in operational mode:</td>
<td></td>
</tr>
<tr>
<td>user@host&gt;</td>
<td></td>
</tr>
<tr>
<td>Configuration mode</td>
<td>A configuration for a device that is running on Junos OS is stored as a hierarchy of statements. In configuration mode, you enter these statements to define all properties of the Junos OS, including interfaces, general routing information, routing protocols, user access, and several system and hardware properties.</td>
</tr>
<tr>
<td>user@host&gt;configure</td>
<td></td>
</tr>
<tr>
<td>user@host#</td>
<td></td>
</tr>
<tr>
<td>To exit the mode, give the following commands:</td>
<td></td>
</tr>
<tr>
<td>user@host# commit and-quit</td>
<td></td>
</tr>
<tr>
<td>commit complete</td>
<td></td>
</tr>
<tr>
<td>user@host</td>
<td></td>
</tr>
<tr>
<td>To exit without commit:</td>
<td></td>
</tr>
<tr>
<td>user@host# exit</td>
<td></td>
</tr>
<tr>
<td>Exiting configuration mode</td>
<td></td>
</tr>
<tr>
<td>user@host&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Active Flow monitoring

Flow monitoring versions 5, 8, and 9 support active flow monitoring. For active flow monitoring, the monitoring station participates in the network as an active router. A router performs the following actions during active Flow monitoring:

- Sampling
  The router selects and analyzes only a portion of the traffic.
- Sampling with templates
The router selects, analyzes, and arranges a portion of the traffic into templates.

- **Sampling per sampling instance**
  The router selects, analyzes, and arranges a portion of the traffic according to the configuration and binding of a sampling instance.

- **Port mirroring**
  The router copies entire packets and sends the copies to another interface.

- **Multiple port mirroring**
  The router sends multiple copies of monitored packets to multiple export interfaces with the next-hop-group statement at the (edit forwarding-options) hierarchy level.

- **Discard accounting**
  The router accounts for selected traffic before it discards. Such traffic is not forwarded out of the router. Instead, the traffic is quarantined and deleted.

- **Flow-tap processing**
  The router processes requests for active flow monitoring dynamically by using the Dynamic Tasking Control Protocol (DTCP).

Some of the commands for these actions are described here.

**Related information:**

- [Flow Monitoring Feature Guide for Routing Devices](#)
- [Active Flow Monitoring Overview](#)

**Configuring J-Flow versions 5 and 8**

Commands to configure J-Flow versions 5 and 8.

**About this task**

<table>
<thead>
<tr>
<th>Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>user@host# set interfaces ge-0/0/0 unit 0 family inet sampling input</td>
<td>Enables sampling on one or more interfaces and specify the direction.</td>
</tr>
<tr>
<td>user@host# set interfaces ge-0/0/0 unit 0 family inet sampling output</td>
<td></td>
</tr>
</tbody>
</table>

Chapter 3. Configuring Flow devices  17
### Commands

<table>
<thead>
<tr>
<th>Description</th>
<th>Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specifies the sampling rate.</td>
<td>user@host# set forwarding-options sampling input rate 100</td>
</tr>
<tr>
<td>CAUTION: Caution: Activation of flow collection can have a significant impact on the performance of the SRX Series device. The smaller the sample rate, the bigger the impact. It is recommended to not use a sampling input rate of 1. Where:</td>
<td></td>
</tr>
<tr>
<td>forwarding-options Starts the inline J-Flow configuration, so that the sampling and the J-Flow service thread are implemented in the forwarding engine.</td>
<td>user@host# set forwarding-options sampling family inet output flow-server 10.10.10.1 port 2056</td>
</tr>
<tr>
<td>sampling Configures the J-Flow packet sampling options.</td>
<td>user@host# set forwarding-options sampling family inet output flow-server 10.10.10.1 version 5</td>
</tr>
<tr>
<td>input Enables sampling.</td>
<td></td>
</tr>
<tr>
<td>rate Specifies the ratio of packets to be sampled.</td>
<td></td>
</tr>
<tr>
<td>Specifies the UDP port number of the host that is collecting cflowd packets.</td>
<td></td>
</tr>
<tr>
<td>Specify the version format 5.</td>
<td></td>
</tr>
</tbody>
</table>

### Related information:

- [SRX Getting Started - Configure J-Flow](#)

### Configuring J-Flow version 9

Commands to configure J-Flow versions 9.

### About this task

<table>
<thead>
<tr>
<th>Description</th>
<th>Commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configures the J-Flow v9 template. Note: Currently, the IPv4 template is supported.</td>
<td>user@host# set services flow-monitoring version9 template v4 flow-active-timeout 30</td>
</tr>
<tr>
<td>Specifies the J-Flow v9 template template v4 flow-inactive-timeout 30</td>
<td>user@host# set services flow-monitoring version9 template v4 &lt;ipv4-template&gt;</td>
</tr>
<tr>
<td>Specifies the sampling rate and run length.</td>
<td>user@host# set forwarding-options sampling input rate 100</td>
</tr>
<tr>
<td></td>
<td>user@host# set forwarding-options sampling input run-length 0</td>
</tr>
</tbody>
</table>
### Commands

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configures the external flow collector and its port number. <strong>Note:</strong></td>
<td><code>user@host# set forwarding-options sampling family inet output flow-server</code></td>
</tr>
<tr>
<td>The J-Flow v9 template is associated with the external flow collector. Up to eight flow collectors can be simultaneously configured.</td>
<td><code>&lt;IP_address&gt;</code> port 2222</td>
</tr>
<tr>
<td>Configures the internal J-Flow, so that the sampling and the J-Flow service thread are implemented in the forwarding engine.</td>
<td><code>user@host# set forwarding-options input</code></td>
</tr>
<tr>
<td>Configure the sampling filter on an interface (or interfaces) in the direction, on which the J-Flow service is required.</td>
<td><code>user@host# set interfaces ge-0/0/14 unit 0 family inet sampling input</code></td>
</tr>
<tr>
<td>Displays all the configured interfaces.</td>
<td><code>user@host# show interfaces descriptions</code></td>
</tr>
</tbody>
</table>

### Related information:

- [Juniper Flow Monitoring](#)  

### Configuring the sampling instance

You can configure active sampling by using a sampling instance and associate that sampling instance to a particular Packet Forwarding Engine. In addition, you can define multiple sampling instances that are associated with multiple destinations (as many as the number of Packet Forwarding Engines in the chassis), with multiple protocol families per each sampling instance destination.

### Related information:

- [Example: Sampling Instance Configuration](#)
# Configuring J-Flow version 9 for SRX-DataCenter devices

Commands to configure J-Flow versions 9 for SRX-DataCenter devices.

## About this task

<table>
<thead>
<tr>
<th>Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>user@host# set services flow-monitoring version9 template &lt;template_name&gt;</code></td>
<td>Configures the J-Flow v9 template</td>
</tr>
<tr>
<td><code>user@host# set sampling family inet output flow server &lt;flow_collector_ip_add&gt; port &lt;flow_collector_port&gt; version9 template &lt;template_name&gt;</code></td>
<td>Configures external flow collector, in this case, Network Performance Insight Collector.</td>
</tr>
<tr>
<td><code>user@host# set forwarding-options sampling instance &lt;instance1&gt; input rate 100</code></td>
<td>Specifies the sampling rate. <strong>Note:</strong> Currently, IPv4 template is supported.</td>
</tr>
<tr>
<td><code>user@host# set forwarding-options sampling instance &lt;instance1&gt; input run-length 0</code></td>
<td>Configures the external flow collector and its port address. <strong>Note:</strong> The J-Flow v9 template is associated with the external flow collector. Up to eight flow collectors can be simultaneously configured.</td>
</tr>
<tr>
<td><code>user@host# set forwarding-options sampling instance &lt;instance1&gt; family inet output flow-server &lt;Ip_address&gt; port 2222</code></td>
<td>Configures the inline-jflow, so that the sampling and the J-Flow service thread are implemented in the forwarding engine.</td>
</tr>
<tr>
<td><code>user@host# set interfaces ge-0/0/14 unit 0 family inet sampling input</code></td>
<td>Configures the sampling filter on an interface (or interfaces) in the direction, on which the J-Flow service is required.</td>
</tr>
</tbody>
</table>

## Related information:

- [SRX Getting Started - Configure J-Flow](#)

## Using the show commands

Describes the possible show command options in configuration mode and Operational mode.

### About this task

```bash
configure
//To enter a configuration mode
show ?
```
Execute this command
> access
> access-profile
> accounting-options
> applications
+ apply-groups
> chassis
> class-of-service
> ethernet-switching-options
> event-options
> firewall
> forwarding-options
> groups
> interfaces
> multi-chassis
> multicast-snooping-options
> policy-options
> protocols
> routing-instances
> routing-options
> schedulers
> security
> services
> smtp
> snmp
> system
> vlans
> pipes

Exit
//To exit the configuration mode
Show
// To run the show command options in User Exec mode
accounting
arp
as-path
authorization-whitelist
bfd
dbg
chassis
class-of-service
cll
configuration
connections
database-configuration
dhcp
dhcpv6
dialer
dotlx
dvmrp
dynamic-tunnels
dss
ethernet-switching
event-options
firewall
forwarding-options
gvrp
helper
hfr
host
iccp
ingress-blocking
interfaces
ipv6
isdn
isis
12circuit
12vpn
lacp
ldp
lldp
log
mld
mld-snooping
mpls
msdp
multicast
mvnp
network-access
ntp
oam
ospf
ospf3
pte
pgm
pim
policer
policy
ppp
pppoe
r2cp
rip
rping
route
rsrp
.sap
.schedulers
.security
.services
.smtp
.snmp
.spanning-tree
.system
.task
.ted
.tgm
.version
.vlans
.vpls
.vrrp
.wan-acceleration
Show accounting profiles and records
Show system Address Resolution Protocol table entries
Show table of known autonomous system paths
Show IPv6 White List MAC addresses
Show Bidirectional Forwarding Detection information
Show Border Gateway Protocol information
Show chassis information
Show class-of-service (CoS) information
Show command-line interface settings
Show current configuration
Show circuit cross-connect connections
Show database replication information
Show Dynamic Host Configuration Protocol information
Show Dynamic Host Configuration Protocol v6 information
Show dialer information
Show 802.1X information
Show Distance Vector Multicast Routing Protocol information
Show dynamic tunnel information information
Show end system-to-intermediate system information
Show Ethernet-switching information
Show event-options information
Show firewall information
Show forwarding-options information
Show Generic VLAN Registration Protocol information
Show port-forwarding helper information
Show information related to Host (Direct route) Fast reroute
Show hostname information from domain name server
Show Inter Chassis Control Protocol information
Show Internet Group Management Protocol information
Show IGMP snooping information
Show Ingress-Replication tunnel information
Show interface information
Show IP version 6 information
Show Integrated Services Digital Network information
Show Intermediate System-to-Intermediate System information
Show Layer 2 circuit information
Show Layer 2 VPN information
Show Link Aggregation Control Protocol information
Show Label Distribution Protocol information
Show Link Layer Discovery Protocol information
Show contents of log file
Show multicast listener discovery information
Show MLD snooping information
Show mpls information
Show Multicast Source Discovery Protocol information
Show Multicast information
Show Multicast Virtual Private Network (MVPN) information
Show network-access related information
Show Network Time Protocol information
Show OAM-related information
Show Open Shortest Path First information
Show Open Shortest Path First version 3 information
Show Packet Forwarding Engine information
Show Pragmatic Generalized Multicast information
Show Protocol Independent Multicast information
Show Interface policer counters and information
Show policy information
Show PPP process information
Show PPP over Ethernet information
Show Radio-to-Router Protocol information
Show Routing Information Protocol information
Show Routing Information Protocol for IPv6 information
Show routing table information
Show Resource Reservation Protocol information
Show Session Announcement Protocol information
Show the information on one or more schedulers
Show security information
Show services
Show Simple Mail Transfer Protocol information
Show Simple Network Management Protocol information
Show Spanning Tree Protocol information
Show system information
Show routing protocol per-task information
Show Traffic Engineering Database information
Show telephony gateway module information
Show software process revision levels
Show VLAN information
Show Virtual Private Layer Protocol information
Show WAN acceleration module information
Verifying the configuration with show commands
To verify that your configuration is correct, use these commands on the monitoring station that is configured for active flow monitoring.

About this task

- `show services`
- `show services flow-monitoring`
- `show services flow-monitoring version9 template <template_name>`
- `show services accounting (flow | flow-detail)`
- `show services accounting memory`
- `show services accounting packet-size-distribution`
- `show services accounting status`
- `show services accounting usage`
- `show services accounting aggregation template template-name name (detail | extensive | terse)`

Most active flow monitoring operational mode commands contain equivalent output information to the following passive flow monitoring commands:

- `show services accounting errors = show passive-monitoring error`
- `show services accounting flow = show passive-monitoring flow`
- `show services accounting memory = show passive-monitoring memory`
- `show services accounting status = show passive-monitoring status`
- `show services accounting usage = show passive-monitoring usage`

The active flow monitoring commands can be used with most active flow monitoring applications, including sampling, discard accounting, port mirroring, and multiple port mirroring. The following command shows the output of the show commands that are used with the configuration example:

```
user@router> show services accounting errors
Service Accounting interface: sp-2/0/0, Local interface index: 542
Service name: (default sampling)
Error information
Packets dropped (no memory): 0, Packets dropped (not IP): 0
Packets dropped (not IPv4): 0, Packets dropped (header too small): 0
Memory allocation failures: 0, Memory free failures: 0
Memory free list failures: 0
Memory overload: No, PPS overload: No, BPS overload: Yes

user@router> show services accounting flow-detail limit 10
```

```
Service Accounting interface: sp-2/0/0, Local interface index: 468
Service name: (default sampling)
```

```
Protocol Source Address Source Port Destination Address Destination Port Packet count Byte count
udp(17) 10.1.1.2 53 10.0.0.1 53 4329 3386035
ip(0) 10.1.1.2 0 10.0.0.2 0 4785 3719654
ip(0) 10.1.1.2 0 10.0.1.2 0 4530 3518679
udp(17) 10.1.1.2 0 10.0.7.1 0 5611 3316767
```

```
user@router> show services accounting memory
```

```
```
Service Accounting interface: sp-2/0/0, Local interface index: 468
Service name: (default sampling)
Memory utilization
   Allocation count: 437340, Free count: 430681, Maximum allocated: 6782
   Allocations per second: 3366, Frees per second: 6412
Total memory used (in bytes): 133416928, Total memory free (in bytes): 133961744

user@router> show services accounting

Service Accounting interface: sp-2/0/0, Local interface index: 468
Service name: (default sampling)

<table>
<thead>
<tr>
<th>Range start</th>
<th>Range end</th>
<th>Number of packets</th>
<th>Percentage packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>96</td>
<td>1705156</td>
<td>100</td>
</tr>
</tbody>
</table>

user@router> show services accounting status

Service Accounting interface: sp-2/0/0, Local interface index: 468
Service name: (default sampling)
Interface state: Monitoring
   Group index: 0
   Export interval: 60 secs, Export format: cflowd v5
   Route record count: 13, IFL to SNMP index count: 30, AS count: 1
   Time set: Yes, Configuration set: Yes
   Route record set: Yes, IFL SNMP map set: Yes

user@router> show services accounting usage

Service Accounting interface: sp-2/0/0, Local interface index: 468
Service name: (default sampling)
CPU utilization
   Uptime: 4790345 milliseconds, Interrupt time: 1668537848 microseconds
   Load (5 second): 71%, Load (1 minute): 63%

Related information:

Verifying Your Work

Viewing device configuration

An example configuration for the J-Flow v9 template ipv4-test, flow collector 172.19.101.85 (port 2222) with sampling rate 1:100 and run length as 0.

For example, to view the configuration for the following set commands:

```
set services flow-monitoring version9 template ipv4-test ipv4-template
set forwarding-options sampling input rate 1
set forwarding-options sampling input run-length 0
set forwarding-options sampling family inet output flow-server 172.19.101.85 port 2222
set forwarding-options sampling family inet output flow-server 172.19.101.85 version9 template ipv4-test
set forwarding-options sampling family inet output inline-jflow source-address 172.19.101.132
set interfaces ge-0/0/14 unit 0 family inet sampling input
set interfaces ge-0/0/14 unit 0 family inet address 23.23.23.1/24
```

Give this command to view the details:

```
show configuration
```
Configuring NetStream traffic on Huawei devices

Huawei devices support NetStream flow, which is a supported flow type in Network Performance Insight.

Related information:

[NetStream (Integrated) Technology White Paper]

Configuring NetStream export

Huawei NetStream works much like Cisco NetFlow. The NetStream process gathers detailed data about flows and stores them to a cache table. NetStream then processes the flow data from the cache table and sends it to Network Performance Insight for monitoring.

About this task

There are export options for flow sampling, aggregation, and flow record content depending on how and what you are monitoring and how you need to export and report.

<table>
<thead>
<tr>
<th>Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[RouterA] ip NetStream export host &lt;hostname&gt;</td>
<td>Enables NetStream on Huawei devices</td>
</tr>
<tr>
<td>&lt;ip_address&gt; 9996</td>
<td></td>
</tr>
<tr>
<td>ip NetStream export source interface &lt;interface_name&gt;</td>
<td>Exports the NetStream data to a specified IP address.</td>
</tr>
<tr>
<td>[RouterA] ip NetStream sampler inbound 100</td>
<td>Configures global sampling.</td>
</tr>
<tr>
<td>[RouterA] ip NetStream sampler outbound 100</td>
<td></td>
</tr>
<tr>
<td>[RouterA] interface gigabitethernet 1/0/0</td>
<td>Sets up an interface.</td>
</tr>
<tr>
<td>[RouterA-GigabitEthernet1/0/0] ip address &lt;IP_address1&gt; &lt;IP_address2&gt;</td>
<td></td>
</tr>
<tr>
<td>[RouterA-GigabitEthernet1/0/0] ip NetStream inbound</td>
<td>Enables NetStream statistics on the inbound and outbound interfaces</td>
</tr>
<tr>
<td>[RouterA-GigabitEthernet1/0/0] ip NetStream outbound</td>
<td></td>
</tr>
</tbody>
</table>
Notices

This information was developed for products and services offered in the US. This material might be available from IBM in other languages. However, you may be required to own a copy of the product or product version in that language in order to access it.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user’s responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not grant you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785
US

For license inquiries regarding double-byte character set (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

Intellectual Property Licensing
Legal and Intellectual Property Law
IBM Japan Ltd.
19-21, Nihonbashi-Hakozakicho, Chuo-ku
Tokyo 103-8510, Japan

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those
websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you provide in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Director of Licensing
IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785
US

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this document and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement or any equivalent agreement between us.

The performance data discussed herein is presented as derived under specific operating conditions. Actual results may vary.

The client examples cited are presented for illustrative purposes only. Actual performance results may vary depending on specific configurations and operating conditions.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

Statements regarding IBM’s future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

All IBM prices shown are IBM’s suggested retail prices, are current and are subject to change without notice. Dealer prices may vary.

This information is for planning purposes only. The information herein is subject to change before the products described become available.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to actual people or business enterprises is entirely coincidental.

COPYRIGHT LICENSE:
This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. The sample programs are provided "AS IS", without warranty of any kind. IBM shall not be liable for any damages arising out of your use of the sample programs.

Each copy or any portion of these sample programs or any derivative work must include a copyright notice as follows:

© (your company name) (year).
 Portions of this code are derived from IBM Corp. Sample Programs.
 © Copyright IBM Corp. _enter the year or years_.

**Trademarks**

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the web at "Copyright and trademark information" at [www.ibm.com/legal/copytrade.shtml](http://www.ibm.com/legal/copytrade.shtml).

Adobe, Acrobat, PostScript and all Adobe-based trademarks are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States, other countries, or both.

IT Infrastructure Library is a registered trademark of the Central Computer and Telecommunications Agency which is now part of the Office of Government Commerce.

Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

Linux is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft and Windows are trademarks of Microsoft Corporation in the United States, other countries, or both.

ITIL is a registered trademark, and a registered community trademark of The Minister for the Cabinet Office, and is registered in the U.S. Patent and Trademark Office.

UNIX is a registered trademark of The Open Group in the United States and other countries.
Terms and conditions for product documentation

Permissions for the use of these publications are granted subject to the following terms and conditions.

Applicability

These terms and conditions are in addition to any terms of use for the IBM website.

Personal use

You may reproduce these publications for your personal, noncommercial use provided that all proprietary notices are preserved. You may not distribute, display or make derivative work of these publications, or any portion thereof, without the express consent of IBM.

Commercial use

You may reproduce, distribute and display these publications solely within your enterprise provided that all proprietary notices are preserved. You may not make derivative works of these publications, or reproduce, distribute or display these publications or any portion thereof outside your enterprise, without the express consent of IBM.

Rights

Except as expressly granted in this permission, no other permissions, licenses or rights are granted, either express or implied, to the publications or any information, data, software or other intellectual property contained therein.

IBM reserves the right to withdraw the permissions granted herein whenever, in its discretion, the use of the publications is detrimental to its interest or, as determined by IBM, the above instructions are not being properly followed.

You may not download, export or re-export this information except in full compliance with all applicable laws and regulations, including all United States export laws and regulations.

IBM MAKES NO GUARANTEE ABOUT THE CONTENT OF THESE PUBLICATIONS. THE PUBLICATIONS ARE PROVIDED "AS-IS" AND WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY,
NON-INFRINGEMENT, AND FITNESS FOR A PARTICULAR PURPOSE.