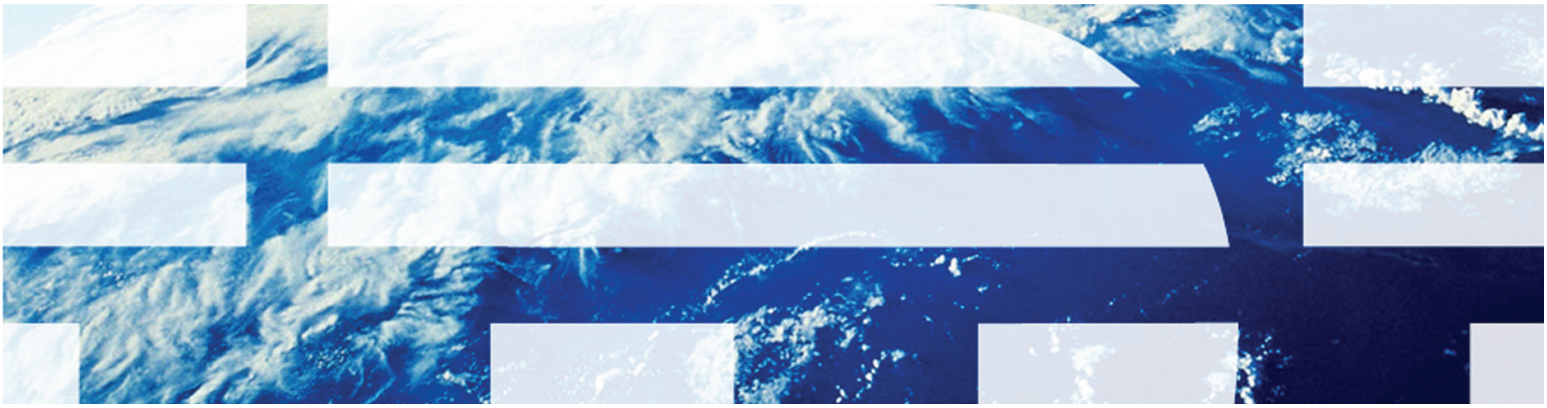

IBM Tivoli NetView for z/OS 6.1: REXX Programming

Student's Training Guide

Course: TZ223 ERC: 1.0

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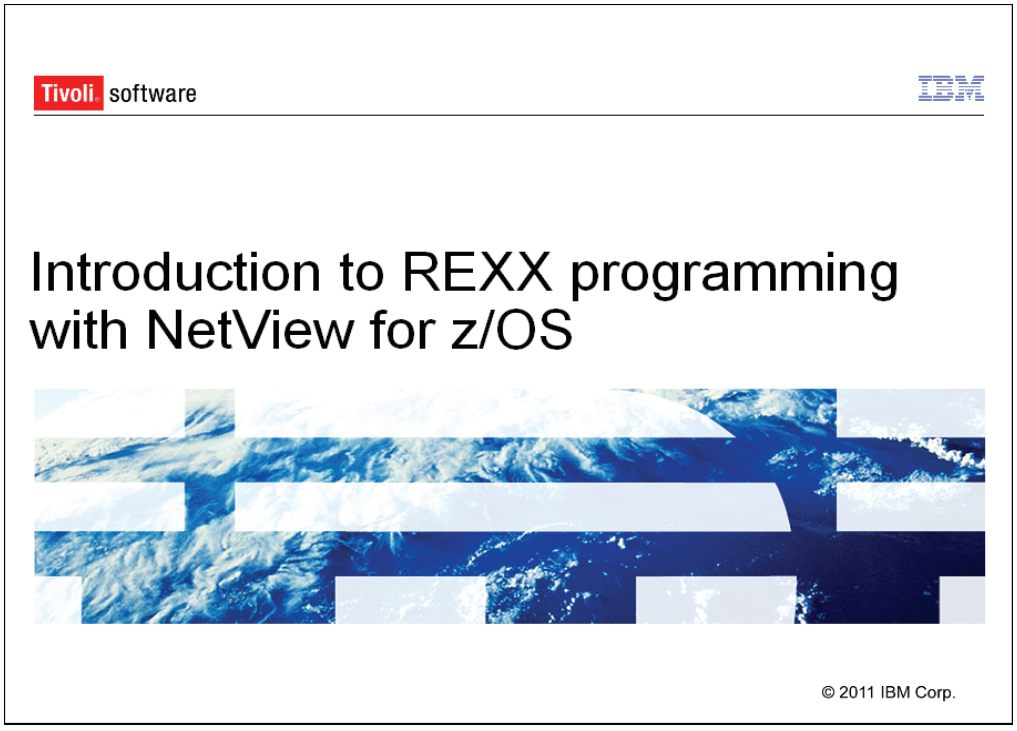
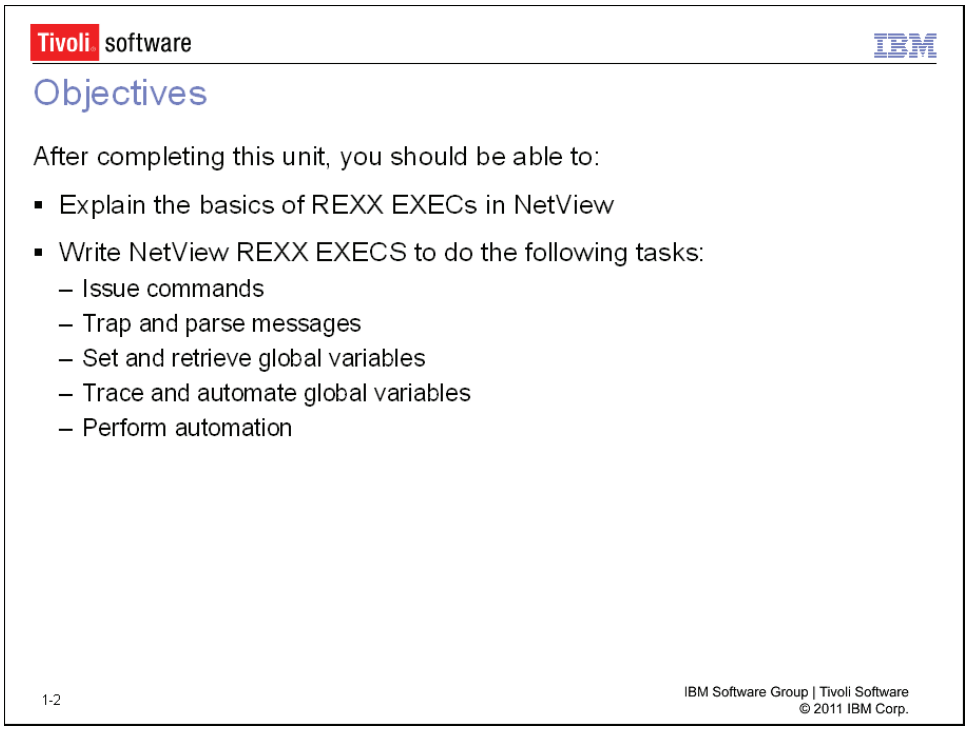


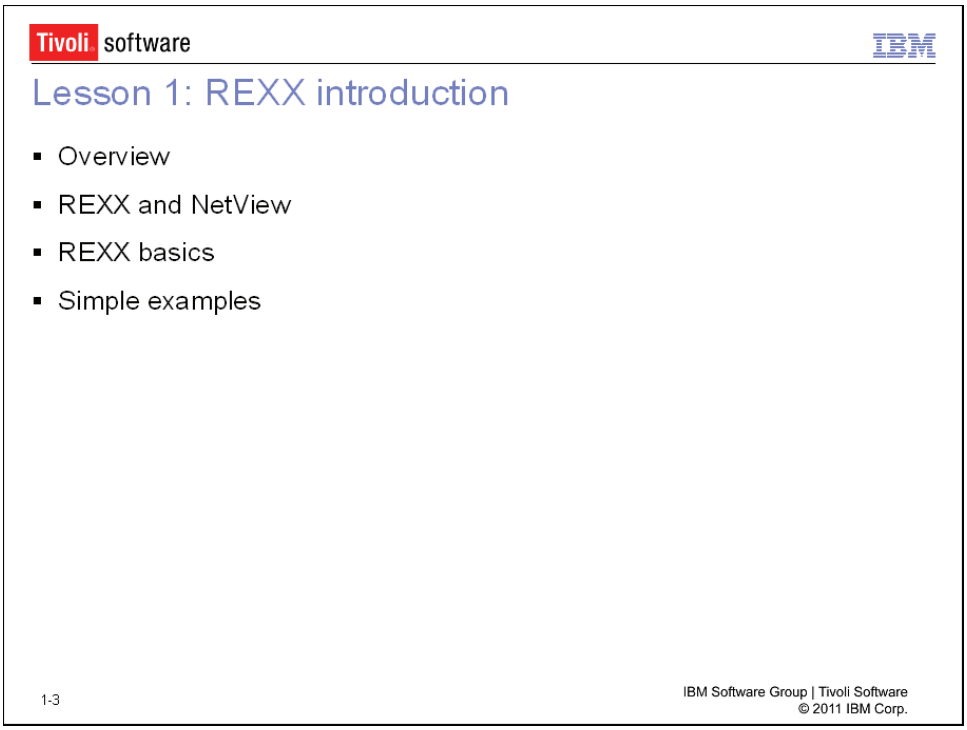
Introduction

This unit provides a background in programming REXX EXECs for your NetView® for z/OS® environment. REXX EXECs are key to improving operator productivity and providing automation.

Objectives

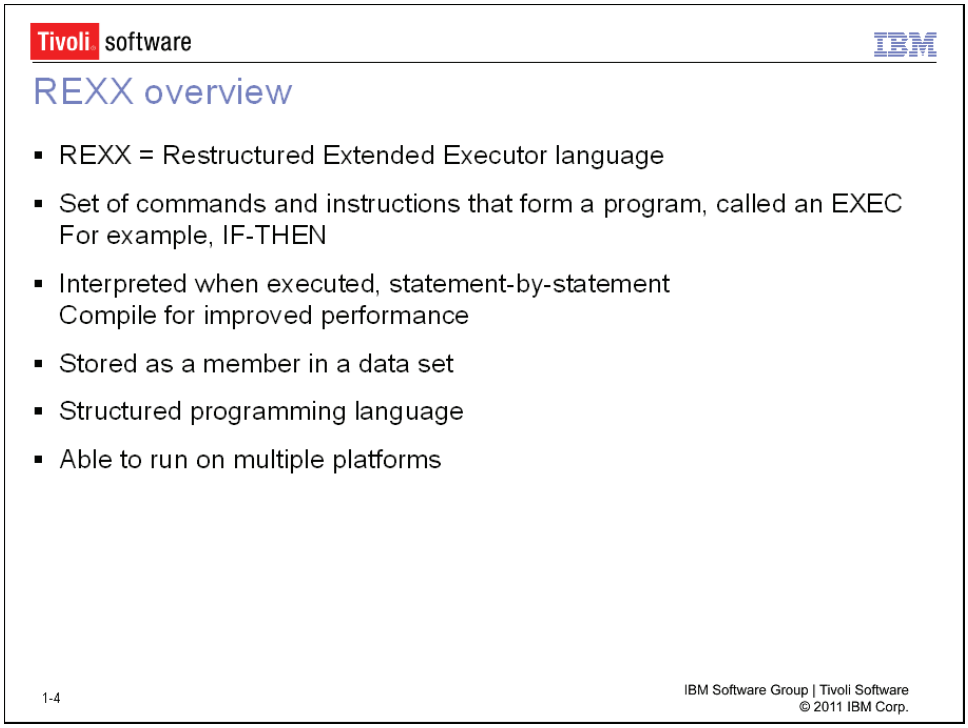


Lesson 1: REXX introduction



This lesson provides a brief introduction to REXX and NetView REXX.

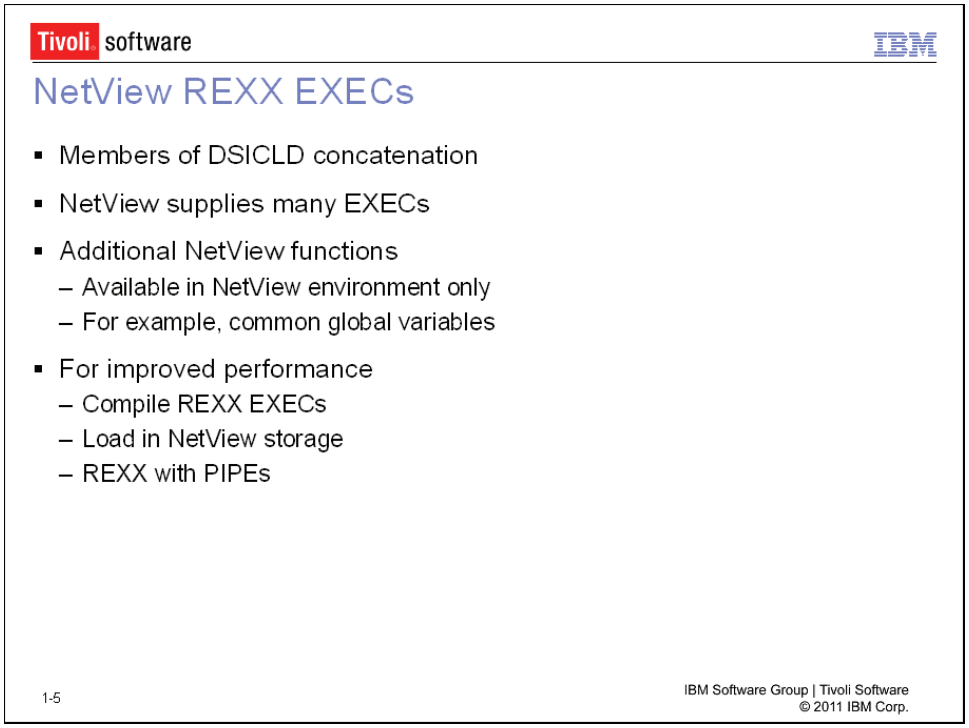
REXX overview



REXX is a structured programming language that is **interpreted** when the program runs. The REXX interpreter operates directly on the program as it runs, line by line and word by word.

Basic REXX EXECs are capable of running on many platforms. One of the operating systems that supports REXX is z/OS. The operating system provides additional commands, environments, or functions in addition to the base that REXX provides. Applications can provide additional commands, environments, or functions. For example, NetView extends the available z/OS REXX functions with some of its own.

NetView REXX EXECs



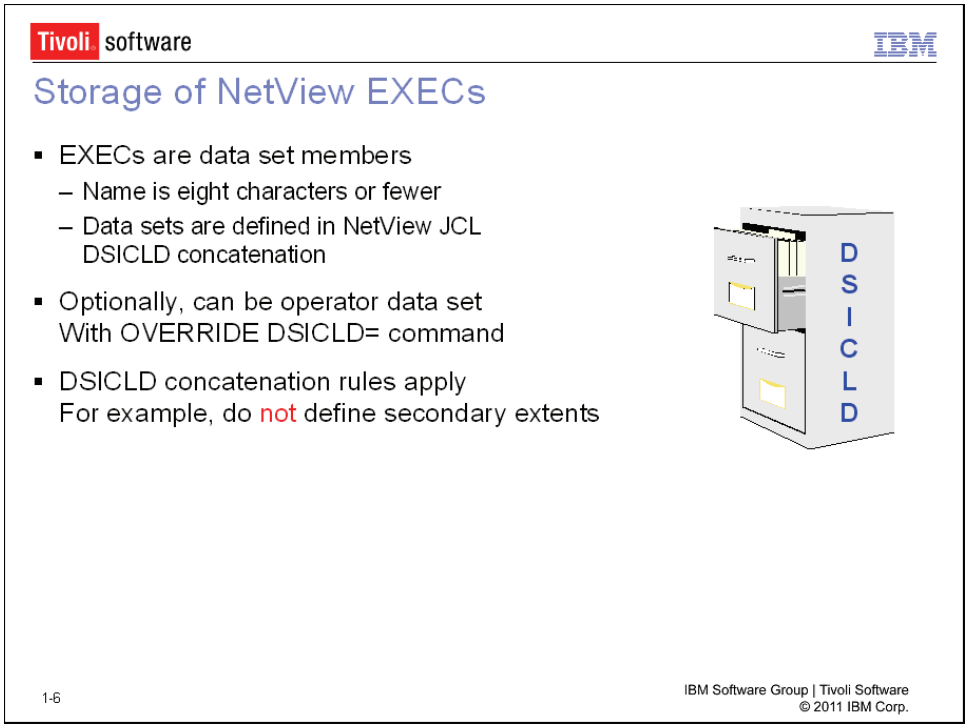
NetView REXX EXECs can be created before NetView starts, or while NetView runs. REXX EXECs are saved as members of a partitioned data set (PDS) and are ready for NetView operators to use immediately. Many NetView commands are actually REXX EXECs that call command processors.

Tip: To reduce the time required to read an EXEC from a data set, load the EXEC in NetView storage.

Optionally, REXX EXECs can be compiled to significantly improve performance. The IBM REXX/370 compiler product must be installed on the system where the EXECs are to be compiled. The run-time library must be installed on the system that runs the compiled EXECs.

To determine if the REXX compiler is installed, issue ADDRESS LINKMVS 'EAGRTPRQ' within a REXX EXEC. If the return code is -3, it is installed.

Storage of NetView EXECs



Each EXEC is a member of a NetView partitioned data set (PDS), which is allocated to the NetView DSICLD concatenation.

The PDS member name is the EXEC name, the name used by your NetView operators. Optionally, you can define a command synonym name for the EXEC by using the CMDSYN parameter of a command definition. The EXEC name must begin with a nonnumeric character and can be from one to eight characters long. Valid characters are as follows: 0-9 A-Z @ $ #. Defining EXECs to NetView discussion comes later.

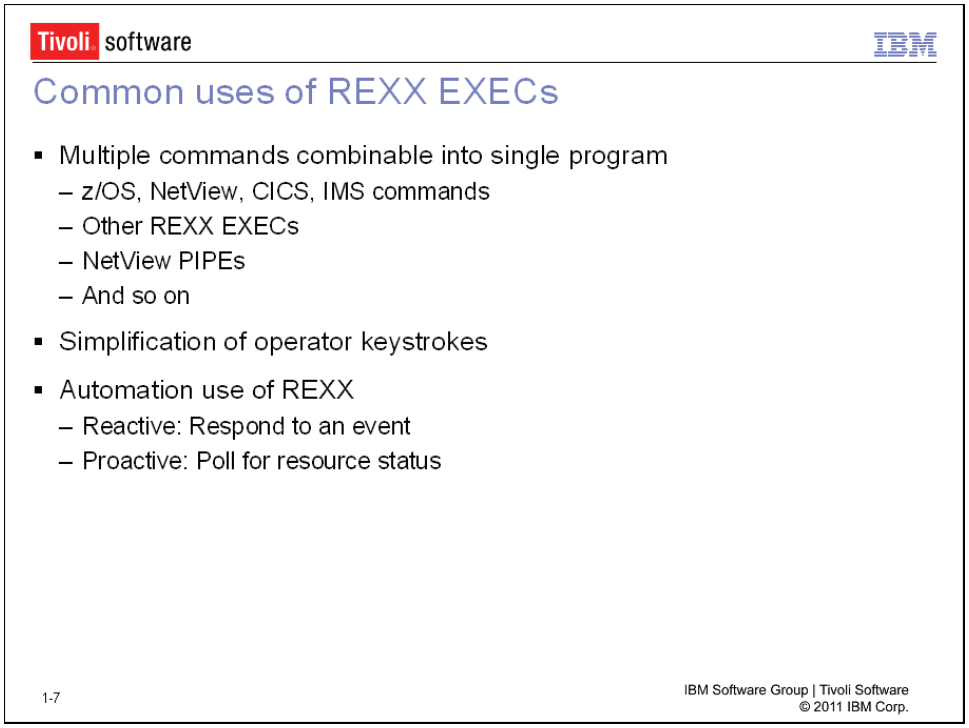
When an EXEC runs, it is read from the partitioned data set. You can load EXECs into storage with the MAPCL and MEMSTORE functions. Discussion of MAPCL and MEMSTORE occurs later.

Avoid using secondary extents when allocating DSICLD data sets. Data sets allocated with secondary extents can create problems for NetView. If the data set goes into secondary extents, you can correct the problem with one of the following actions:

- Issuing the **REACC** command
- Compressing the DSICLD data set by using IEBCOPY in a batch job

You can use the **LISTA** command to list the files that are allocated to the NetView program. Files can be those that are allocated by statements in the JCL and those allocated dynamically by the NetView **ALLOCATE** command.

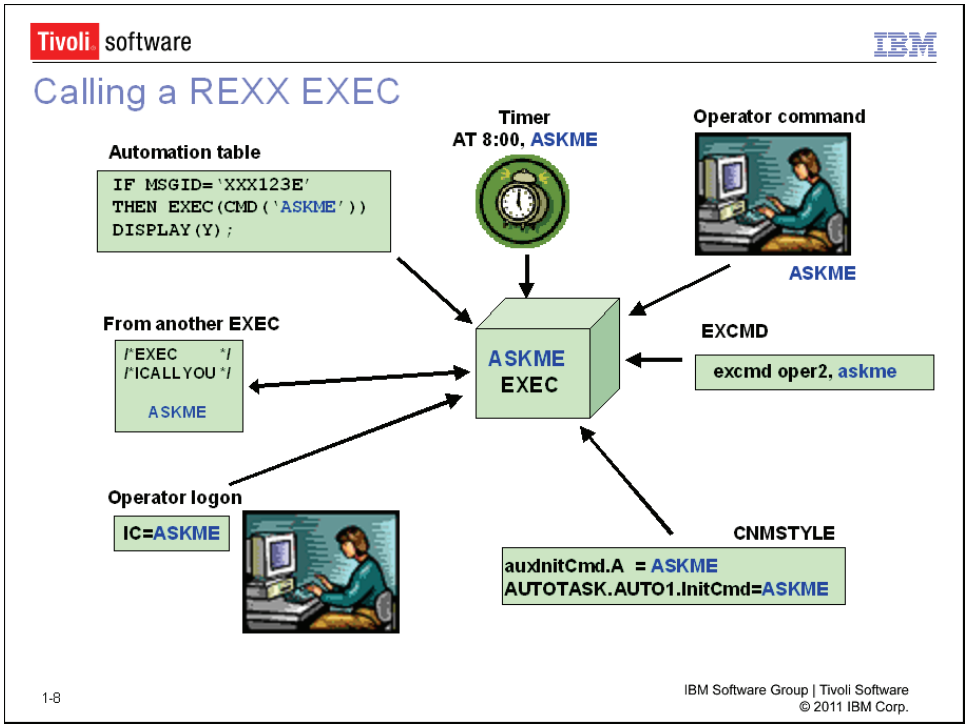
Common uses of REXX EXECs



Using REXX EXECs, you can combine several commands into one single program, simplifying the number of commands that your operators must issue. EXECs can issue commands, trap and interrogate responses (messages) to the commands, and take more complex actions.

EXECs play a key role in automation. EXECs can be driven directly from an event driving the NetView automation table or scheduled on a timer basis to proactively monitor statuses of resources.

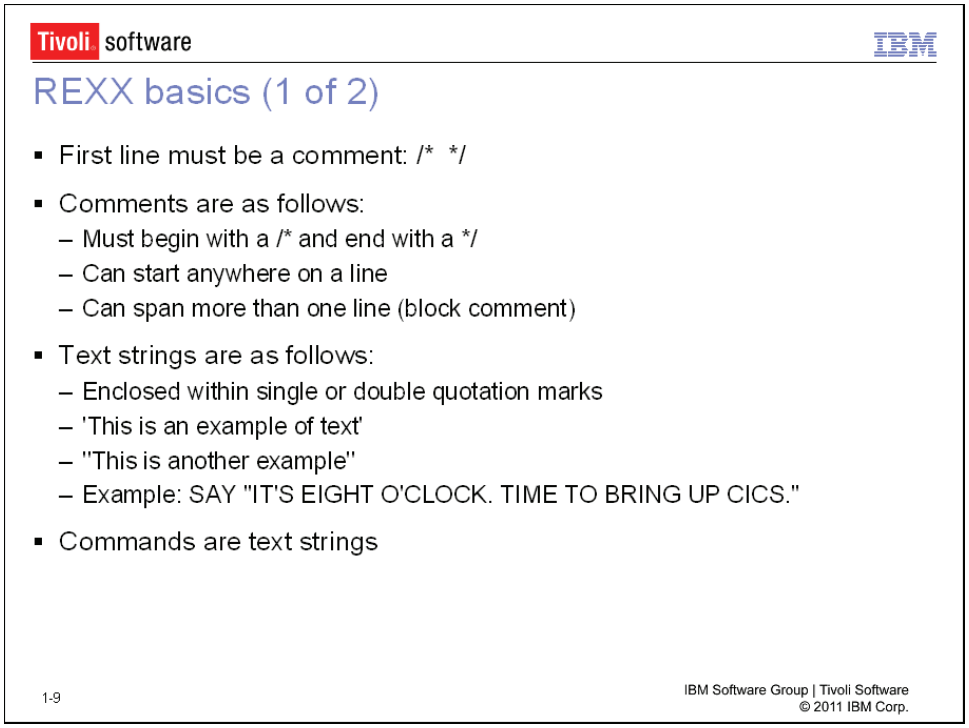
Calling a REXX EXEC



A REXX EXEC can be run in many ways. Calling an EXEC by using some of these methods can force limitations on the commands that can be used within the EXEC. For example, an EXEC that an automated operator runs cannot run full-screen commands.

With an operator station task (OST), an operator can enter commands and receive messages. An OST starts for each operator at logon. This task is used when a NetView operator runs an EXEC. The EXEC can call other EXECs that also run under the OST.

REXX basics (1 of 2)



Each NetView REXX EXEC must begin with a comment. You can also code additional comments in your EXEC wherever necessary.

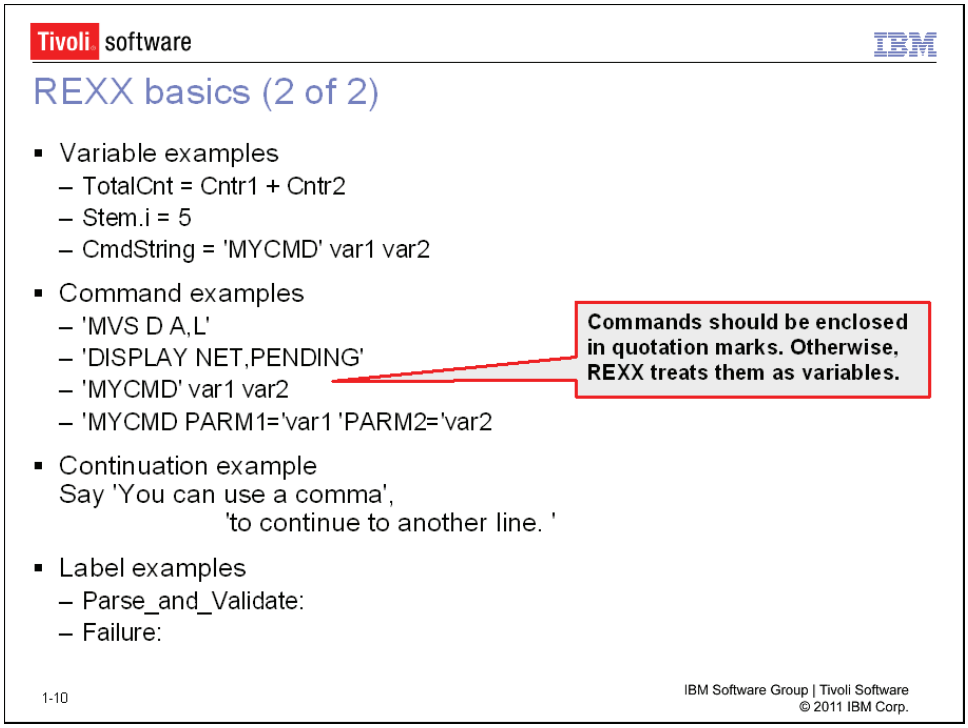
A series of clauses, each having a separate purpose, make up the functional body of an EXEC. In a simple REXX EXEC, the clauses are interpreted in the sequence that they are coded. The sequence can change by using specific commands that alter the processing order, for example, CALL Label1. (Use quotation marks when you do not want REXX to evaluate the string as a variable.)

Note: Commands are examples of text strings. Place commands within quotations (single or double) so that the REXX interpreter does not perform variable substitution on the string.

Command examples are as follows:

- All NetView commands, including PIPEs
- All MVS commands

REXX basics (2 of 2)



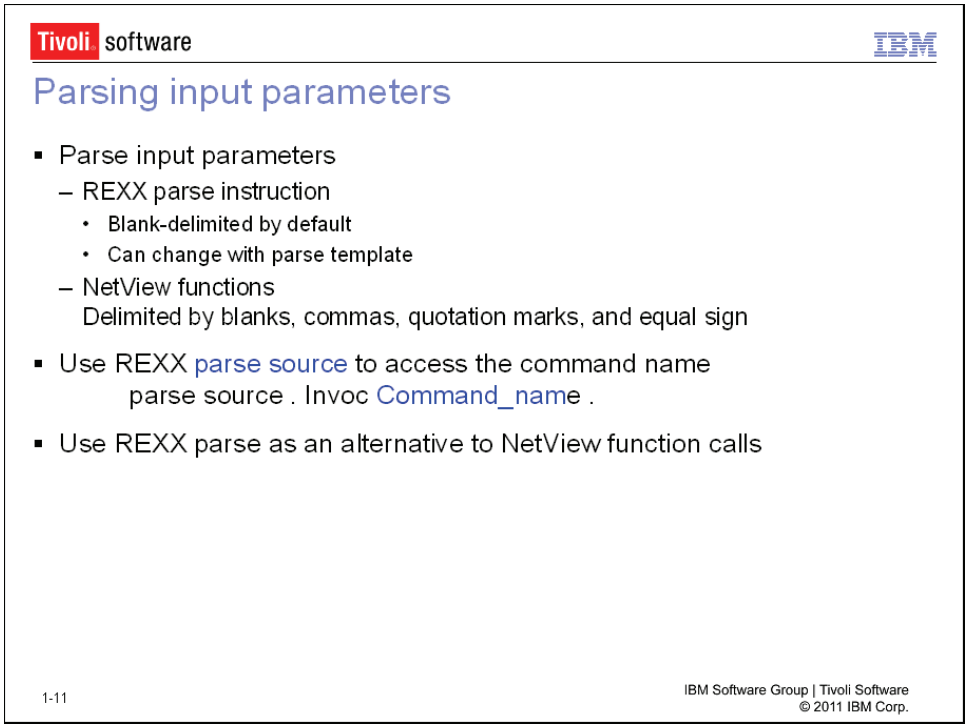
This slide illustrates examples of variables, commands, continuation, and labels.

'MYCMD' var1 var2 example:

- Suppose variable *var1* has a value of 1 and variable *var2* has a value of 2.
- When MYCMD is called, it would be passed 1 for the first parameter and 2 for the second parameter.
- In this case, MYCMD is the name of a command or another EXEC.

  You should enclose the text string, MYCMD, in quotation marks to prevent the REXX interpreter from treating the command name as a variable. If you also had a variable named *mycmd* and omitted quotation marks, the REXX interpreter substitutes the value of the variable as the command name.

Parsing input parameters



EXECs can accept input parameters. The input parameters can be parsed with REXX parsing instructions or NetView functions. REXX parsing is blank-delimited, by default, but can be changed with a parse template that is specified on the **PARSE** instruction.

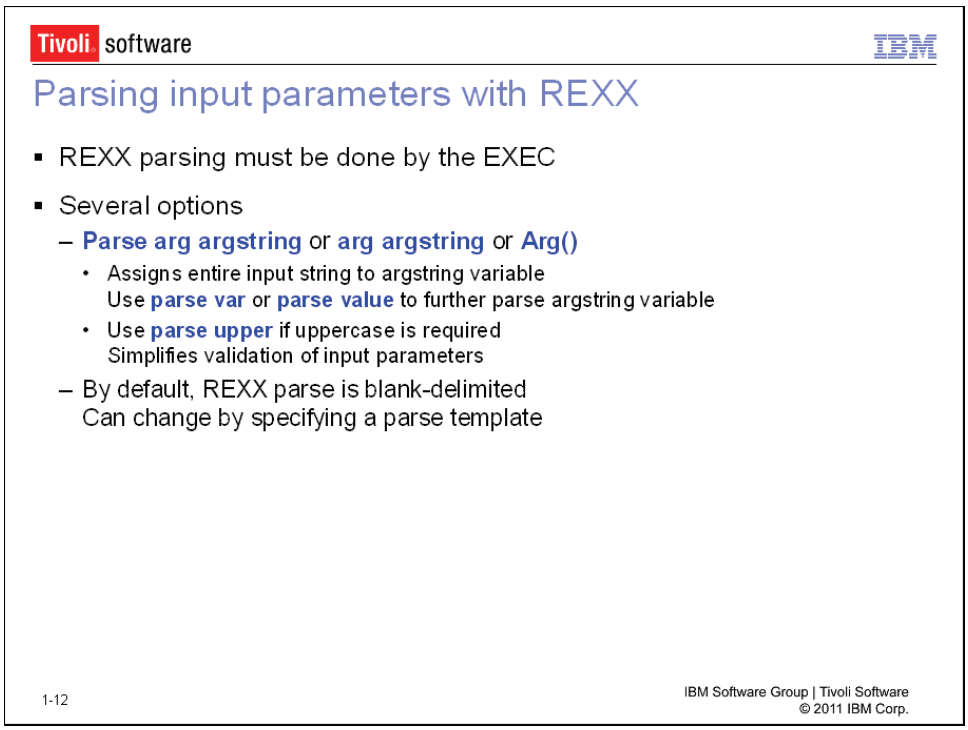
Using the REXX **PARSE** instruction keeps the EXEC running under the REXX interpreter, which can improve the performance of your REXX EXEC. If you use NetView functions, the REXX interpreter is stopped to call the NetView function.

Use the REXX **parse source** to parse the name of the EXEC (command name). The command name can be used when displaying error messages from the EXEC. REXX also provides a CmdName() function to parse the command name.

You can use periods within a parse statement as a placeholder to skip one or more tokens in the text. The parse source example uses periods as follows:

1. Ignore the first token.
2. Place the value of the second token into the *Invoc* variable.
3. Place the value of the third token into the *Command_name* variable.
4. Ignore all remaining tokens.

Parsing input parameters with REXX



REXX parsing is flexible. By default, input parameters are blank-delimited. Suppose an EXEC, MYEXEC, is called with four input parameters: **parm1 parm2 parm3 4,5**

- parse arg argstring

  Sets the variable, argstring, to the entire input string

- parse arg p1 p2 p3 p4

  Sets p1 to the text string *parm1*

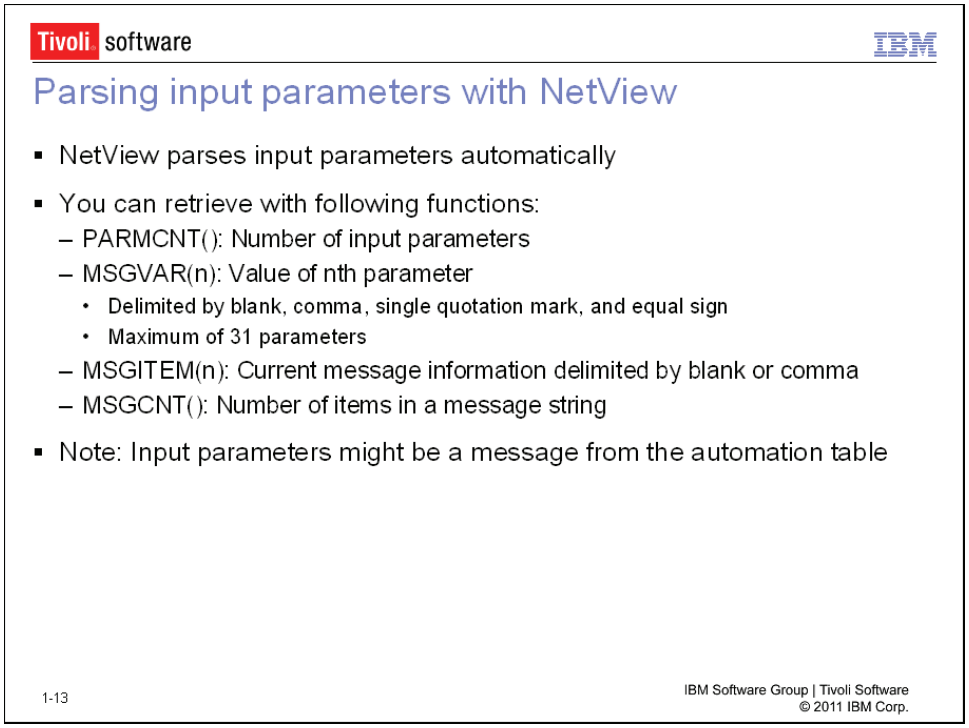
  p2 to the text string *parm2*

  p3 to the text string *parm4*

  p4 to the text string *4,5*

Arg *argstring* is a shortened version of a **parse arg *argstring*** instruction. You can use either format. REXX also provides an Arg() function to parse input parameters.

Parsing input parameters with NetView



When a REXX EXEC is invoked, NetView automatically parses the input to the EXEC and sets the values of several NetView functions.

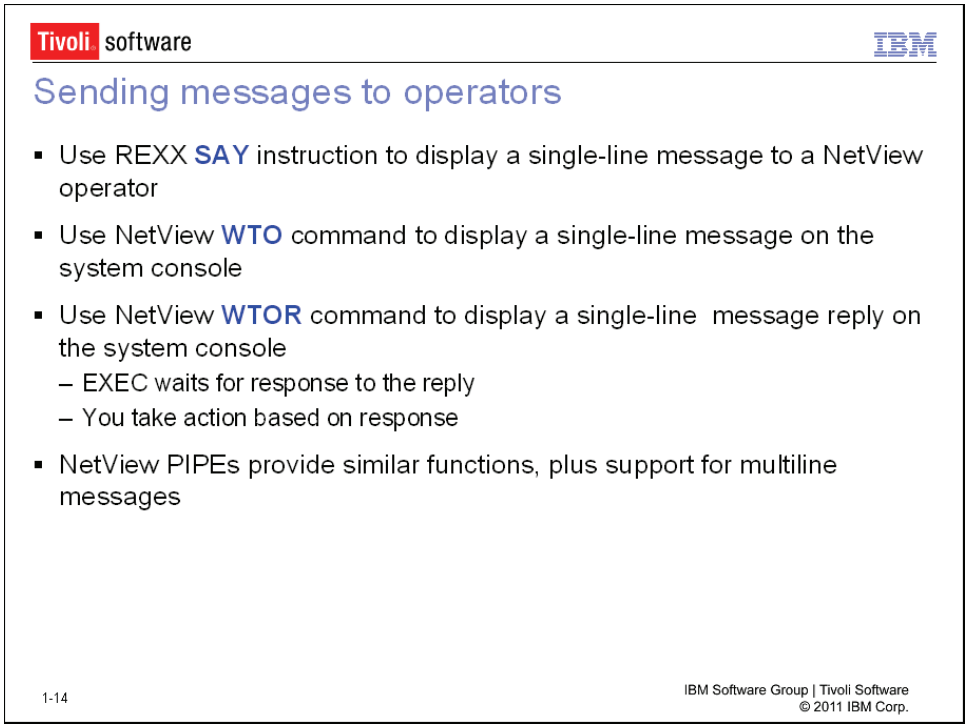
PARMCNT() identifies the number of input parameters. You can use PARMCNT() to test for the exact number of input parameters and issue a message to the user if an error occurs.

MSGVAR(*n*) can be set to one of the following parameters:

- An input parameter to the EXEC
- A parameter of a message that is read from the trapped message queue

Delimiters that are used for setting these NetView functions are comma, apostrophe, blank, or equal sign.

Sending messages to operators



You can use the REXX **SAY** instruction to send single-line messages to the NetView operator. If a REXX EXEC is issued within a pipeline, any output that the SAY instruction produces becomes input for the next PIPE stage.

You can send single-line messages to the z/OS system console by issuing NetView **WTO** or **WTOR** commands. The **WTOR** command causes the EXEC to wait for a response to the message. The response is contained in the **WTOREPLY** variable.

Using the SAY instruction

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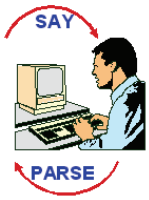
Using the SAY instruction

- Write data to screen (maximum of 32,728 characters)
  - Messages
  - Instructions to the NetView operator
- If first token contains a message ID
  Can satisfy an outstanding WAIT or result in a match in automation table
- Use SAY to describe expected NetView operator input before PARSE EXTERNAL



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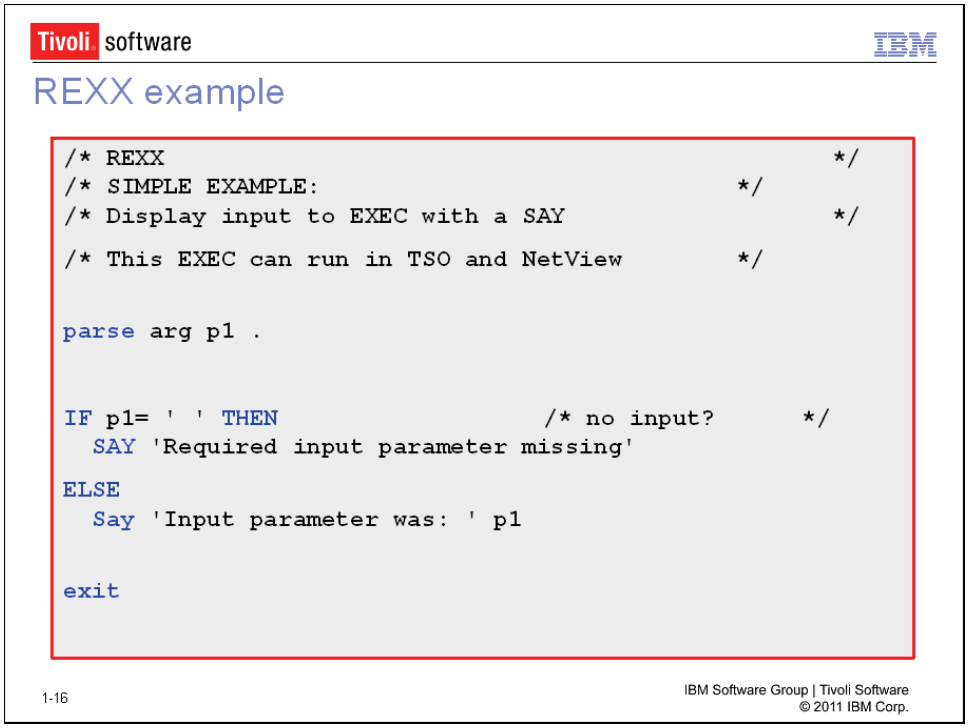
The REXX **SAY** instruction is useful for communicating information to the NetView operator running an EXEC. The **SAY** instruction generates a single-line message that drives the NetView automation table.

Note: Be careful when using a message ID in the first token of a SAY instruction. The message ID might generate an event that is trapped erroneously in the automation table, for example. To avoid this, a common practice is to prepend text (for example, three asterisks) to the message ID.

If your EXEC needs to pause for input from the operator, issue a say instruction to describe the required input. Follow the instruction with the **PARSE EXTERNAL** instruction to parse the operator input.

REXX example



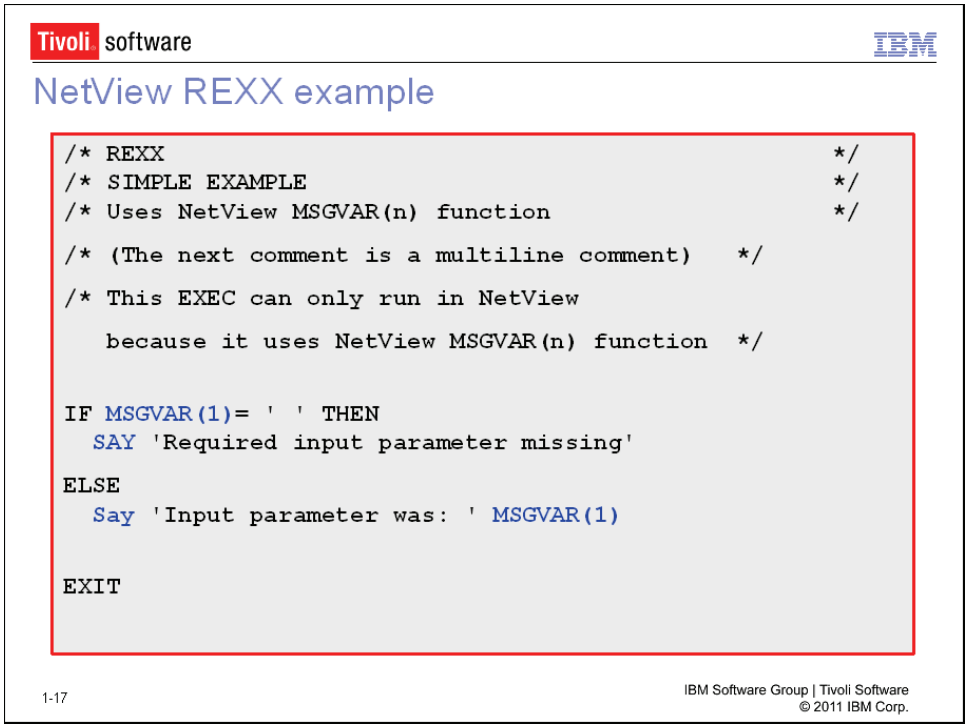
This example REXX EXEC does not use any NetView-specific instructions, functions, or commands. The first four lines are single-line comments. (Note that comments can span multiple lines.)

The **parse arg** instruction parses the input parameters. In this case, the first token is placed into local variable *p1*. *A*ll remaining parameters are ignored because of the placement of the period at the end of the statement. The remaining statements in this example EXEC test if variable *p1* is null.

- If *p1* is null, a message routes to the operator: **Required input parameter missing**
- If *p1* is not null, its value is displayed in a message to the operator: **Input parameter was: 5**

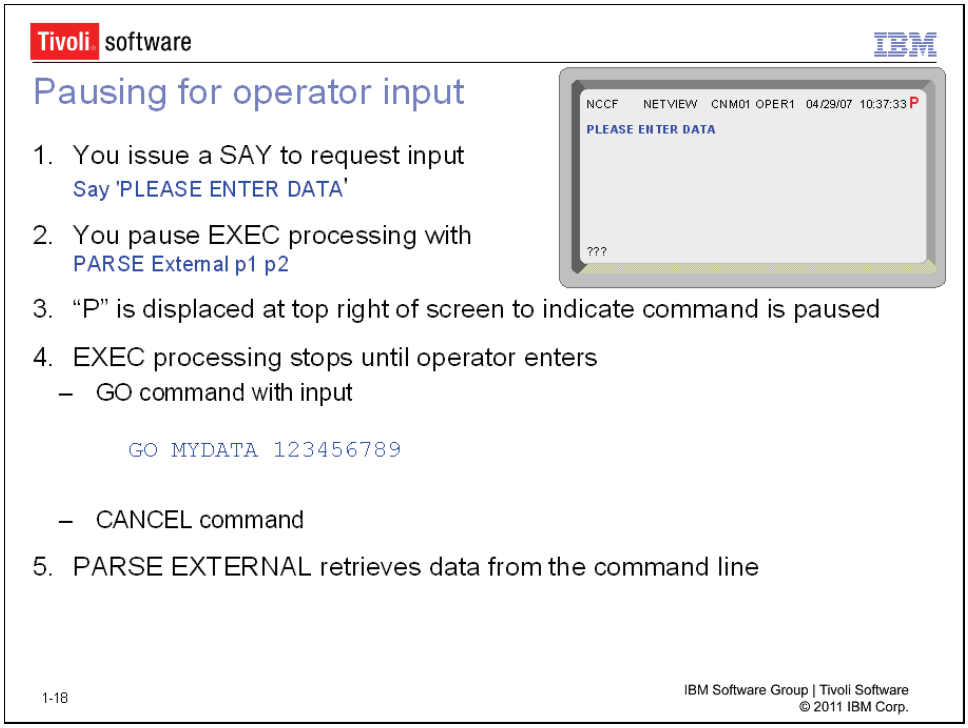
Optionally, you can specify a return code on the **exit** instruction. For example, if variable p1 was null, you can exit with a return code of 8 by coding **exit 8**.

NetView REXX example



This is the same REXX example, but using the NetView MSGVAR() function to parse the input to the REXX EXEC. NetView sets MSGVAR(1) automatically to the value of the first input parameter without requiring explicit parsing. Note that lines five and six are a multiline comment.

Pausing for operator input



You can use **PARSE EXTERNAL** or **PARSE PULL** instructions to wait for input from the operator. You should issue a **SAY** command to describe the expected input.

If data exists on the REXX *data stack*, it is read before any operator input from the command line if you use **PARSE PULL** or **PULL**. Use PARSE PULL for mixed-case text and PULL for upper-case text.

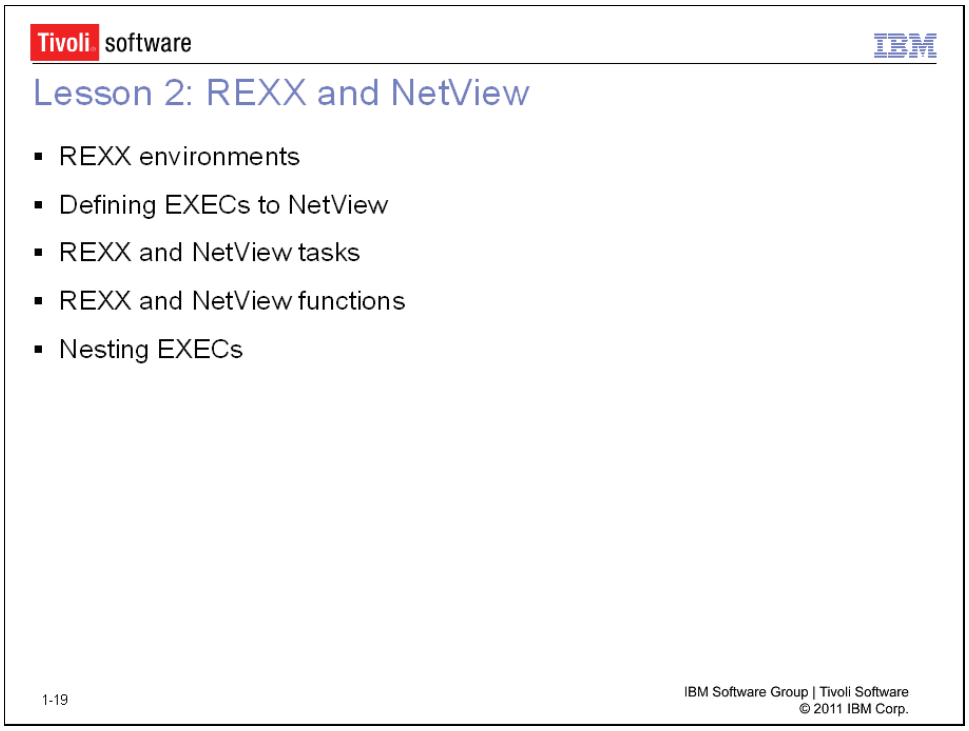
To ensure that the data is read from the operator only, use **PARSE EXTERNAL** to place the input in a specified variable. For example, suppose you need an operator to respond with YES or NO before continuing processing within a REXX EXEC. Issue a SAY command with instructions, then a PARSE EXTERNAL immediately after the SAY:

```
SAY 'ENTER "GO YES" OR "GO NO" TO CONTINUE'
PARSE EXTERNAL ANSWER
```

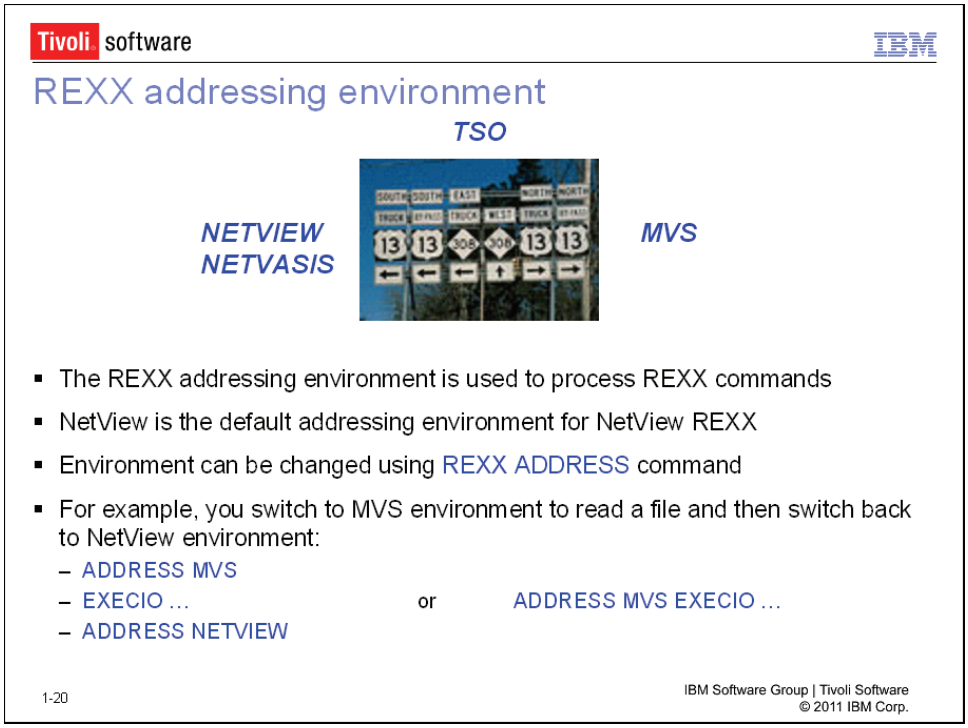
The local variable, *answer*, should contain YES or NO. To require the input in upper case, code as follows:

```
PARSE UPPER EXTERNAL ANSWER
```

Lesson 2: REXX and NetView



REXX addressing environment



REXX EXECs that run in NetView automatically are to run in the NetView environment. Commands can also run in environments such as MVS.

In the NETVIEW addressing environment, the entire command string converts to uppercase characters. If you want to issue a command that contains mixed-case text, change the addressing environment to **NETVASIS**:

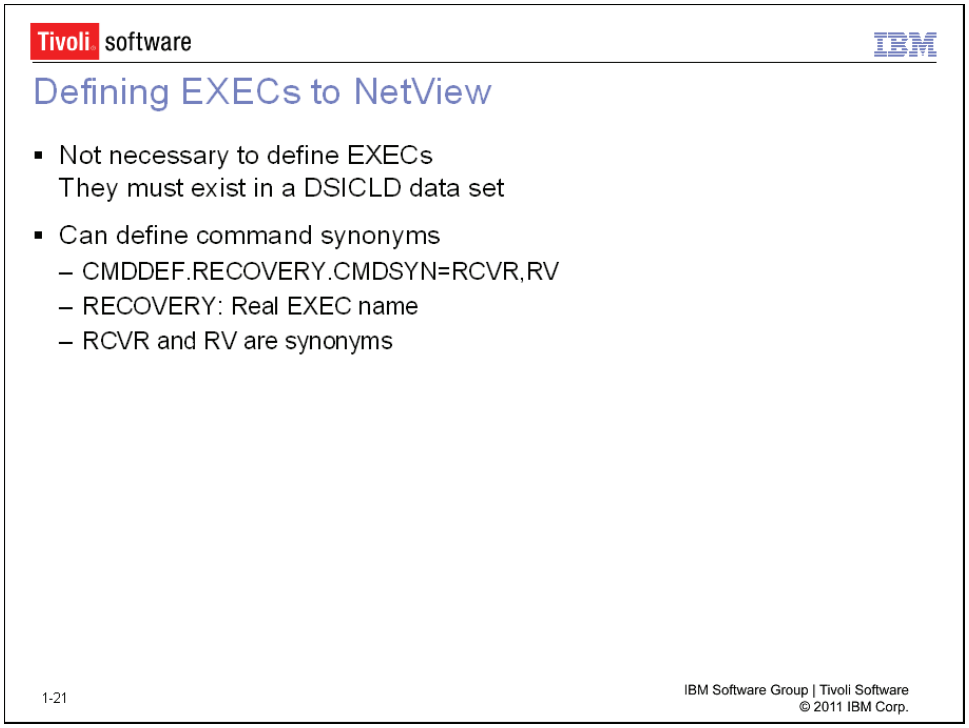
```
address netvasis 'WTO This is a mixed case message.'
```

The **WTO** command displays *This is a mixed case message.* on the z/OS system console.

You can use the ADDRESS instruction on a single line or multiple lines. Refer to the TSO/E REXX manuals for more information about the REXX ADDRESS instruction.

Note: With DATA REXX, the only environment that the ADDRESS instruction supports is NETVDATA, the host environment for DATA REXX.

Defining EXECs to NetView



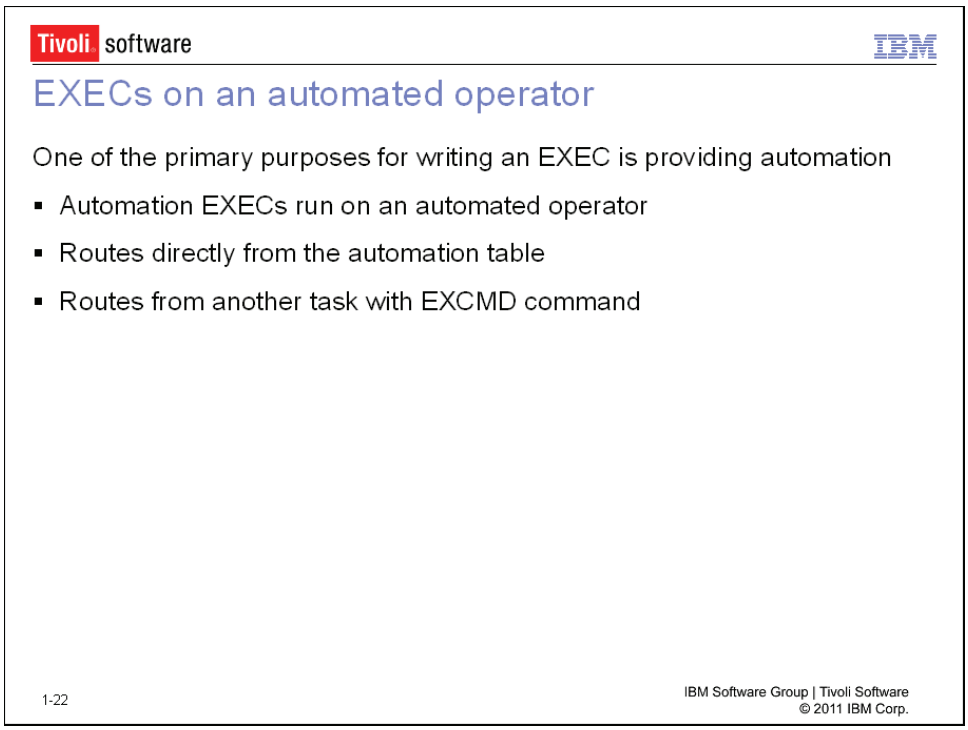
EXECs are available for use by operators immediately after they are created. If the EXEC is in an operator override data set, you must issue an OVERRIDE DSICLD command to refresh the data set.

EXECs can be defined to NetView to create more meaningful synonym names or for security. Use the **CMDDEF** definition statement to define EXECs to NetView. In this case, the command name is RECOVERY. It has two synonyms: RCVR and RV. Operators can call the EXEC by issuing RECOVERY, RCVR, or RV.

Because EXECs can issue commands, many customers require a level of security for controlling the operators who have access to the EXECs. The EXEC must first be defined to NetView with the **CMDDEF** statement. Then corresponding NetView Command Authorization Table (CAT) or Security Access Facility (SAF) definitions must be created to restrict access to the EXEC or its parameters.

For more information about CMDDEF, see the *Tivoli NetView for z/OS Administration Reference*. For more information about security, see the *Tivoli NetView for z/OS Security Reference*.

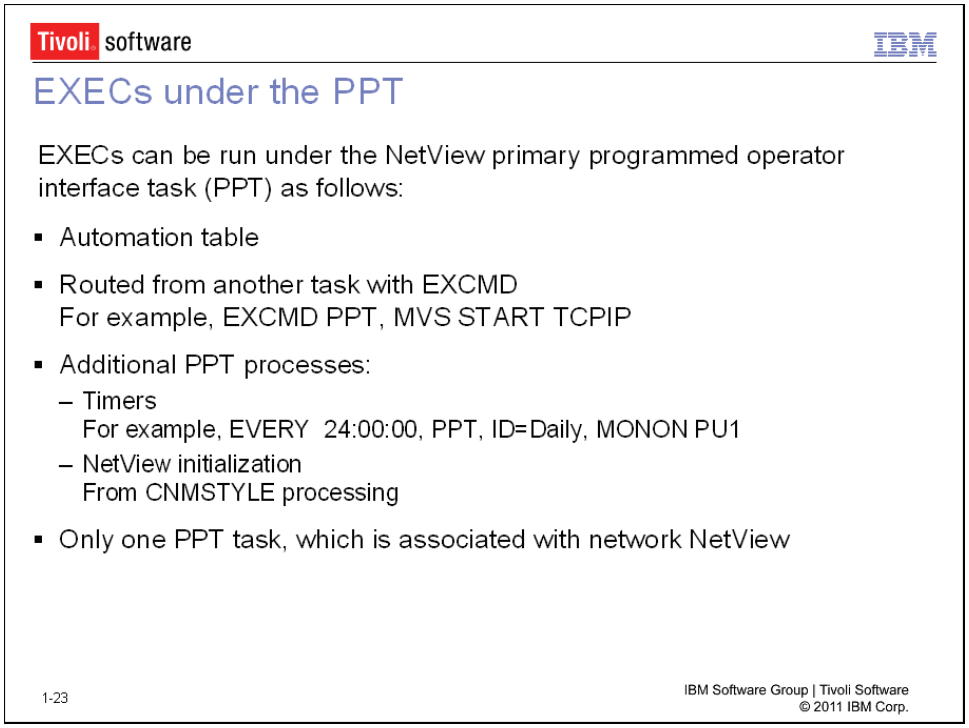
EXECs on an automated operator



Automation is typically performed on an *automated operator*. REXX EXECs can be specified as the automated actions driven from the automation table on the automated operator. Automated operators do not support the following items:

- Full-screen commands
- Keyboard functions, such as PF keys
- AUTOWRAP

EXECs under the PPT



The primary program operator interface task (PPT) receives the following message types:

- Unassigned, unsolicited messages from VTAM
- Message traffic that are exchanged between the z/OS system console and VTAM.

The PPT opens a (primary) programmed operator interface (POI) to VTAM to receive these messages.

Each NetView program has one PPT. The PPT starts when the NetView program starts. NetView cannot run without the PPT. If automated tasks (autotasks) are not active during initialization, the PPT task can be used to run critical NetView EXECs.

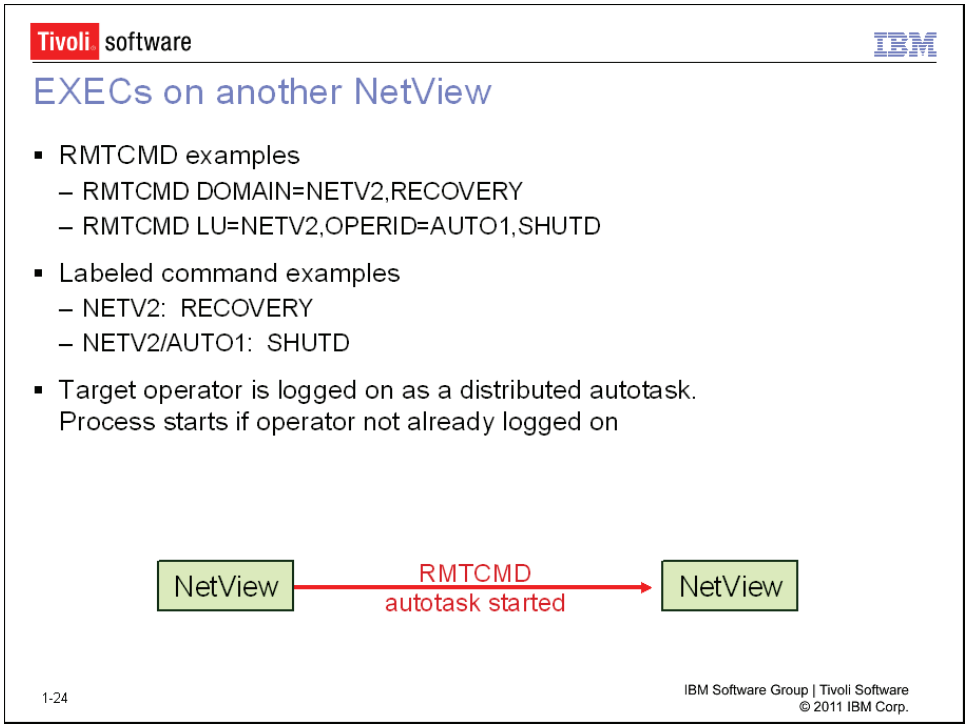
Note: Ensure that the PPT is not overly utilized. Otherwise, NetView (network) performance problems might occur.

The primary purpose of the PPT is handling VTAM unsolicited messages. At network startup, or times of network problems, such messages might be significant. PPT output is displayed on the z/OS system operator console if it is not routed elsewhere.

The PPT does not support the following commands:

- AUTOWRAP
- BGNSESS
- INPUT
- LOGOFF
- ROUTE
- SET
- SUBMIT
- The following REXX instructions under the PPT:
  - FLUSHQ
  - MSGREAD
  - PARSE EXTERNAL
  - PARSE PULL if there is nothing in the REXX data stack
  - PULL if there is nothing in the REXX data stack
  - TRAP
  - WAIT

EXECs on another NetView

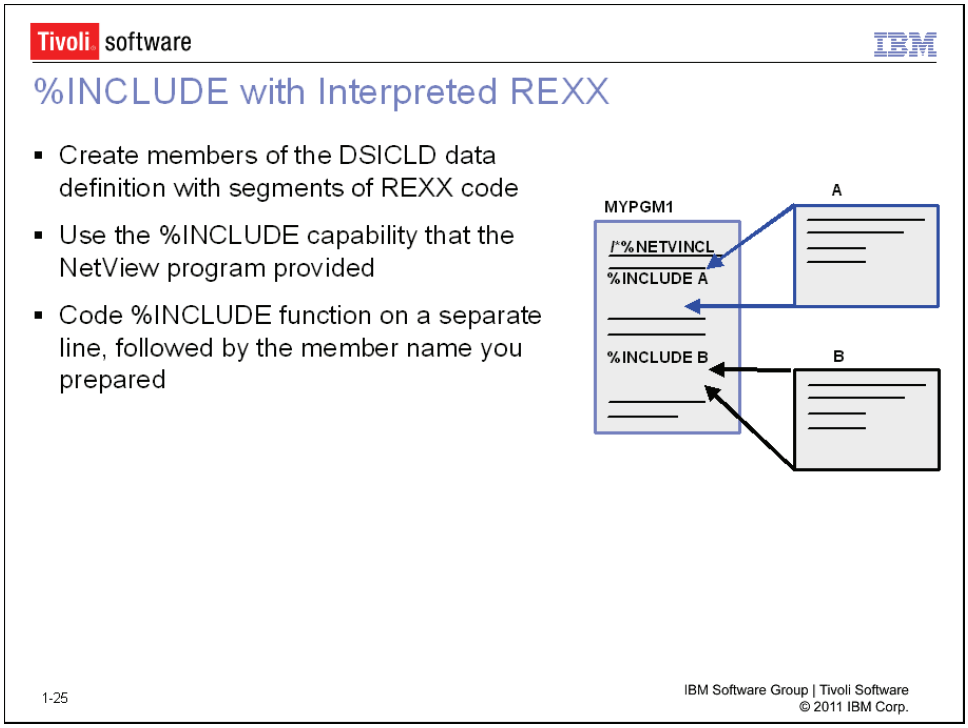


EXECs can run in other NetView domains that use the RMTCMD command. The EXEC must be defined in the DSICLD concatenation of the remote NetView domain.

The RMTCMD command routes system, subsystem, and network commands to a remote NetView domain for processing. The responses to these commands are returned to the RMTCMD issuer. To do this, RMTCMD can use an existing task, if it is already active. If the task specified by the OPERID value is not active, RMTCMD processing automatically starts the task. The command specified with RMTCMD is processed by the task. Responses are returned to the RMTCMD issuer.

RMTCMD supports SNA LU 6.2 and TCP/IP session connectivity.

%INCLUDE with interpreted REXX

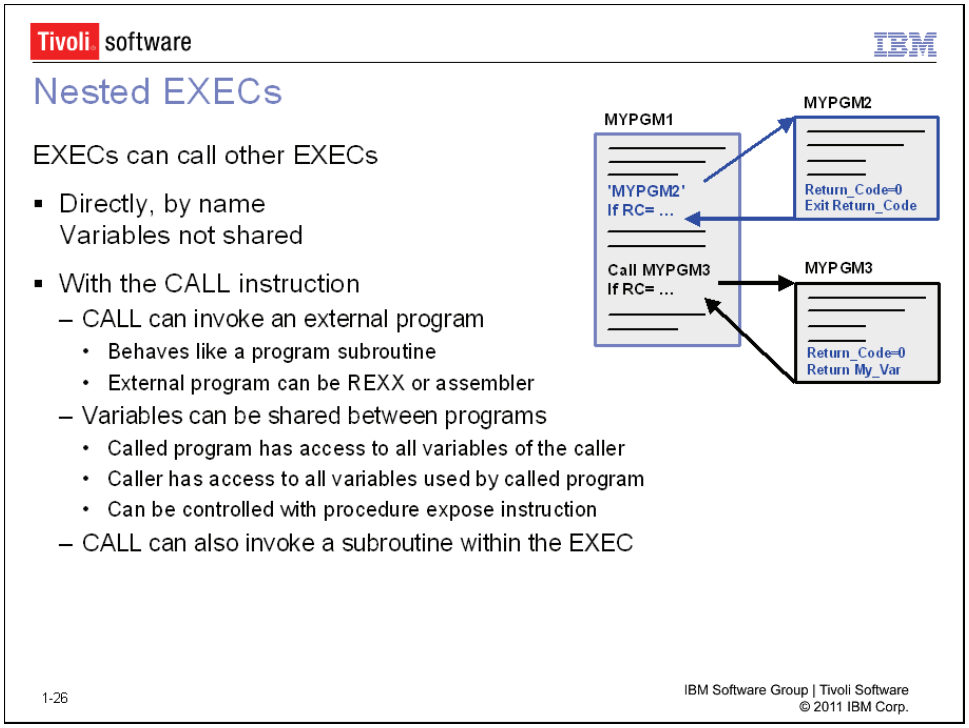


To facilitate code reuse, you can create members of the DSICLD data definition with segments of REXX code and use the %INCLUDE capability that the NetView program provides. To include a prepared code segment, the first line of your program must begin with /*%NETVINCL, followed by comments of your choice.

Code %INCLUDE anywhere in your program on a separate line, followed by the member name that you prepared. The prepared code segment is present when your program is interpreted as if it had been imbedded in your program.

Important: Do not use the INCLUDE function if you intend to compile your REXX program.

Nested EXECs

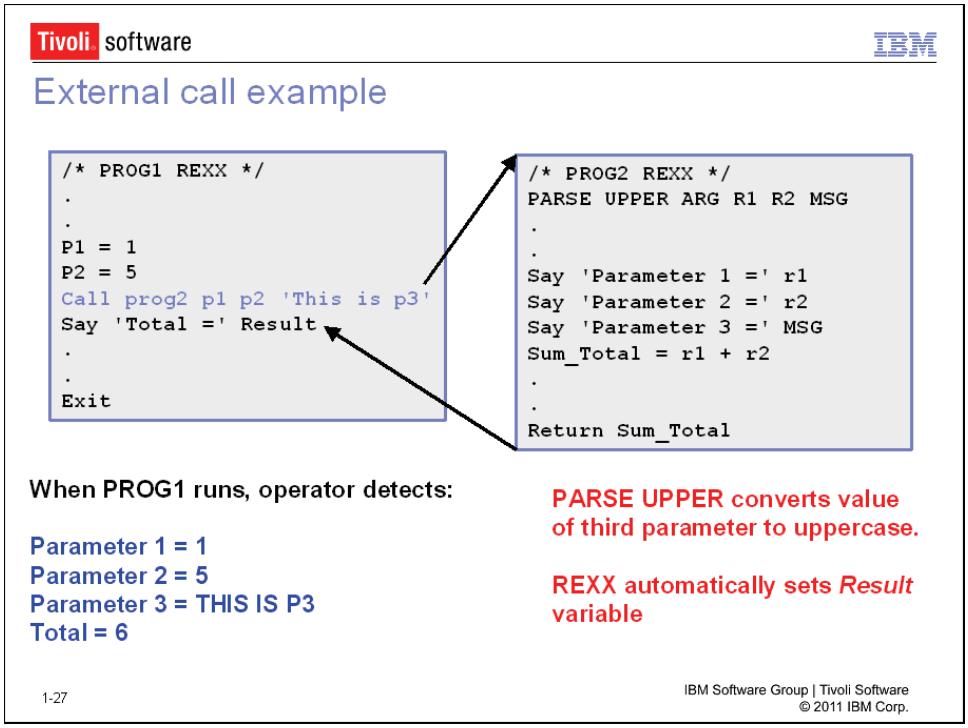


REXX EXECs can call other REXX EXECs with operands that are passed from the calling EXEC to the nested EXEC as follows:

- Directly using the EXEC name. When the nested EXEC finishes, only a return code routes to the calling EXEC.
- Using the CALL instruction. In this case, data can return in a variable and the return code can be checked.

To pass variables between the calling EXEC and the nested EXEC, you can use NetView global variables, PIPE SAFE, or PIPE INSTORE.

External call example



This example shows a use of the CALL instruction. PROG1 calls PROG2 with three parameters:

1. 1
2. 5
3. This is p3

PROG2 parses the input parameters into three variables, displaying them with a SAY instruction. Note that the third parameter is a text string and is also converted to upper case, based on the PARSE UPPER instruction in PROG2.

When an operator runs PROG1, the following information is displayed:

Parameter 1 = 1 (from the SAY in PROG2)

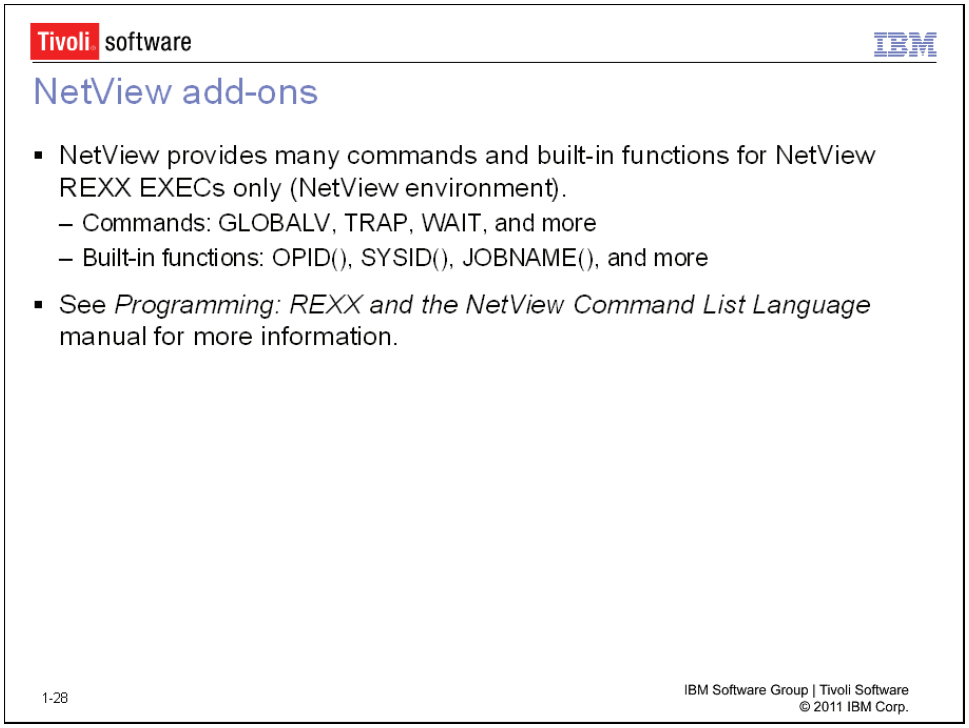
Parameter 2 = 5 (from the SAY in PROG2)

Parameter 3 = THIS IS P3 (from the SAY in PROG2)

Total = 6 (from the SAY in PROG1)

The CALL instruction supports a maximum of 16 nested EXECs. **SIGNAL ON HALT** detects an error in a nested EXEC and terminates all EXECs. Discussion about SIGNAL ON conditions occurs in more detail later.

NetView add-ons

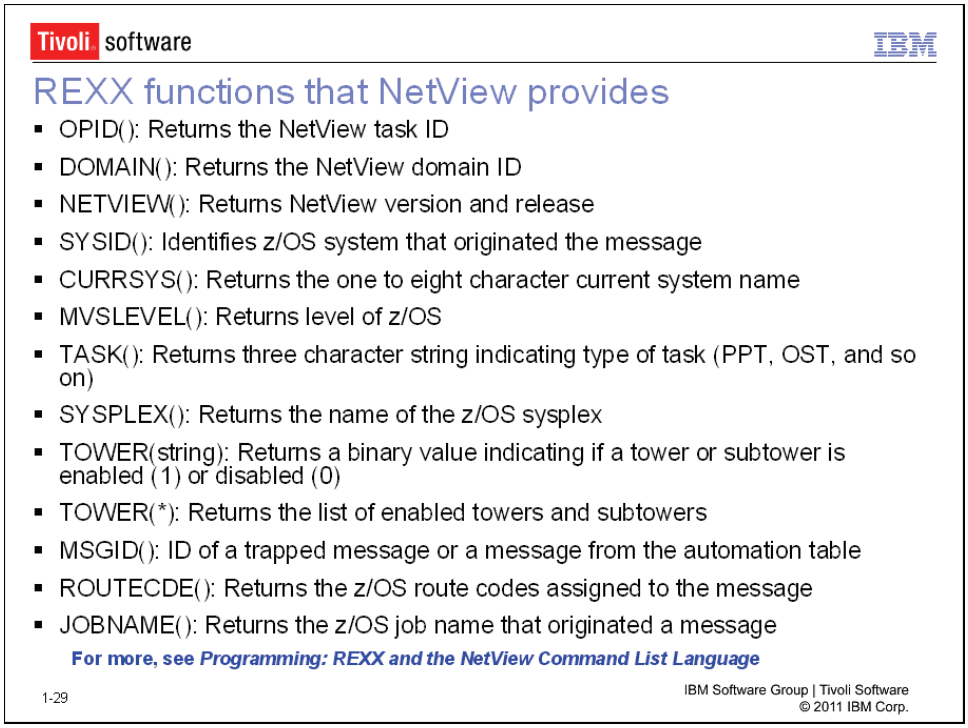


NetView provides several instructions to perform NetView specific activities. The NetView-provided instructions can be used only in EXECs that run in a NetView environment. Examples are as follows:

- TRAP: Defines messages that are to be trapped, and specifies whether or not the messages should be displayed to the operator.
- MSGREAD: Causes NetView to read a trapped message from the message queue.
- FLUSHQ: Removes all trapped messages from the message queue that using MSGREAD had not removed.
- WAIT: Temporarily suspends processing of that command procedure until a specified event occurs.
- WAIT CONTINUE: Specifies to continue waiting for additional messages, operator input, or data before command procedure processing resumes.
- GLOBALV: Enables you to define, put, get, automate, and trace global variables in REXX and NetView EXECs.

Discussion about global variables and trapping and processing messages occurs later.

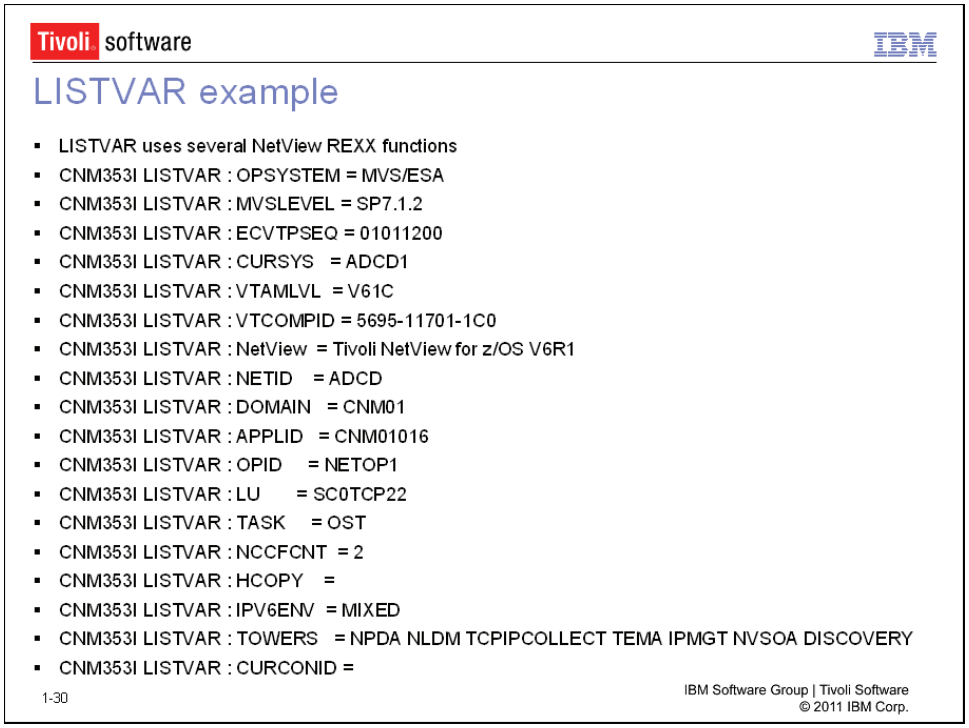
REXX functions that NetView provides



NetView provides functions to perform NetView-specific activities. Because these are NetView-specific and not standard REXX functions, you can use them only in EXECs that run in a NetView environment. NetView provides functions as follows:

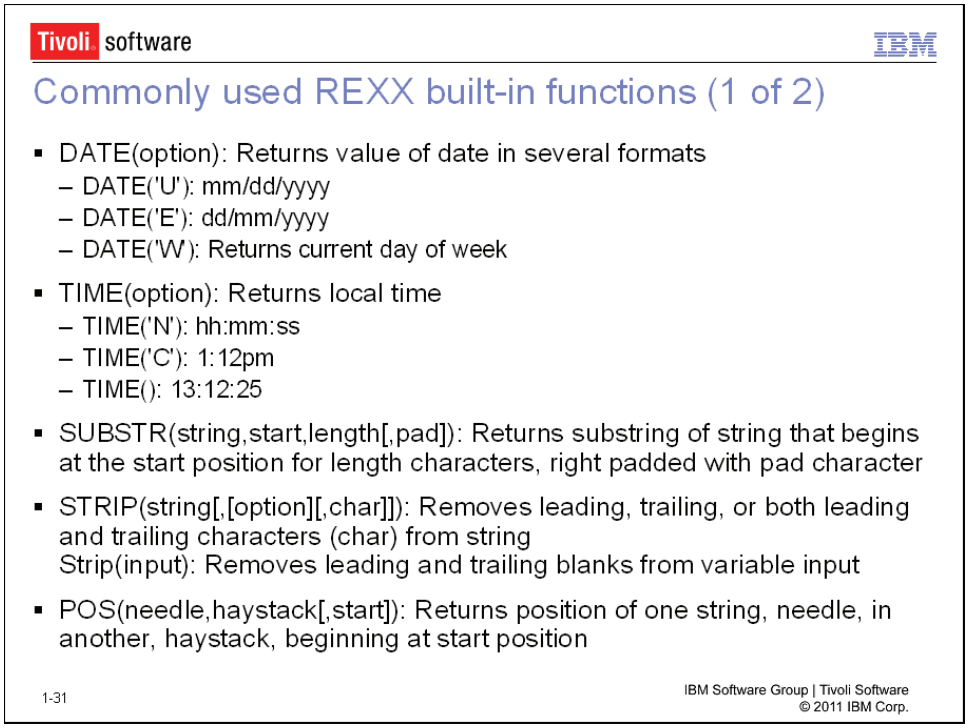
- Translation
- EXEC information
- Cross-domain information
- Data set information
- Message processing information
- REXX Management Services Units (MSU) information
- Operator information
- Session information
- REXX environment information
- Console information

LISTVAR example



The slide shows an example of the NetView **LISTVAR** command. **LISTVAR** displays information that several of the NetView REXX functions contain: APPLID(), OPID(), and others. Issue **BROWSE LISTVAR** to view more details on the LISTVAR command and functions that it uses.

Commonly used REXX built-in functions (1 of 2)



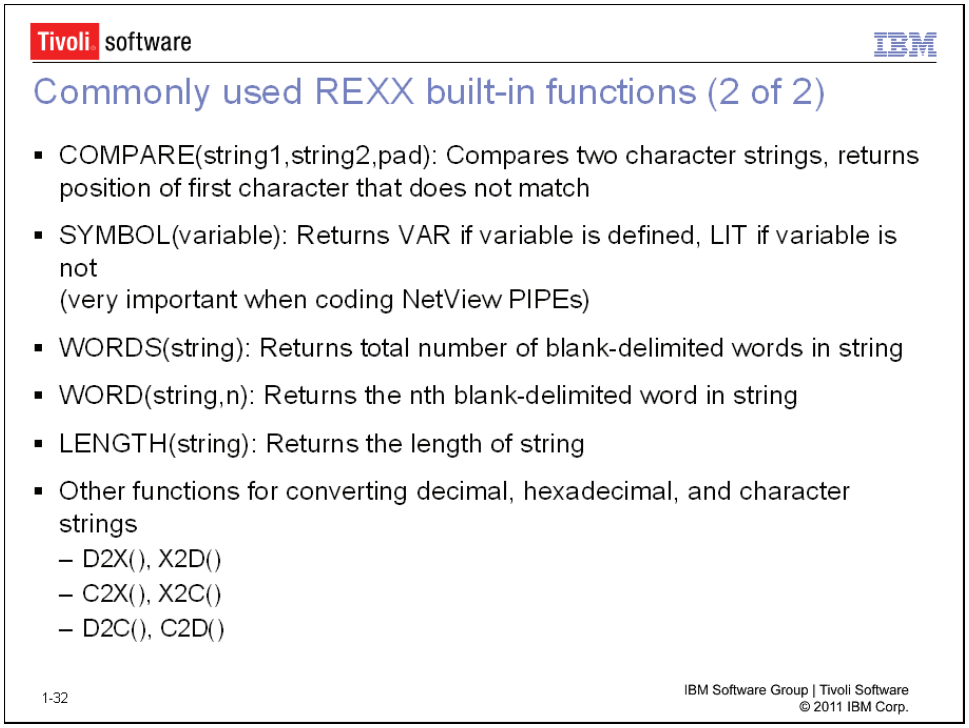
You can use many REXX built-in functions in your NetView REXX EXECs. This slide shows examples of using the DATE() and TIME() built-in functions.

You can manipulate text strings by using the SUBSTR(), STRIP(), and POS() built-in functions. For example, after parsing a text string, remove all leading and trailing blanks from the string by coding as follows:

```
Input = Strip(input)
```

For more information about these and other REXX functions, see *TSO/E REXX Reference Guide*.

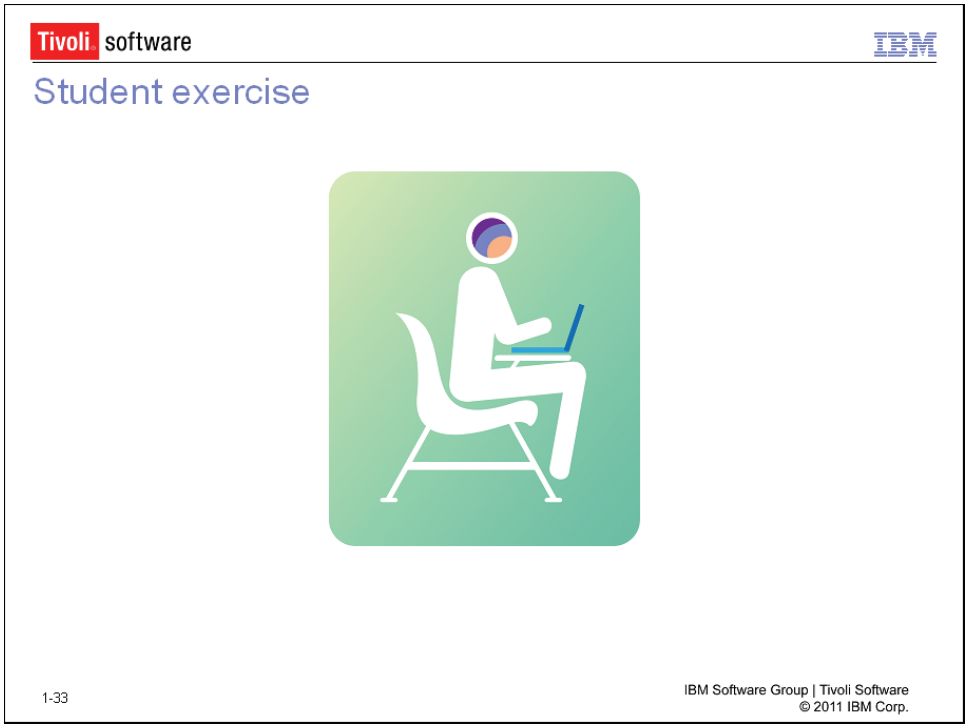
Commonly used REXX built-in functions (2 of 2)



This slide shows more REXX built-in functions that you can use for manipulating text strings. The SYMBOL() function is very useful when using REXX with NetView PIPEs. In some cases, after using a PIPE, you need to test a variable. PIPEs resets variables and, if not set within the pipeline, a NOVALUE condition can occur. To avoid the NOVALUE condition, you can use the SYMBOL() function to test if the variable is set (VAR) or not (LIT). An example is as follows:

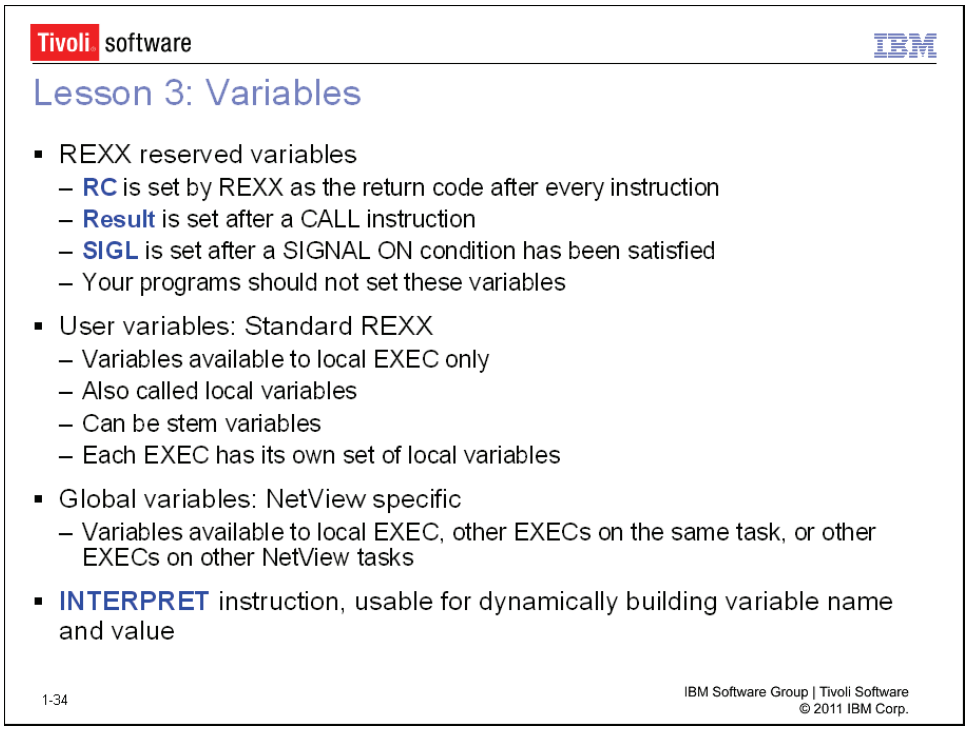
```
A = 1
'PIPE NETV command | ... | VAR A'
if SYMBOL(A) = 'LIT' then
   SAY 'Error encountered - variable A is not set'
```

Student exercise



Open your *Student Exercises* book and perform Exercise 1.

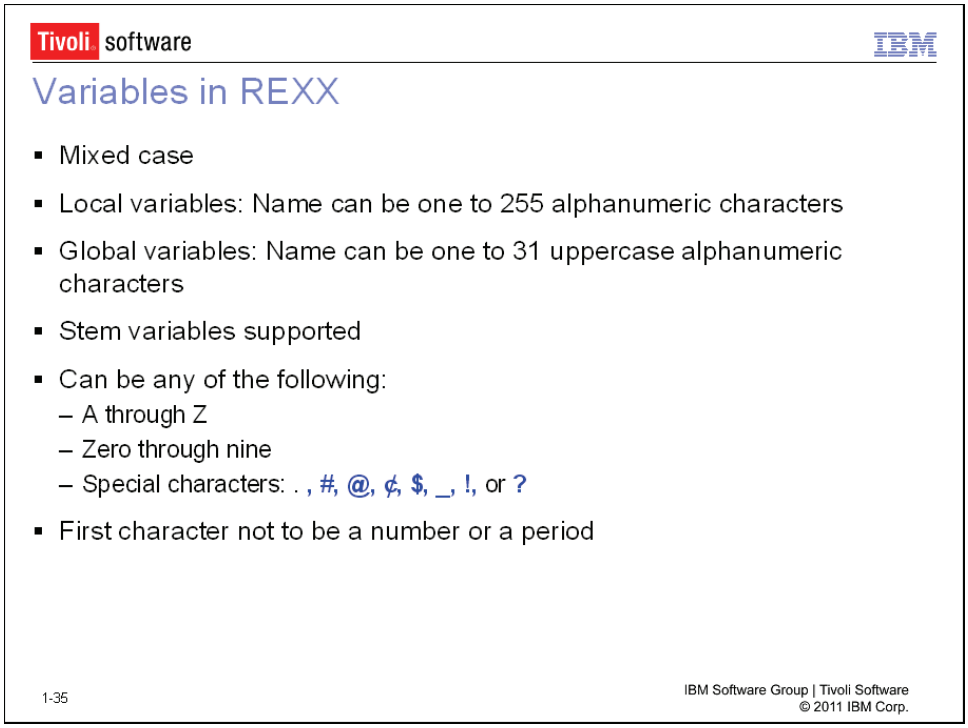
Lesson 3: Variables



The three types of variables in REXX EXECs are as follows:

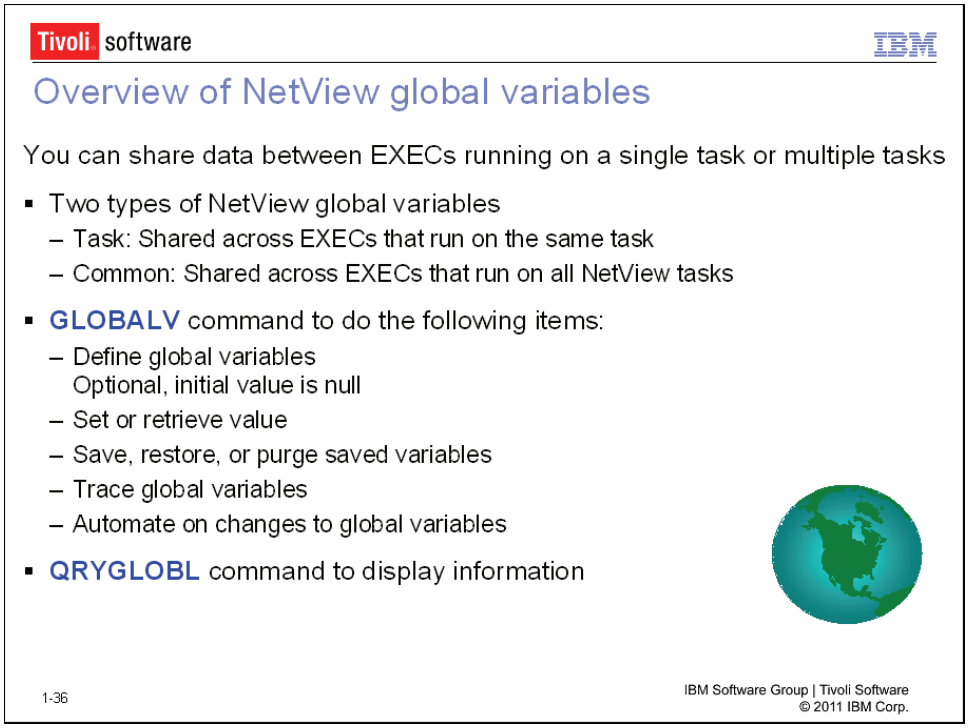
- Reserved variables, which REXX sets and that your EXECs should not use.
- User variables, which are the variables that are used within your EXECs.
- Global variables, which are specific to NetView, providing a mechanism for sharing data between EXECs on one task or EXECs on several tasks.

Variables in REXX



Products from IBM prefix their global variables with a three-character product prefix (for example, CNM or FKX). You can use any other global variable names. If you use a naming convention, you can issue a **QRYGLOBL** command to help display them more easily.

Overview of NetView global variables



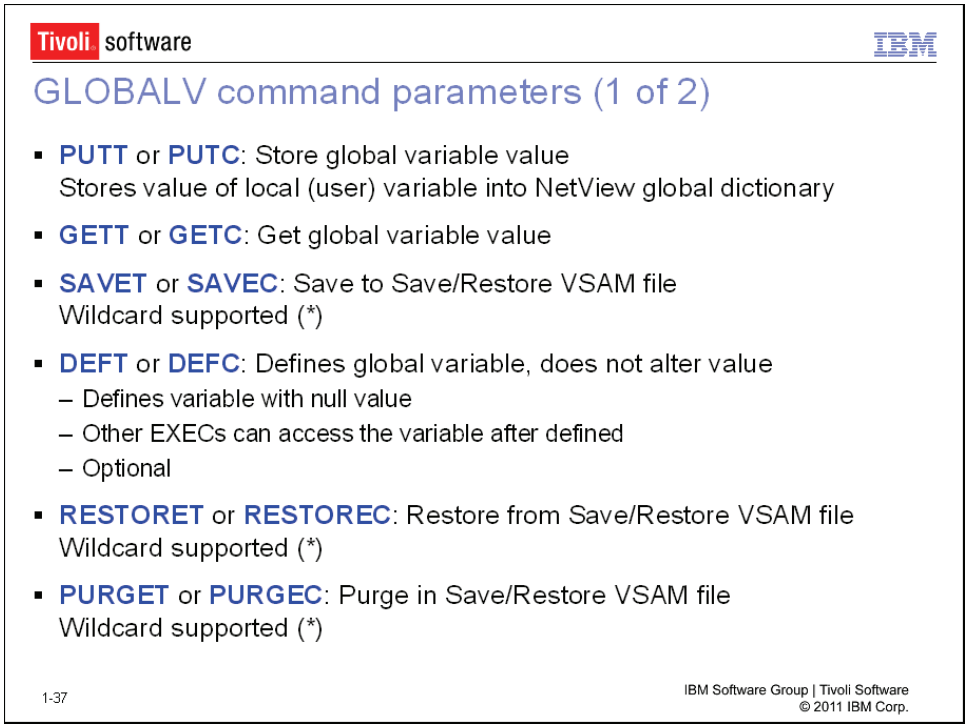
NetView provides global variables for use in REXX EXECs.

- Task global variables can be used for sharing data between EXECs that are running on the same task.
- Common global variables can be used for sharing between EXECs that are running on different tasks.

The NetView **GLOBALV** command has several operands to define, set, retrieve, save, restore, trace, automate, and purge saved variables. The NetView **QRYGLOBL** command can display the values of task or common global variables. QRYBALV and QRYGLOBL discussions occur later in this lesson.

Tip: When using GLOBALV in a REXX EXEC, remember to enclose it in single or double quotes.

GLOBALV command parameters (1 of 2)



GLOBALV is a NetView command for managing task and common global variables. This section discusses the parameters.

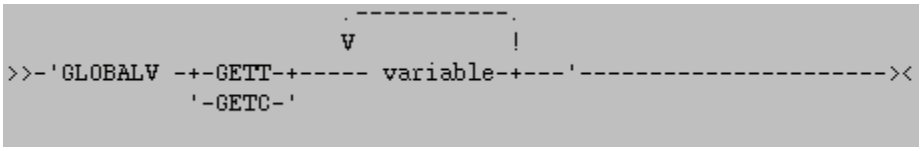
GLOBALV PUTT | PUTC:

Use PUT*x* to create or update a global variable in the NetView *dictionary* and save its value.

Tip: The local REXX variable must be set to a value before issuing the PUT*x*. When an EXEC updates the value of the local REXX variable, it should issue another PUT*x*.

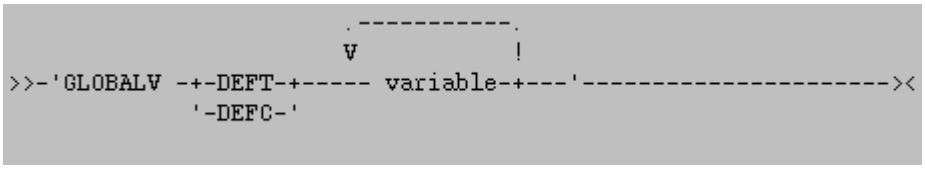
GLOBALV GETT | GETC:

Use GET*x* to retrieve the value of a global variable. If the global variable is not set, its value becomes null, and the GLOBALV command return code is 144.



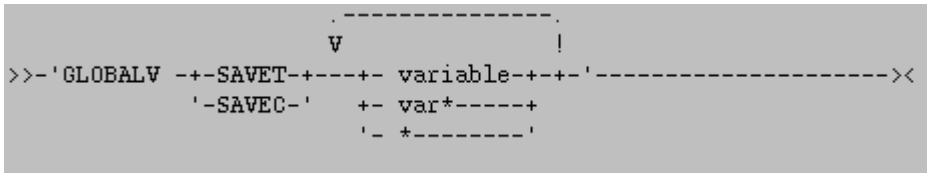
GLOBALV DEFT | DEFC:

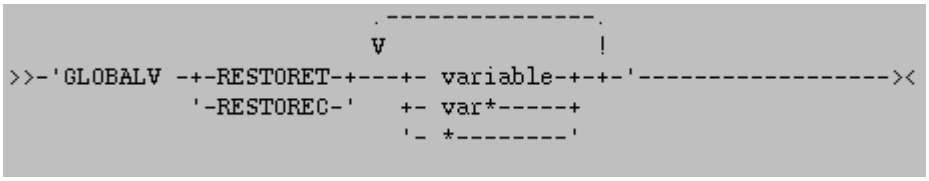
Use DEF*x* to define a global variable in the NetView *dictionary*. It has an initial value of null.

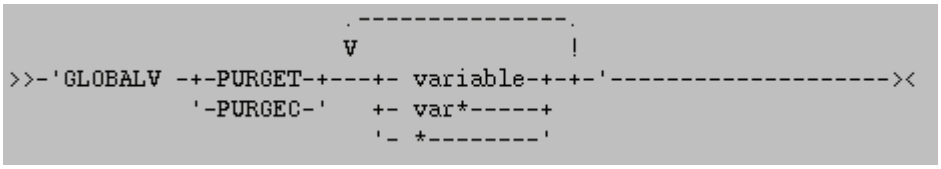


GLOBALV SAVE*x* | RESTORE*x* | PURGE*x*:

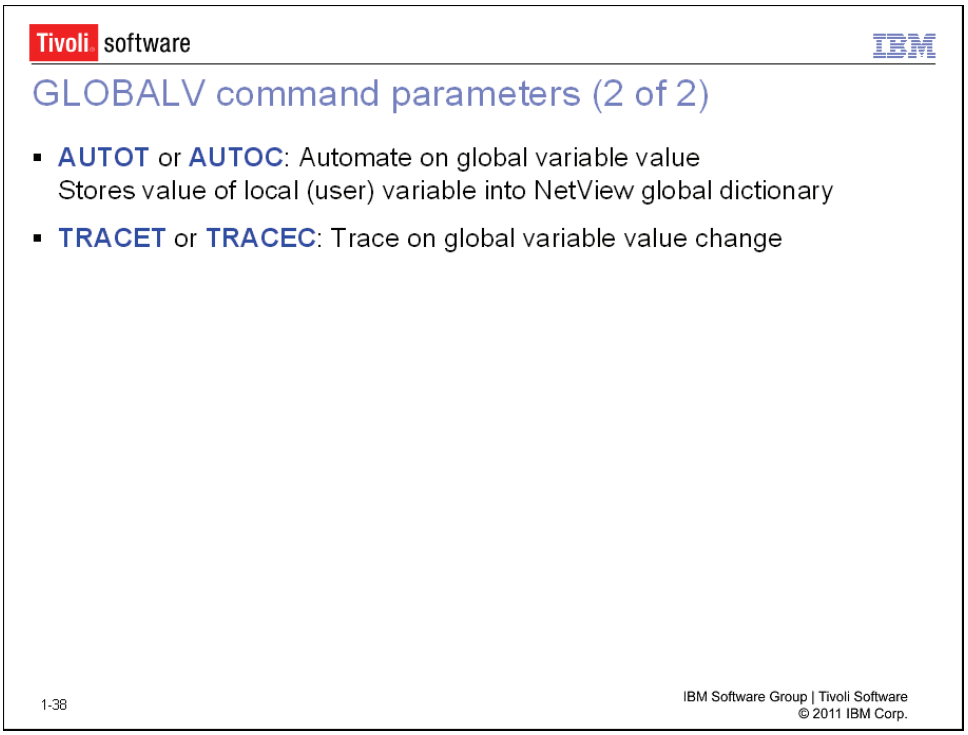
Use these options to save, restore, or purge global variables in the NetView Save/Restore VSAM file. SAVE*x*, RESTORE*x*, and PURGE*x* support **wildcards** with an asterisk (*****).







GLOBALV command parameters (2 of 2)



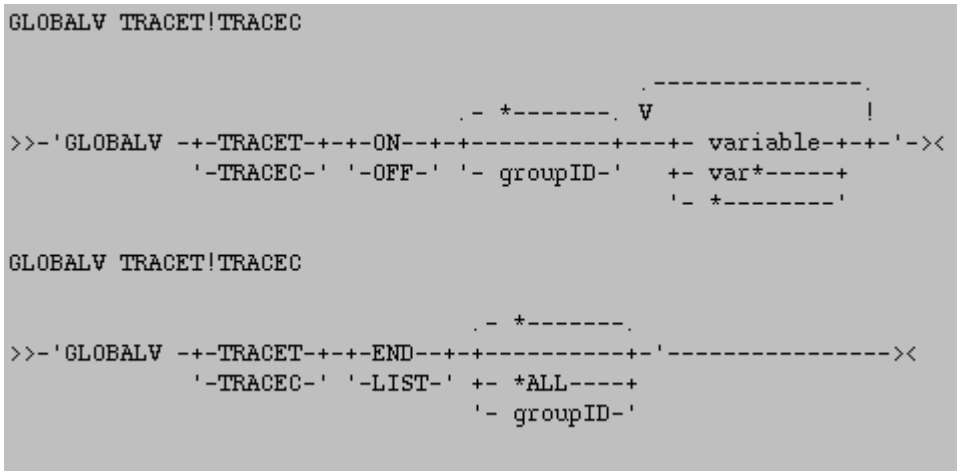
GLOBALV AUTO*x*:

Use these options to turn on or off automation of global variables. The LIST option displays current automation settings. When a change occurs to a automated variable, a DWO994I message is issued with variable name, old value, and new value of variable. Automation table entries can be coded to process this message. By default, this message is not displayed or logged unless modified by an automation table entry.

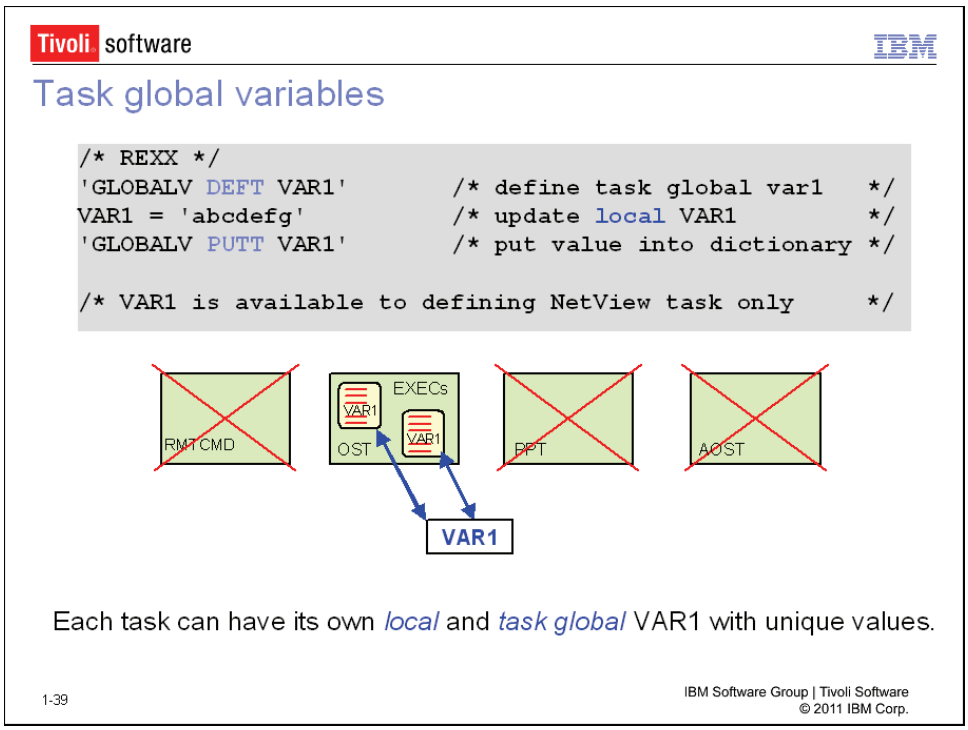
```
GLOBALV AUTOT!AUTOC

                                          .---------------.
                              .- *-------. V               !
>>-'GLOBALV -+-AUTOT-+-+-ON--+-+----------+---+- variable-+-+-'->< 
             '-AUTOC-' '-OFF-' '- groupID-'   +- var*-----+
                                              '- *--------'

GLOBALV AUTOT!AUTOC

                              .- *-------.
>>-'GLOBALV -+-AUTOT-+-+-END--+-+----------+-'----------------><
             '-AUTOC-' '-LIST-' +- *ALL----+
                               '- groupID-'
```


GLOBALV TRACEx

Use these options to turn on or off trace of global variable changes. The LIST option displays current traces. When a change occurs to a global variable that is being traced, a DWO990I message is issued with name of the global variable, old value, and new value.



Task global variables



Task global variables are available to all EXECs running on one task. This slide example shows the following sequence:

1. Defines VAR1 as a task global variable (optional).
2. Sets the value of local REXX variable VAR1 to a character string.
3. Stores the value of local variable VAR1 into the NetView dictionary as task global variable VAR1.

Note: Each time a global variable updates, you should replace its value in the dictionary. For example, if VAR1 updates later in the same EXEC, another **GLOBALV PUTT VAR1** must be issued to save its current value.

Common global variables

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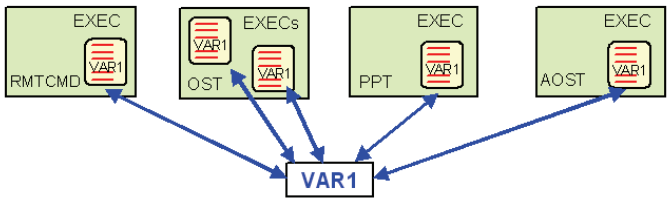
Common global variables

```
/* REXX */
'GLOBALV DEFC VAR1'       /* define common global VAR1 */
VAR1 = 'abcdefg'          /* update local VAR1         */
'GLOBALV PUTC VAR1'       /* put value into dictionary */

/* Common global VAR1 is available to any NetView task */
```



Each task can have a *local* VAR1 until it issues a GLOBALV DEFC, GETC, or PUTC for VAR1.

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Common global variables are available to all EXECs running on all tasks. This slide example shows the following sequence:

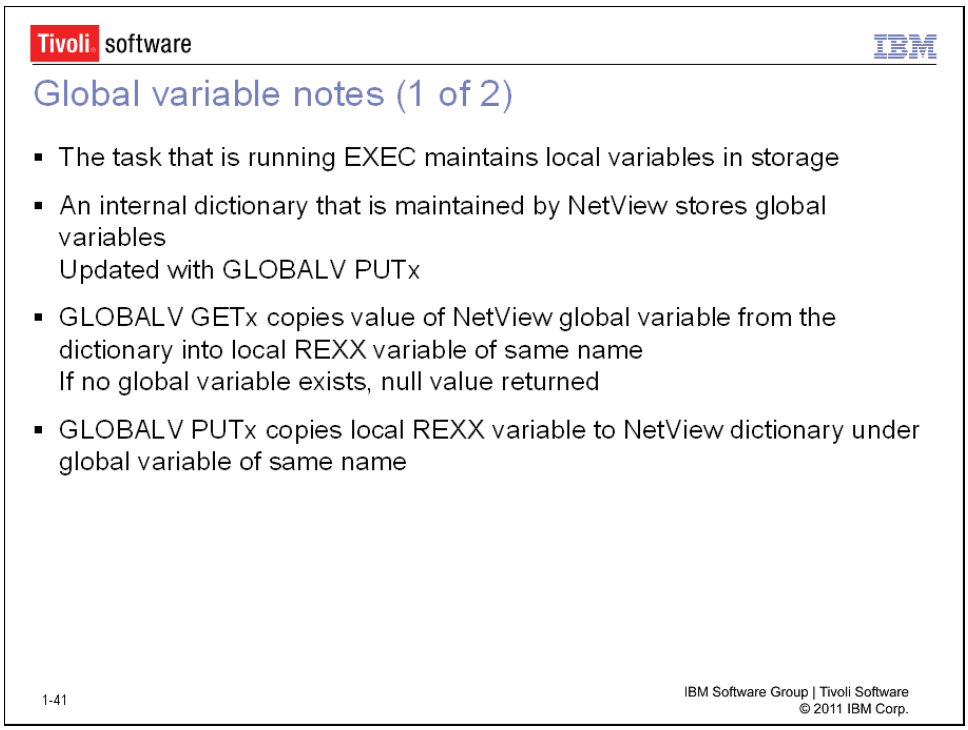
1. Defines VAR1 as a common global variable (optional).
2. Sets the value of local REXX variable VAR1 to a character string.
3. Stores the value of local variable VAR1 into the NetView dictionary as common global variable VAR1.

Each time a global variable updates, you should replace its value in the dictionary. For example, if VAR1 updates later in the same EXEC, another **GLOBALV PUTC VAR1** must be issued to save its value. VAR1 can also be updated by another EXEC.

If VAR1 is a counter (for example, counting of the number of times that a resource failed), you should synchronize updates under one task to ensure no loss of data.

Note: You can define VAR1 as a local REXX variable, task global variable, **and** common global variable at the same time.

Global variable notes (1 of 2)

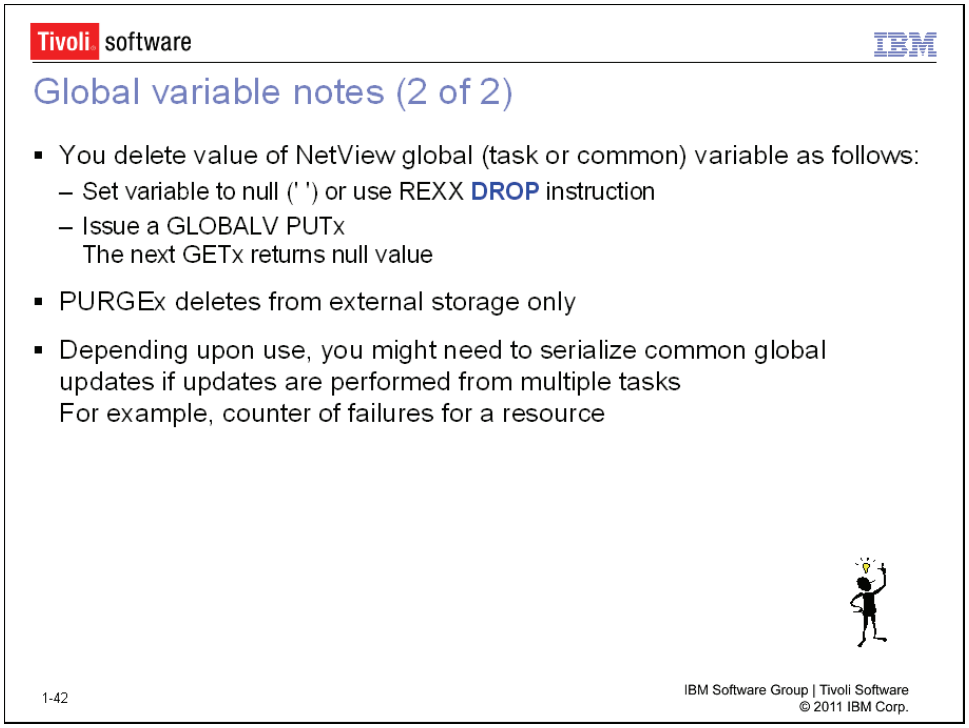


Global variables are *snapshots* of local variables that are stored in a dictionary that NetView maintains.

Note: If you put a global variable value to the dictionary and update its value, only the local REXX variable is updated. You must issue another GLOBALV PUT*x* command to update the dictionary.

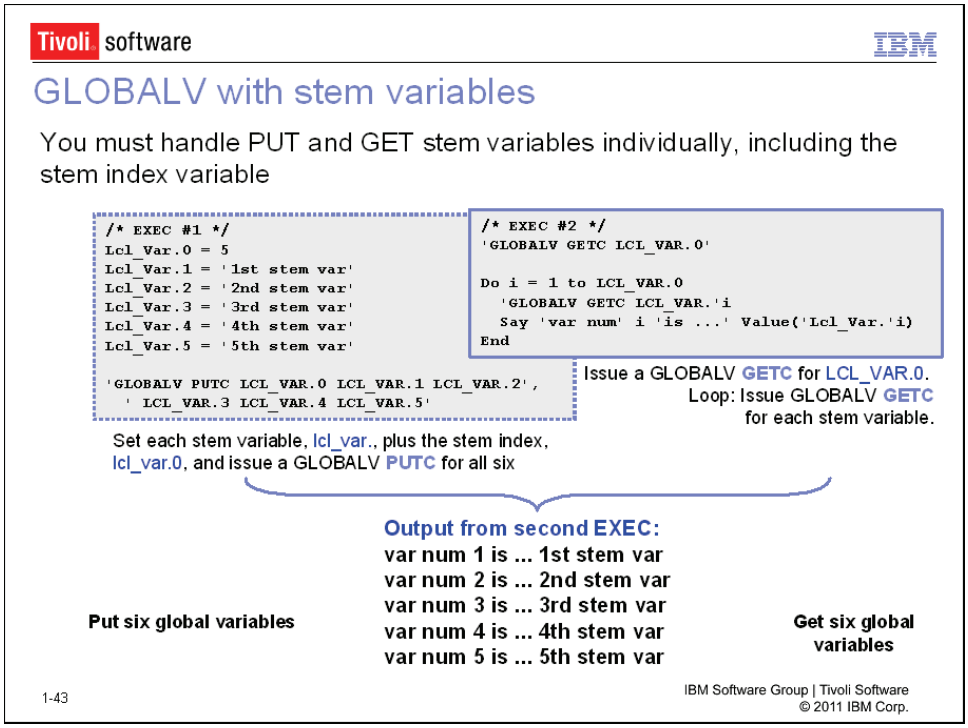
Global variable values in the dictionary are not updated dynamically.

Global variable notes (2 of 2)



To delete a global variable value, you must set its local variable to null (or use DROP). Update the dictionary value with a **GLOBALV PUT*x*** command. If the global variable is saved to the Save/Restore file, you must issue a GLOBALV PURGE*x* command to remove the global variable from the Save/Restore file.

GLOBALV with stem variables



This slide illustrates special handling of REXX stem variables that are used as global variables. EXEC#1 creates a stem variable, Lcl_Var, with five elements. Each stem variable (Lcl_Var.1 to Lcl_Var.5) is set to a value and put into the common global dictionary. The index (Lcl_Var.0) is also set and put into the common global dictionary.

Before using the stem variable values, EXEC#2 must issue a GLOBALV GETC for each. A typical approach is as follows:

1. Retrieve the stem index (Lcl_Var.0).
2. Create a DO loop within the EXEC to retrieve the *nth* element of the stem variable (Lcl_Var.n).

This set of actions results in putting six global variables in EXEC#1 and retrieving six global variables in EXEC#2.

Note: For maximum performance, minimize the use of GLOBALV GETC commands in EXEC#2 by building a list of common global variables to retrieve. An example follows:

```
VarList = ''
Do i = 1 to LCL_VAR.0
   VarList = VarList || Lcl_Var.i
End
VarList = Strip(VarList)
'GLOBALV GETC 'VarList
```

Displaying global variables

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Displaying global variables

- Operators can use the **QRYGLOBL** command to display common and task global variables

```
              .- BOTH---.
>>-QRYGLOBL--+----------+--+---------------+---------------------->
             +- COMMON-+   '- VARS=varspec-'
             '- TASK---'

>--+-------------------------------------------------------+------><
   '- FILE=membername--+----------------+--+----------+-'
                       '- MODE=modename-'   '- REPLACE-'
```

- Examples
  - QRYGLOBL COMMON VARS=*: Displays all defined common global variables
  - QRYGLOBL TASK VARS=MYVAR*: Displays all defined task global variables that begin with the characters MYVAR
    For the issuing task only

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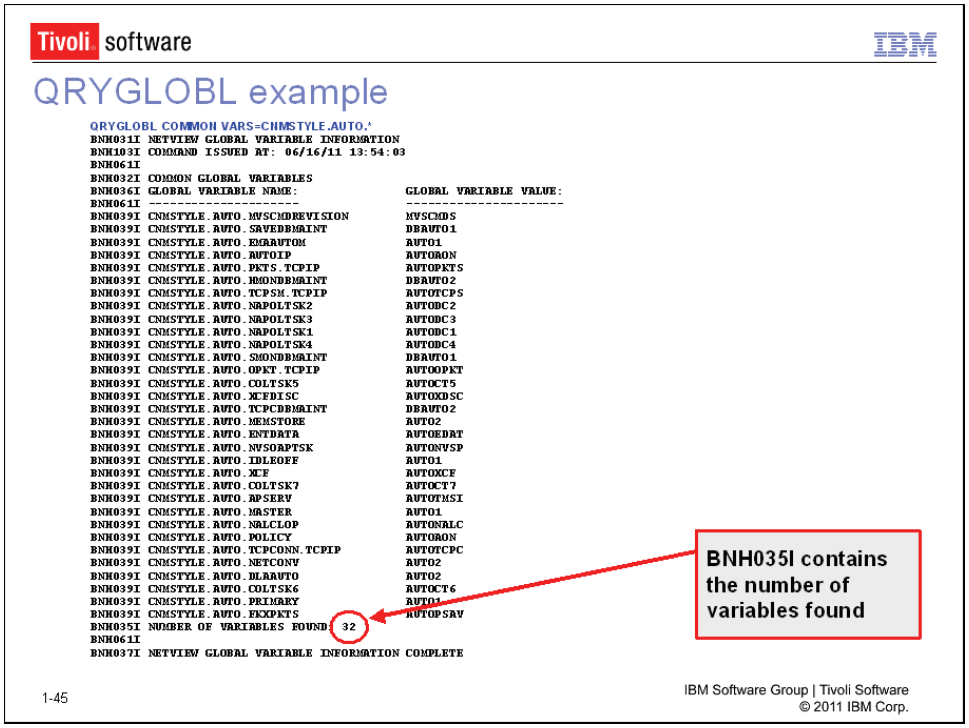
QRYGLOBL, which either a NetView operator or an EXEC can issue, can be used for displaying NetView common and task global variables.

QRYGLOBL example



This slide shows an example of using the QRYGLOBL command to list all of the automation operators (autotasks) defined in CNMSTYLE.

Suppose you want to determine which functions are using AUTO2. You can look for the BNH039I messages and correlate a value of AUTO2 with each global variable name. Or, you could code a NetView PIPE similar to the following one:

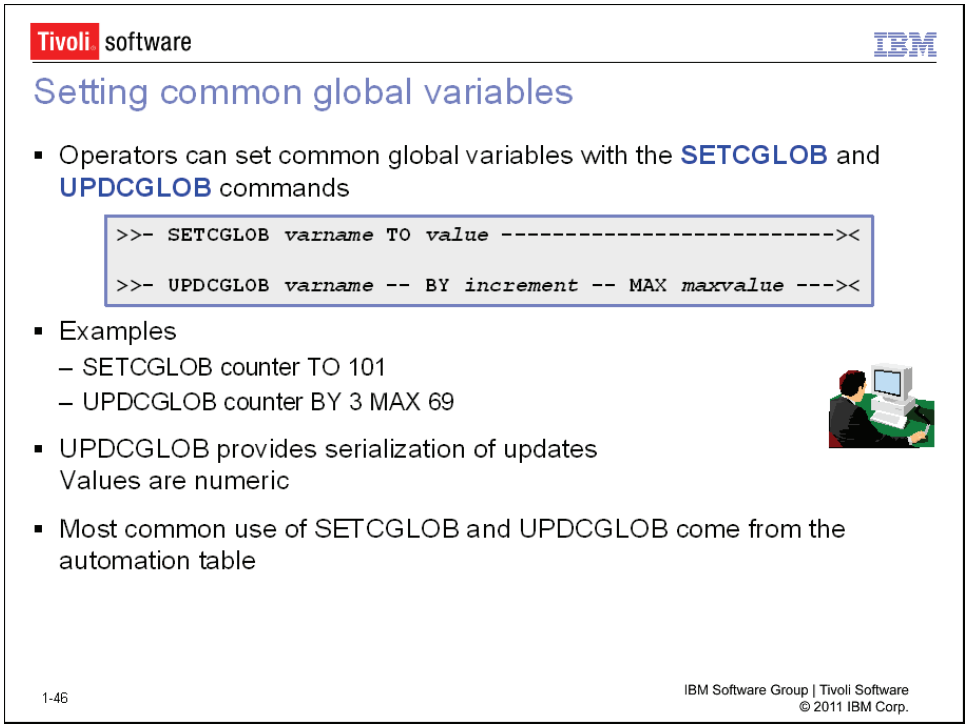
```
'PIPE NETV QRYGLOBL COMMON VARS=CNMSTYLE.AUTO.*',
 '| CORR',
 '| SEP',
 '| LOC /BNH039I/' ,
 '| LOC / AUTO2/' ,
 '| CONS'
```

The results should look similar to examples as follows:

```
BNH039I CNMSTYLE.AUTO.NETCONV                AUTO2
BNH039I CNMSTYLE.AUTO.MEMSTORE               AUTO2
BNH039I CNMSTYLE.AUTO.DLAAUTO                AUTO2
BNH039I CNMSTYLE.AUTO.MASTER                 AUTO2
```

NetView PIPEs discussion is in the NetView pipelines training module.

Setting common global variables



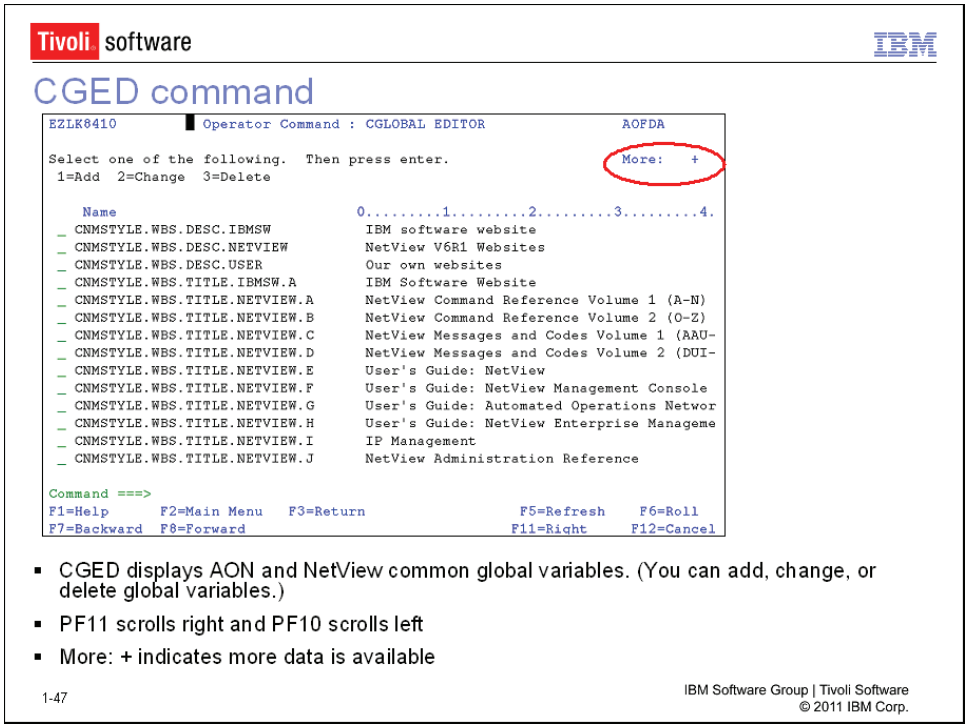
SETCGLOB and **UPDCGLOB** are NetView REXX EXECs for setting common global variables from the automation table. You can use **SETCGLOB** for setting the value of the specified common global variable. Note the following restrictions to this command:

- The use of SETCGLOB is limited to the command procedure and automation environments. (The command must originate in REXX, HLL, automation, or an optional task.)
- The SETCGLOB command sets a common global variable to any value. This command is appropriate to use in any situation where serializing the access among multiple tasks is not important. If serialization of updates is important, use PIPE VARLOAD. If the value is numeric, you can use the UPDCGLOB command.

The **UPDCGLOB** command adds the value that is specified as an increment to the current value of the common global variable. The command runs if the result does not exceed the specified *maxvalue*. If the specified variable is not set (has a null value), it is treated as zero. The new value becomes the value of the increment.

The UPDCGLOB command serializes updates for common global variables by using PIPE VARLOAD to give the effect of a compare and swap logic. If serialization between tasks is not important, you can use the SETCGLOB command instead.

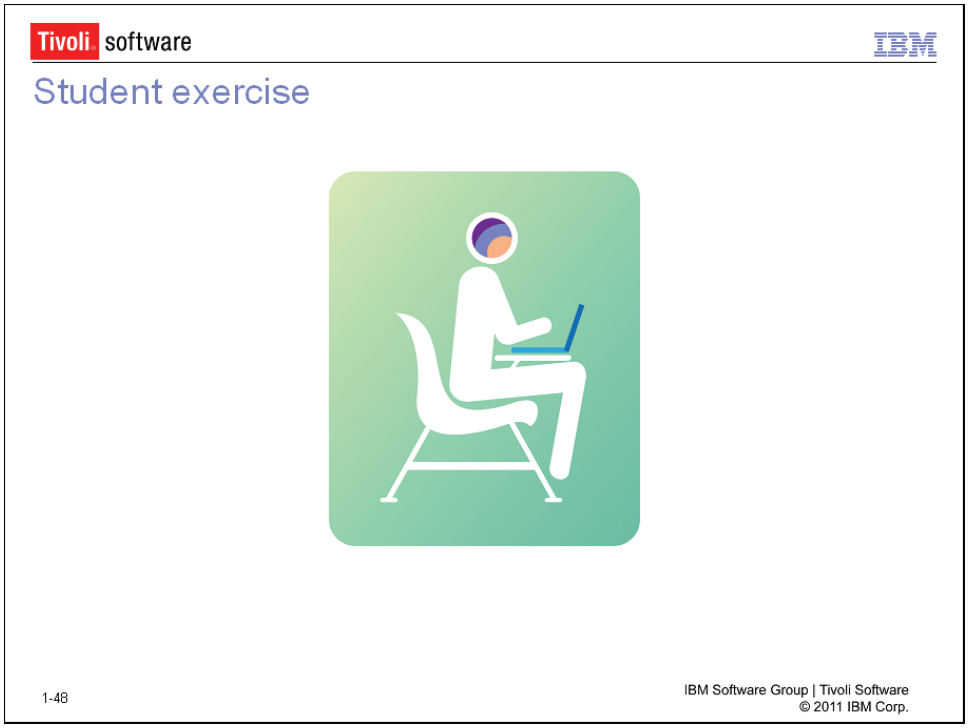
CGED command



CGED displays both AON and NetView common global variables. Options are provided so that you can create new common global variables and delete or modify an existing common global variable. You can also see more information by using your keyboard keys as follows:

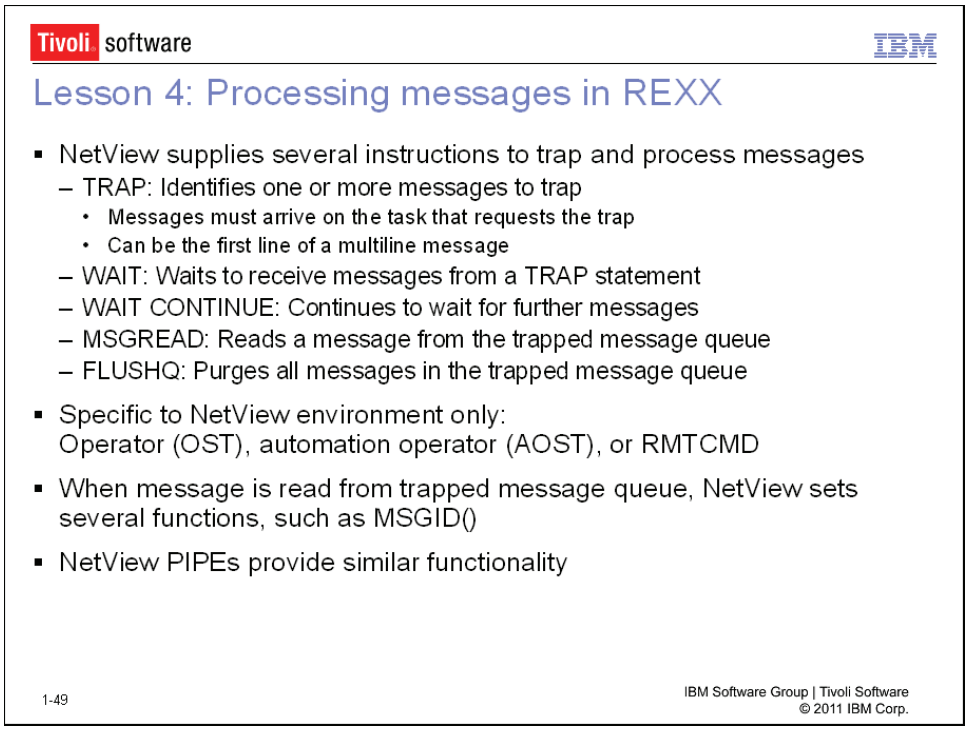
- When you see "**More: +**" press PF8 to see more data.
- Press PF10 and PF11 to scroll left and right.

Student exercise



Open your *Student Exercises* book and perform Exercises 2 and 3.

Lesson 4: Processing messages in REXX



The **TRAP** instruction causes NetView to monitor the operator task for specified messages. If the messages occur, they are trapped and added to the *trap message queue*. Trapped messages that fulfil a **WAIT** instruction and can be read by using **MSGREAD**. MSGREAD removes the message from the trap message queue and sets several NetView functions with information pertaining to the message. An example is MSGID().

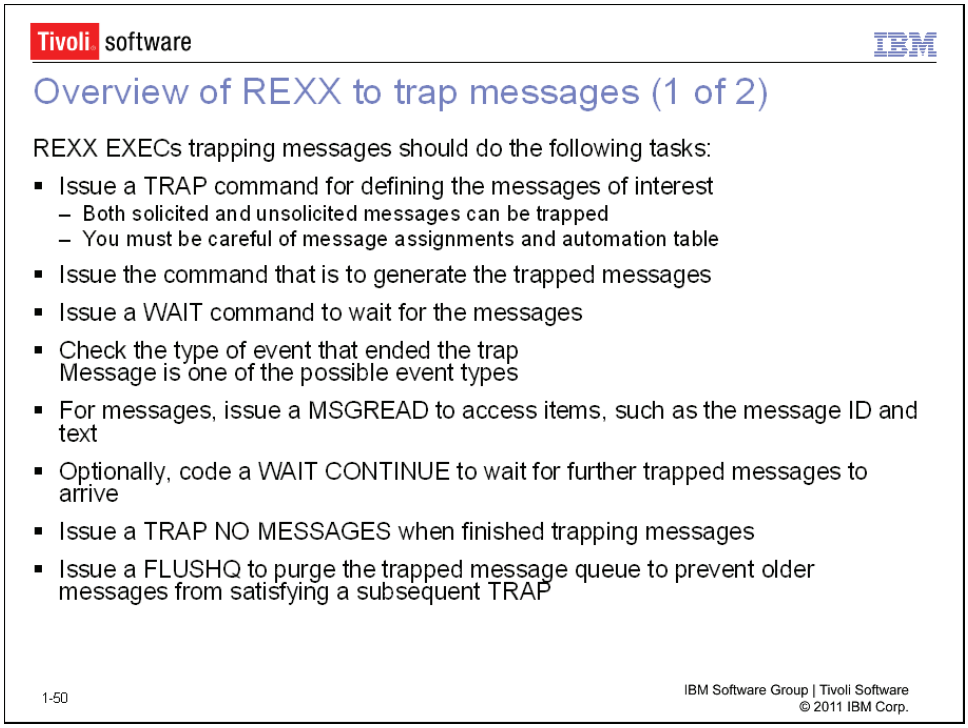
A **WAIT CONTINUE** instruction can be coded to specify that processing should continue to wait for additional messages, operator input, or data before EXEC processing resumes. When processing resumes, the next instruction after the WAIT CONTINUE runs.

The **FLUSHQ** instruction is used for removing all trapped messages from the trap message queue that have not been read (removed) using MSGREAD.

Note: EXECs that wait for messages result in an error when they run under the PPT task.

Tip: NetView PIPEs provide functions to issue commands and process their responses in a pipeline. *In most cases, you can replace the TRAP, WAIT, and MSGREAD commands (plus the REXX code) with a single pipeline.*

Overview of REXX to trap messages (1 of 2)



You can trap a single message, multiple messages, or a multiline message. The basic logic for trapping messages is as follows:

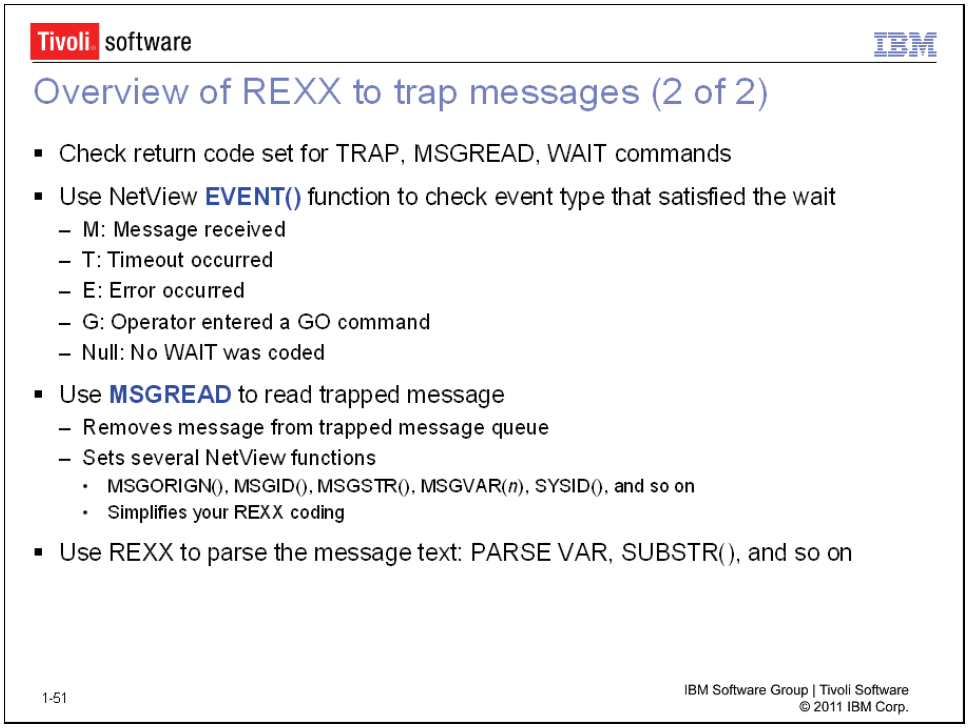
1. Define the messages to trap with a TRAP command.
2. Issue the command that generates the messages being trapped.
3. WAIT for the messages.

   During the wait, the operator can see a **W** in the upper corner of the screen.
4. Test the type of event that ended the trap.

   Discussion of the four different event types is on the next slide.
5. Use MSGREAD to read the message from the trapped message queue.
6. Continue waiting, if necessary, for more messages.
7. End trapping messages when done to prevent newer messages that would fulfill a message trap.
8. Flush the messages in the trapped message queue.

Messages that occur as a result of a command are *solicited* messages. When specifying a TRAP, be aware that *unsolicited* messages can be trapped. You can test if a message is solicited or unsolicited in your REXX EXECs.

Overview of REXX to trap messages (2 of 2)

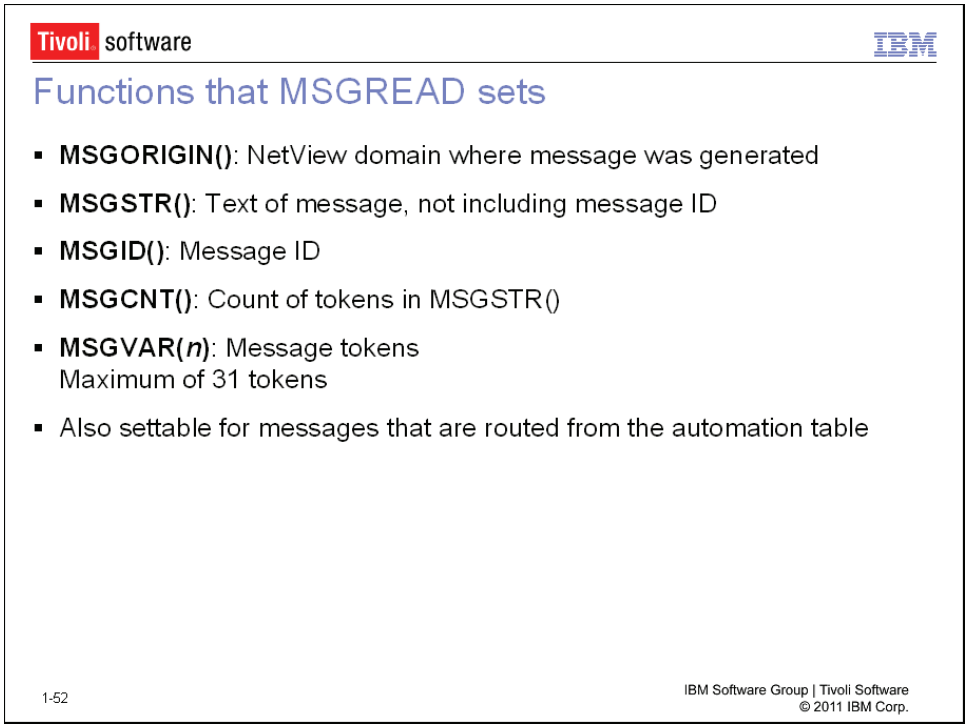


The REXX-reserved variable, RC, is set after each instruction within an EXEC, including MSGREAD, TRAP, and WAIT instructions.

When a wait is satisfied, you should check the event type that satisfied the wait. In typical operation, the event is message (EVENT()='M'). If the command response does not arrive within the timeout specified on the WAIT instruction, the event becomes a timeout (EVENT()='T').

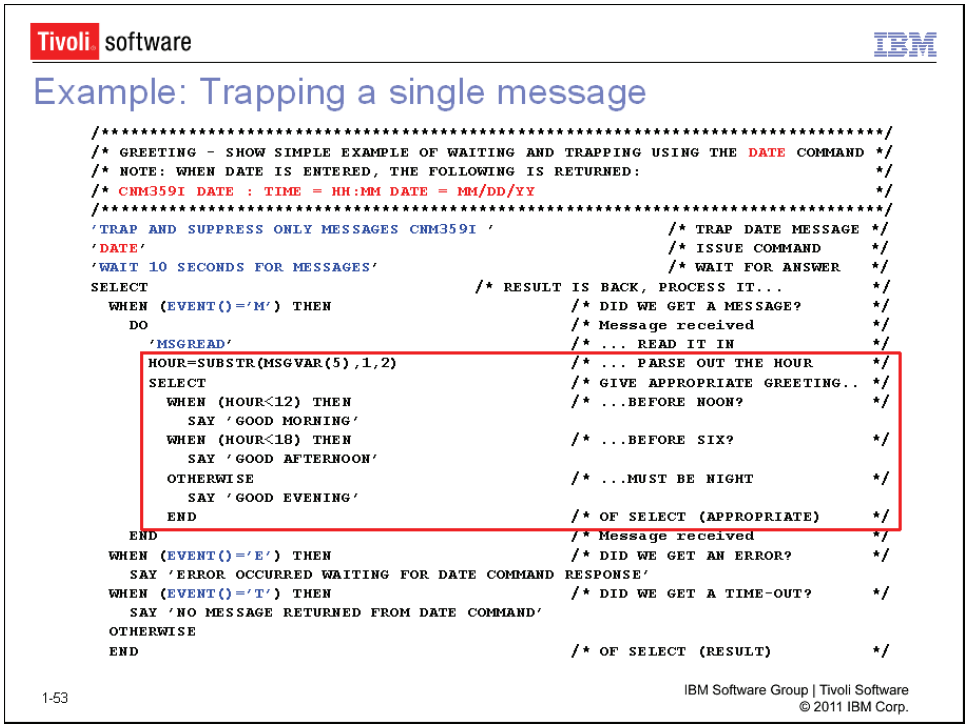
MSGREAD reads a message from the trap message queue and sets several NetView functions. You can use the NetView functions to parse the message: MSGID(), MSGSTR(), MSGVAR(*n*), and so on. You can also use a REXX PARSE of MSGSTR() to further parse the text of the message.

Functions that MSGREAD sets



NetView sets many built-in functions when you issue a MSGREAD command.

Example: Trapping a single message



This slide shows an example of a TRAP for one message, CNM359I, that results from issuing the NetView **DATE** command. The message is suppressed. When the message is received, the following actions occur:

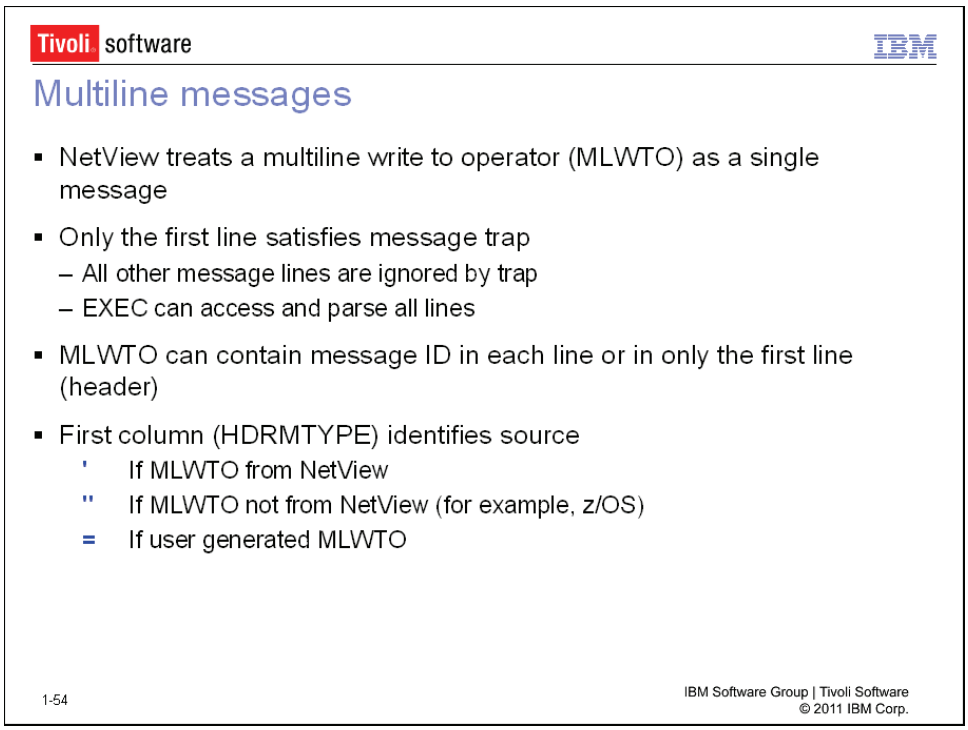
1. NetView sets the event function: EVENT()='M'
2. The EXEC parses the fifth message token.
3. Based on the value of the fifth token, a greeting message goes out.

This example is also coded to handle errors, EVENT()='E,' and wait timeout conditions, EVENT()='T.'

You can use the following example as a sample for coding many other REXX EXECs to TRAP and WAIT for messages.

1. Modify the TRAP AND SUPPRESS statement.
2. Issue the command to generate the trapped messages.
3. Replace the Select-When logic after the MSGREAD command to parse the trapped messages.

Multiline messages

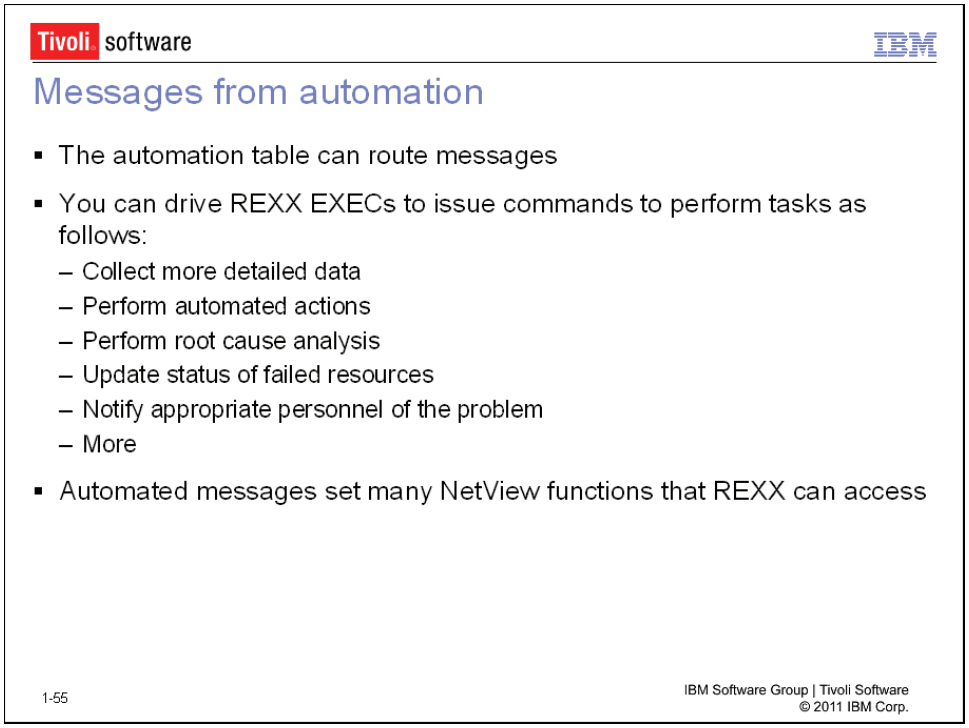


In addition to single-line messages and multiple single-line messages, multiline messages can be trapped and processed. Multiline messages are commonly called multiline write-to-operator (MLWTO) messages.

Only the first line of an MLWTO can be trapped. REXX EXECs can parse any line of the MLWTO. MLWTO messages can be identified by using the HDRMTYPE function. Some MLWTO messages contain a message ID on every line, making the MLWTO appear to be multiple single-line messages.

A method for parsing MLWTO messages is using NetView PIPEs. Discussion about NetView PIPEs is in the NetView Pipelines training module.

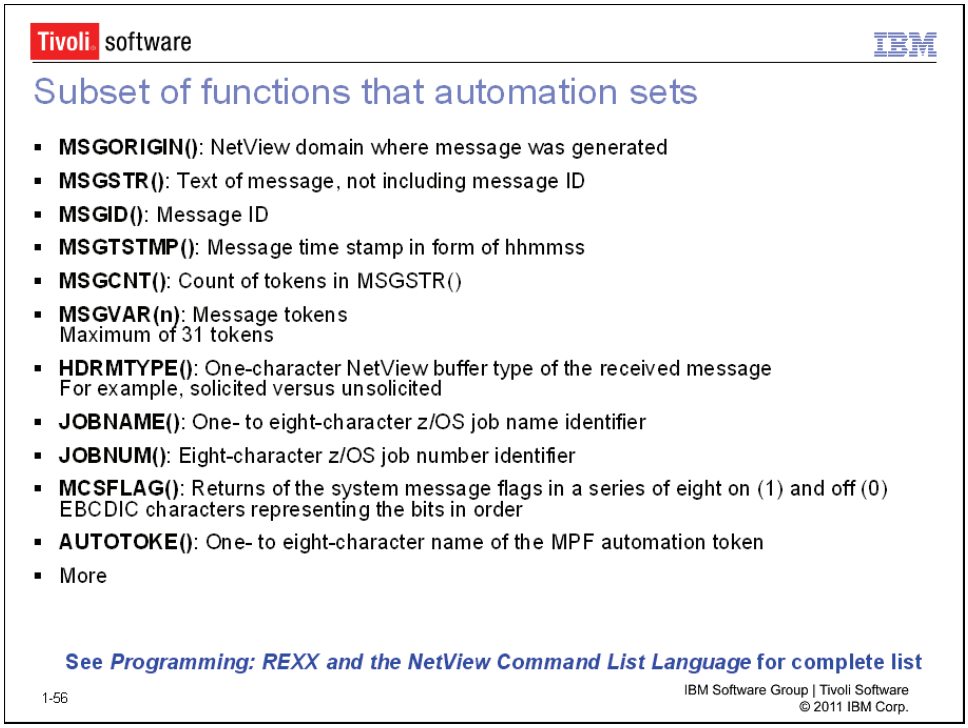
Messages from automation



One of the primary purposes of a REXX EXEC is to take action based on events that drive the NetView automation table. Actions can range from collecting more data (pertaining to the event or the resource) to notifying appropriate personnel of the failure. For example, you can use one of the two following notification methods:

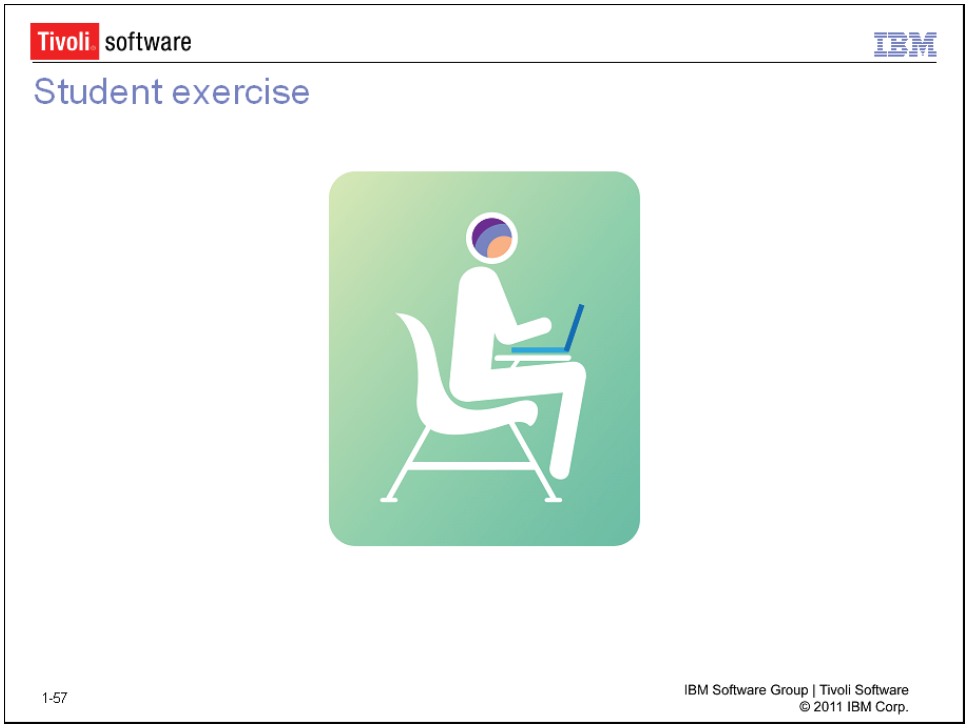
- SMTP on z/OS for sending an email
- **System Automation for Integrated Operations Management** (SA IOM) for sending an email or voice notifications

Subset of functions that automation sets



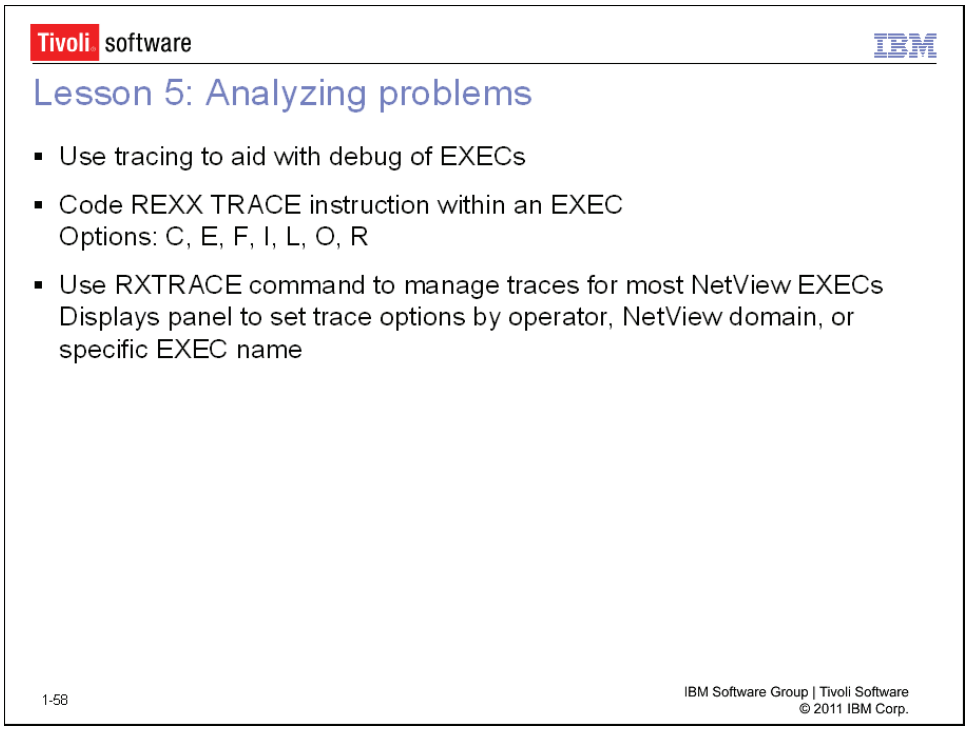
When a REXX EXEC is called from the automation table, many functions are set with information that pertain to the event. MSGID() and MSGSTR() have been discussed in relation to trapping messages. They work the same way when called from the automation table. More details about the functions that the automation table processes set are in the *IBM Tivoli NetView for z/OS: Programming: REXX and the NetView Command List Language* manual.

Student exercise



Open your *Student Exercise*s book and perform Exercise 4.

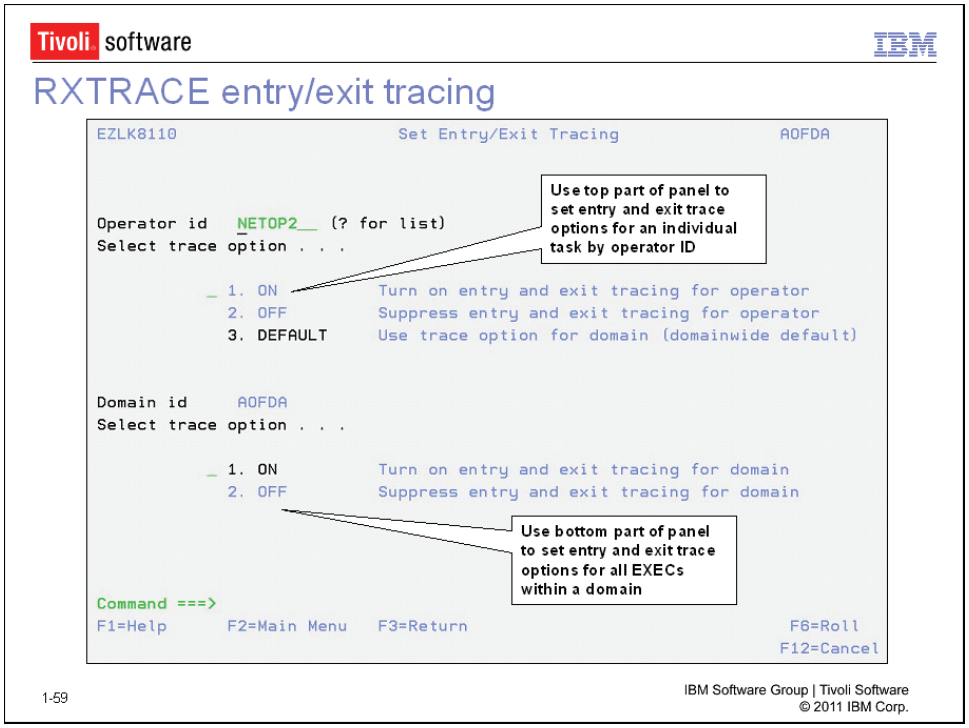
Lesson 5: Analyzing problems



Supported REXX TRACE options are as follows:

- **C** (Command): All commands are traced before they run, and any error return code from the commands is displayed.
- **E** (Error): Any command that runs and results in error or failure is traced afterward. Any error return code from the command is also displayed.
- **F** (Failure): Any command that runs and results in failure is traced.
- **I** (Intermediate): All clauses are traced before they run, and any intermediate results are traced during expression evaluation and substitution.
- **L** (Label): All labels that are passed during execution are traced, making it convenient to note all subroutine calls and signals.
- **O** (Off): All trace is turned off, and any previous trace settings are reset.
- **R** (Result): All clauses are traced before they run, and final results of evaluating expressions are traced. This option is useful for general debugging.

RXTRACE entry/exit tracing

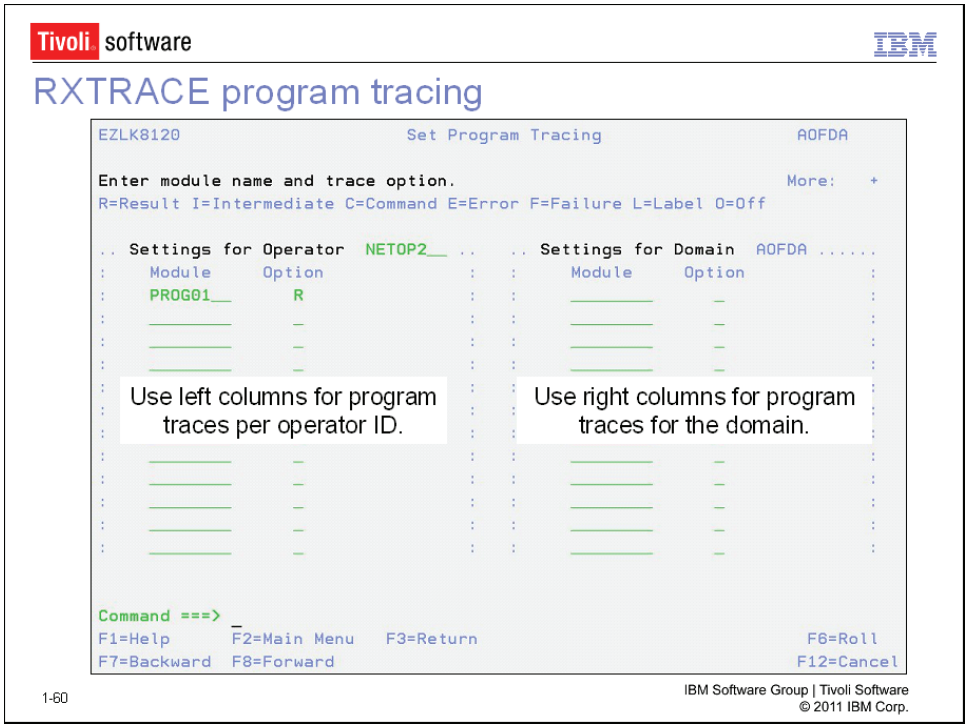


In this slide example, entry/exit tracing is active for the AOFDA domain. NETOP2 is running with the default settings. All supported EXECs create entry and exit trace messages. When entry/exit traces are enabled, EZL260I messages in DSILOG are similar to the following message:

```
EZL260I 09/03/07 17:49:22 NETOP2   EZLE600A ENTRY
EZL260I 09/03/07 17:49:22 NETOP2   EZLE6000 ENTRY
EZL260I 09/03/07 17:49:24 NETOP2   EZLE6000 EXIT       RC=0
EZL260I 09/03/07 17:49:24 NETOP2   EZLE600A EXIT       RC=0
```

- The entry trace identifies the command and input parameters, if any are specified.
- The exit trace identifies the return code for the program.

RXTRACE program tracing

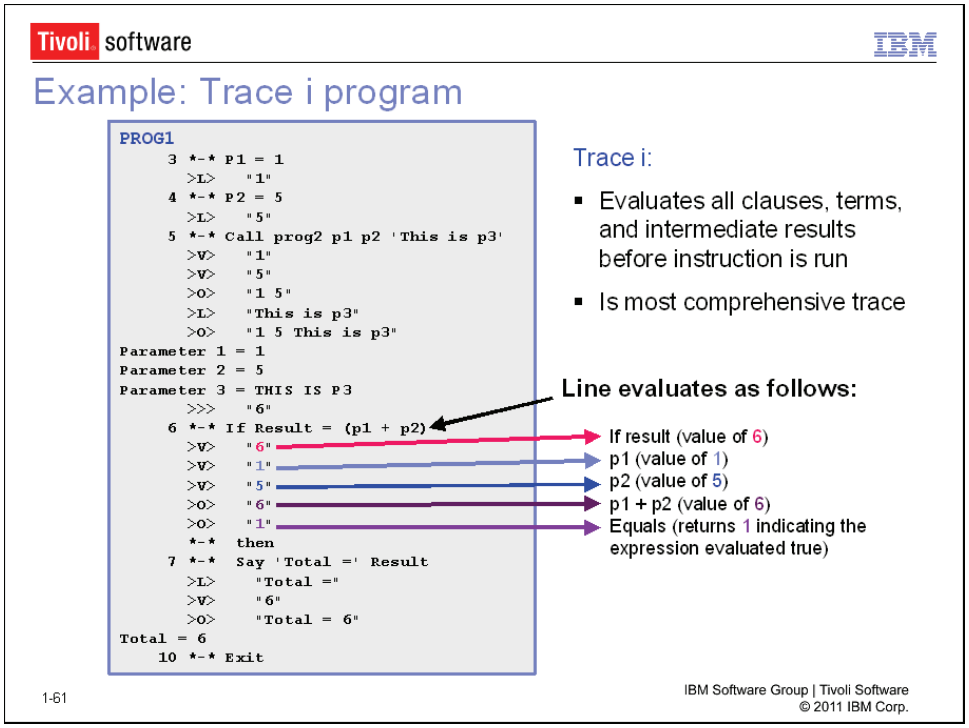


You can enable program traces for many NetView EXECs. You can specify the traces for a single task (for example, NETOP2) or for all tasks in the NetView domain (AOFDA). If you need to trace an EXEC on AUTO2, the following steps apply:

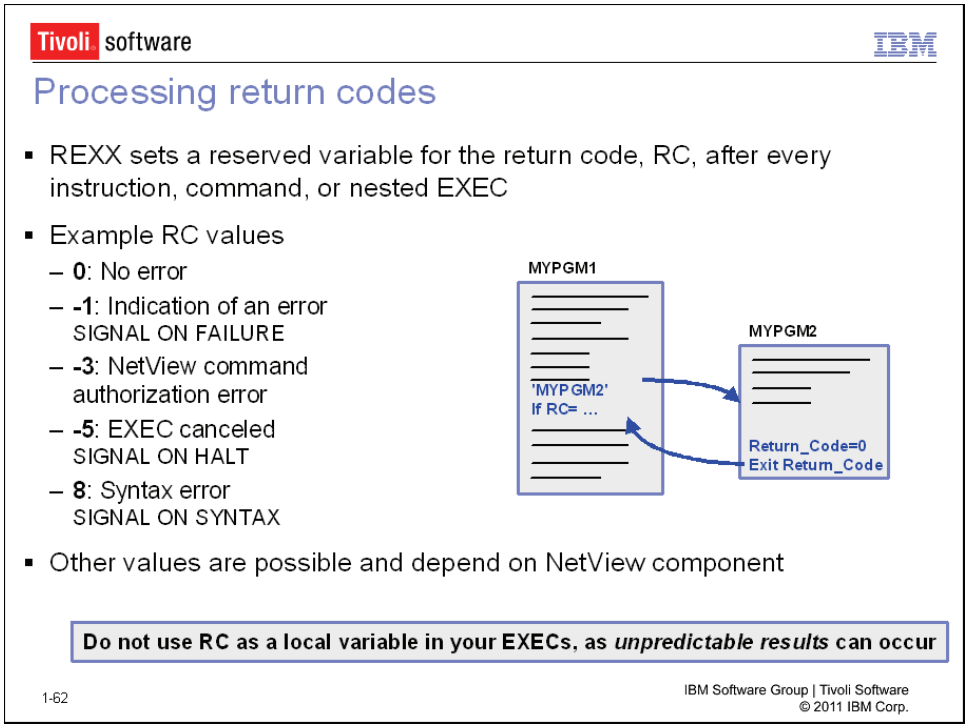
1. Tab over to the *Settings for Operator* field.
2. Enter AUTO2.
3. Press the Enter key.

The EZLK8120 panel displays the current settings for AUTO2. You can add your program trace to the list.

Example: Trace i program



Processing return codes



Important: RC is one of several variables reserved for REXX use. If you set RC, you create a user variable and nullify the use of the reserved REXX variable.

Processing standard errors

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Processing standard errors

Use REXX **SIGNAL** instruction to handle error conditions

- Interrupts normal flow, passes control to specified label that matches the signal condition
- Does not return control
- Used for testing and emergency actions
  For example, save local variables or issue a message about the error
- An example is SIGNAL ON FAILURE
- REXX sets a variable, **SIGL**, to the line number that triggered the condition

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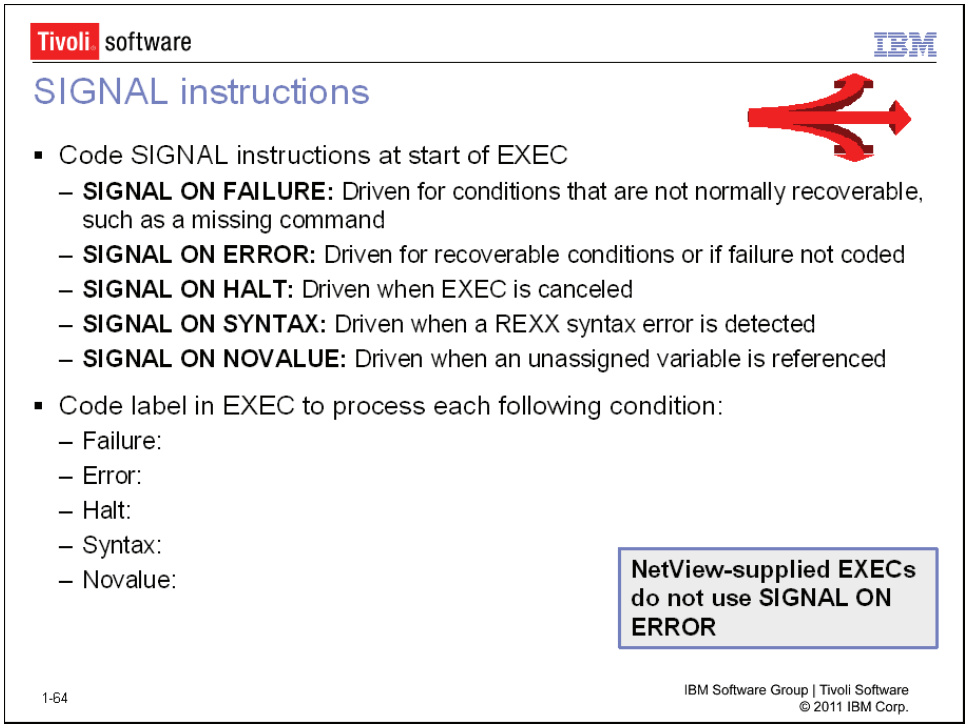
SIGNAL instructions



SIGNAL ON HALT should set return code -5 to cancel all calling EXECs.

Example: NOVALUE

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Example: NOVALUE

```
/*-------------------------------------------------------------------*/
/* COMMAND exec FAILED : LINE Sigl HAD A VARIABLE WITH NO VALUE      */
/*-------------------------------------------------------------------*/
NOVALUE:
  Say 'COMMAND' cmd_name 'FAILED : LINE' Sigl 'HAD A VARIABLE WITH NO
        VALUE: ' Condition('D')
  Return_Code = 7                    /* return to caller           */
Exit return_code
```

Actions to take when a variable novalue condition is detected

- Branch to the NOVALUE: label
- In this case, issue an error message and exit with a return code 7
  - Cmd_name: Command that was parsed within the REXX EXEC with a parse source statement
  - Sigl: Line number that the novalue condition sets
  - Condition('D'): Function that contains the variable name

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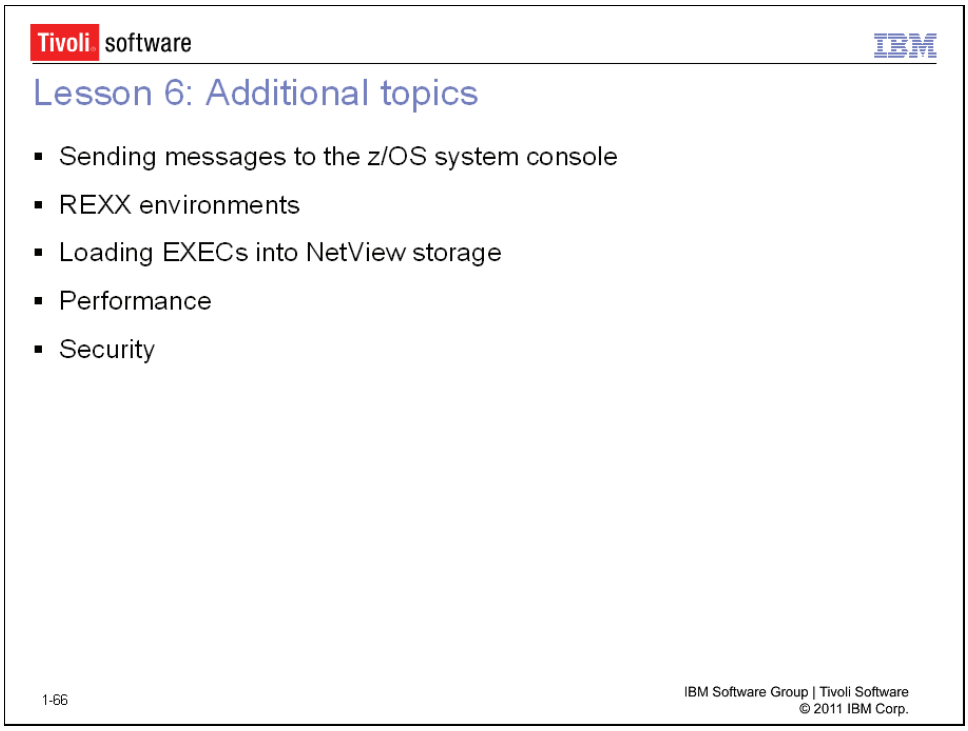
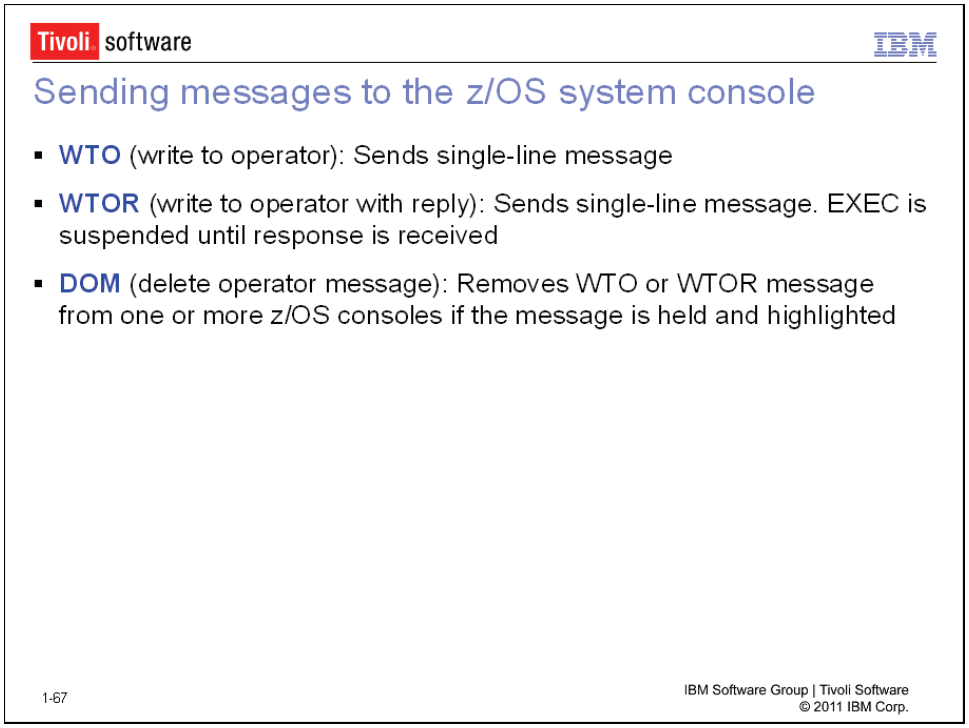
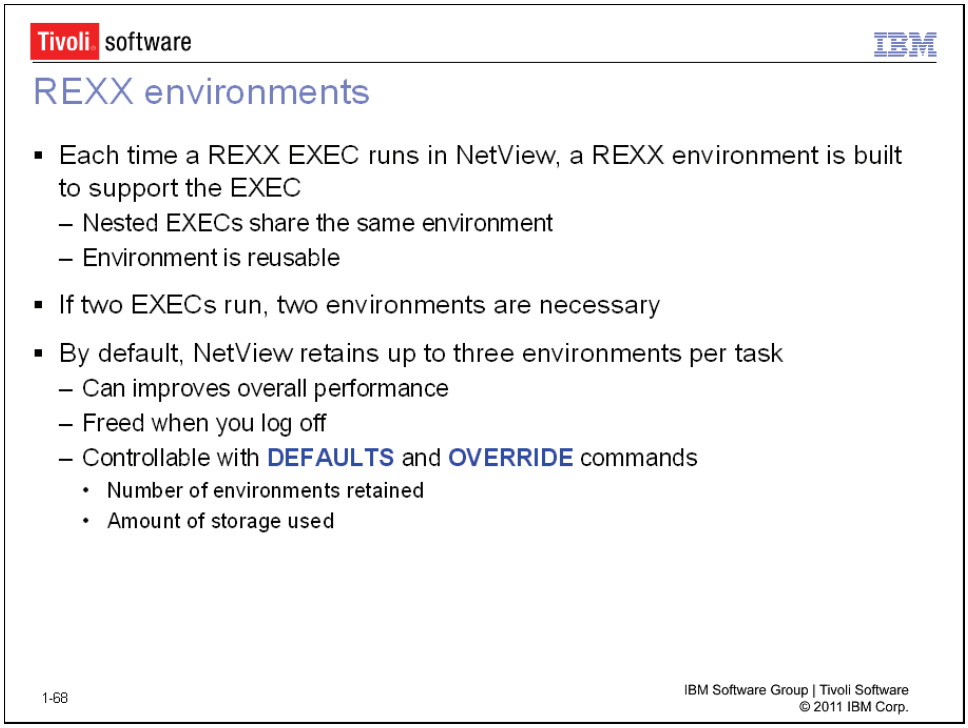
Lesson 6: Additional topics



Sending messages to the z/OS system console



REXX environments



If you exceed the number of REXX environments, a CNM416I message is displayed as follows:

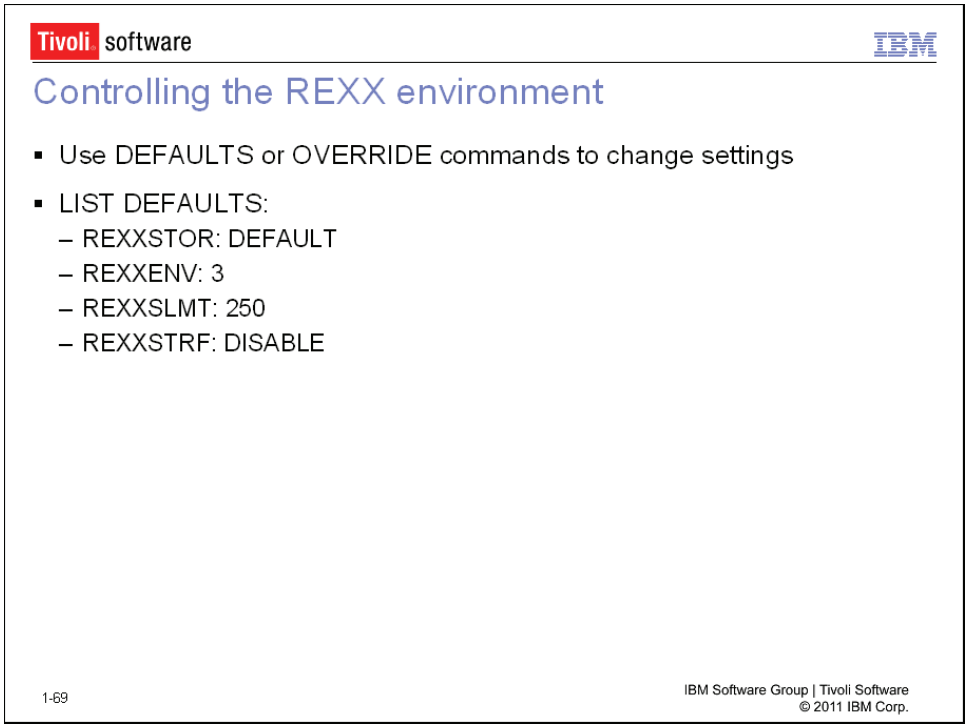
CNM416I REXX INTERPRETER ENVIRONMENT INITIALIZATION FAILED FOR TASK *task*, RETURN CODE = *20*, REASON CODE = *24*

A reason for a CNM416I message is that the number of entries in IRXANCHR is insufficient for your NetView environment.

Request that your system administrator increase the number of REXX environments that are defined in IRXANCHR. IRXANCHR is in SYS1.SAMPLIB. Refer to the *TSO/E REXX Reference* for an explanation about increasing the number of entries in IRXANCHR. To determine the number of IRXANCHR entries needed, see the *IBM Tivoli NetView for z/OS Tuning Guide*.

Note: Any EXEC running on your system requires REXX environments, including EXECs from other products or TSO/E EXECs you write.

Controlling the REXX environment



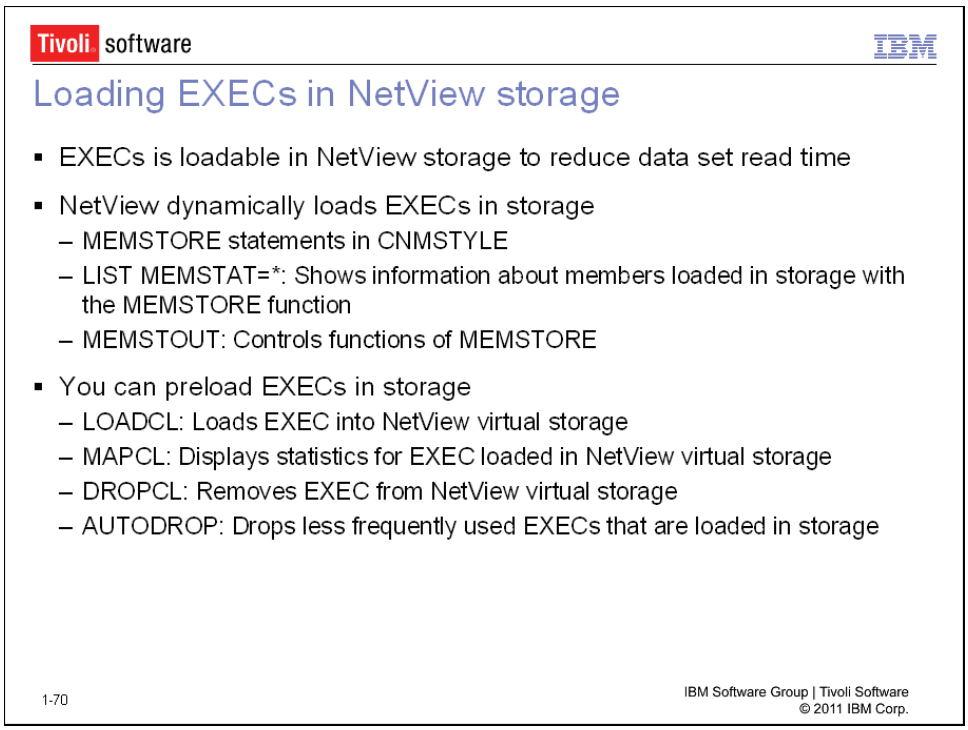
REXXSTOR: Specifies the amount of storage, in 1K increments, to be acquired by REXX environment initialization processing. The default: NetView is to specify that TSO/E REXX use the TSO/E REXX default.

REXXENV: Specifies the number of active and inactive, but initialized, REXX environments to be retained for each operator. The default is **3**.

REXXSLMT: Specifies the amount of storage, in 1K increments, that a REXX environment is allowed to accumulate before being stopped after its current use completes. The default value is **250**.

REXXSTRF: Specifies if the NetView operator can run REXX EXECs that use the REXX STORAGE function. By default, this is disabled.

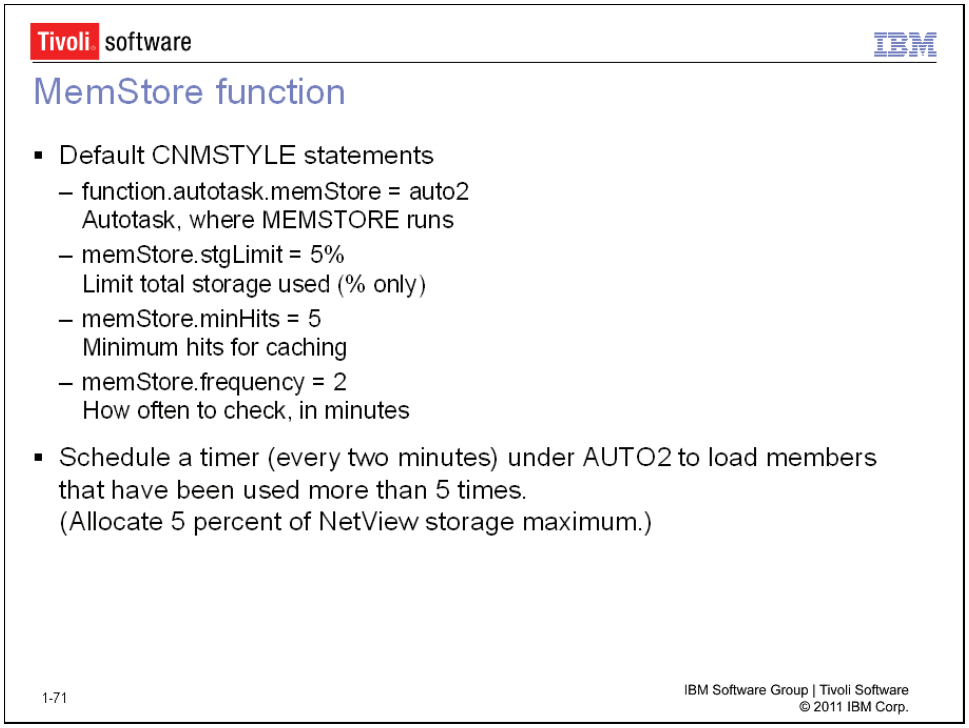
Loading EXECs in NetView storage



Loading EXECs in NetView storage reduces the allotted time for reading the EXEC from a data set. By default, NetView uses MEMSTORE statements in CNMSTYLE to automatically load the most commonly used EXECs (and other data set members) into storage.

You can also use the LOADCL command to load EXECs in NetView storage. You can schedule the AUTODROP command to monitor the use of the EXECs and drop less-often used EXECs.

MemStore function



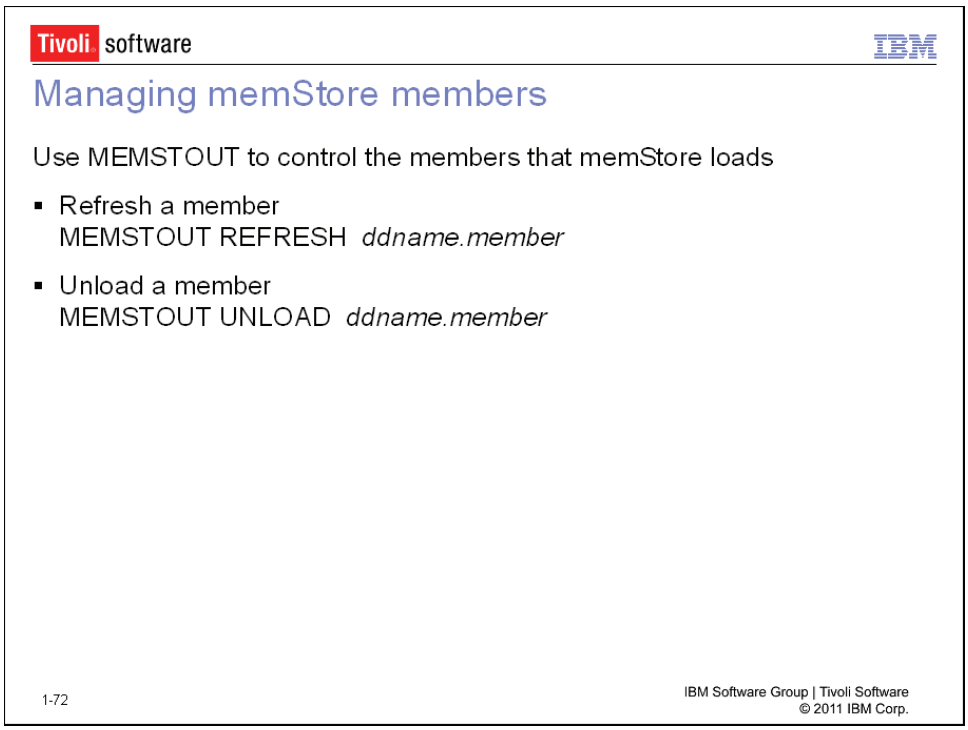
By default, NetView loads members that are used more than five times into storage, up to a maximum of five percent of NetView storage. Members can be excluded from being loaded in storage with the memStore.never statement, as the following example shows.

```
memStore.never =
           DSIPARM.DSIOPF
           DSIPARM.DSIOPFU
           DSILIST.*
           *.USERMEM
```

You can disable the memStore function by setting the maximum storage limit to zero percent as follows:

```
memStore.stgLimit = 0%
```

Managing memStore members

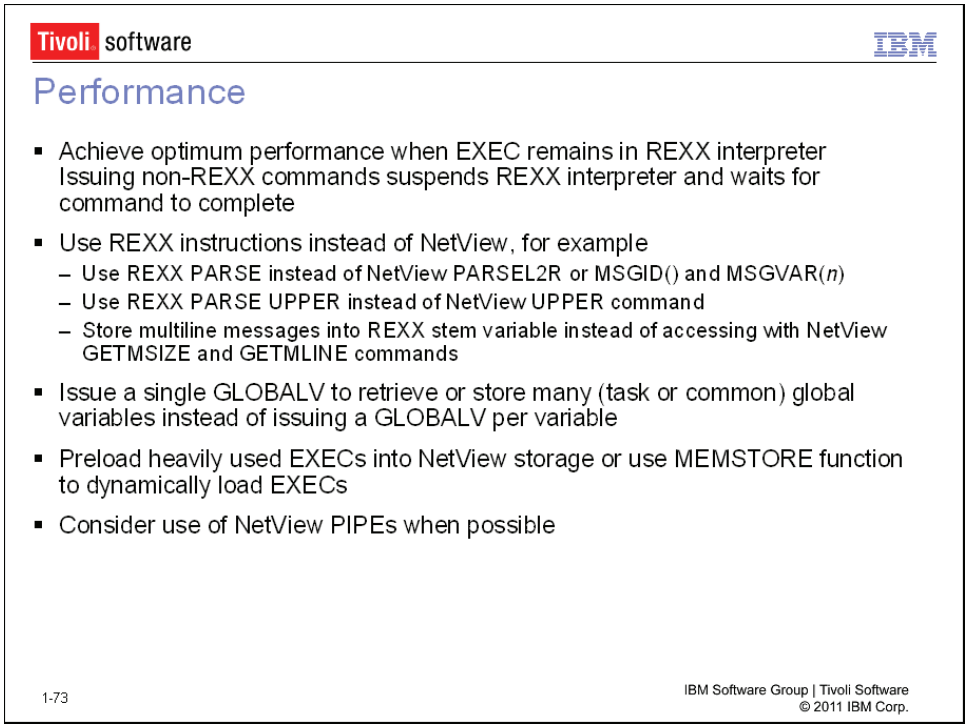


You can use the MEMSTOUT command to delete (unload) or refresh members that are controlled with the memStore function. You can also use MEMSTOUT to update the list of members to exclude from memStore.

REFRESH specifies that members cached by MEMSTORE are removed from the cache, but can be cached again after being read from disk.While UNLOAD specifies that members cached by MEMSTORE are removed from the cache and not cached again.

Note: A common occurrence pertaining to memStore occurs when you initially create and test a REXX EXEC. After several tests, changes you make do not seem to run. This condition can occur because the EXEC loads in storage. Use MEMSTOUT to remove the EXEC from storage.

Performance



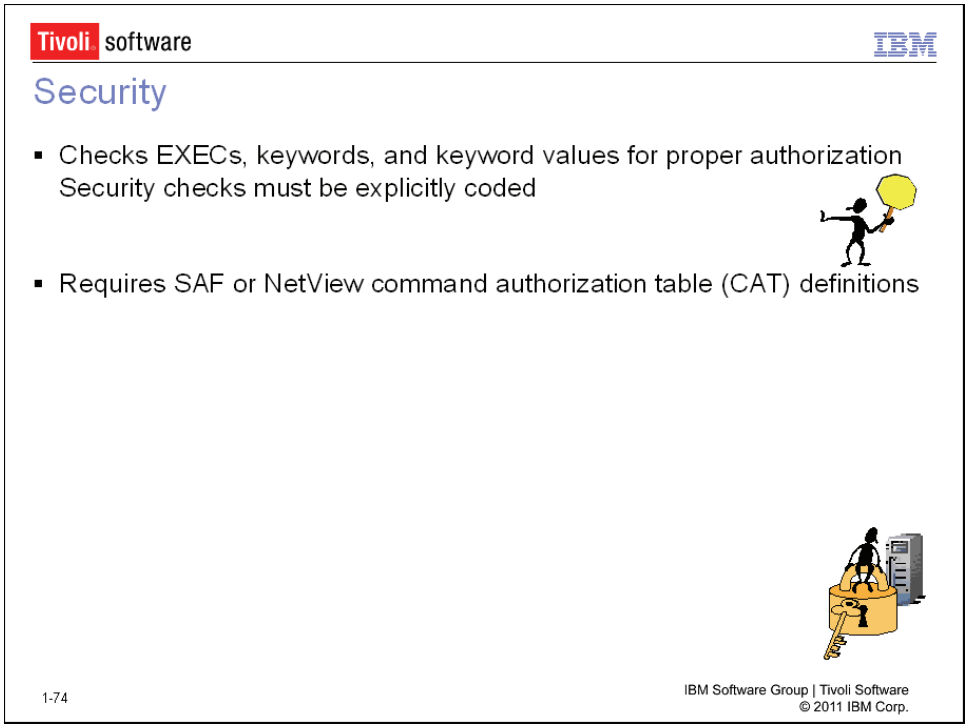
This slide provides several methods for improving the overall performance of your REXX EXECs. Use REXX instructions and functions whenever possible. Doing so can keep your EXEC in the REXX interpreter and improve performance.

Consider the use of NetView PIPEs as follows:

- Use PIPE QSAM to read from and write to files instead of using REXX EXECIO.
- Use PIPE NETV or MVS with LOC, TOSTRING, TAKE, DROP, and so on, instead of TRAP, WAIT, and MSGREAD.

In addition, limit the use of the REXX INTERPRET for dynamically building statements.

Security



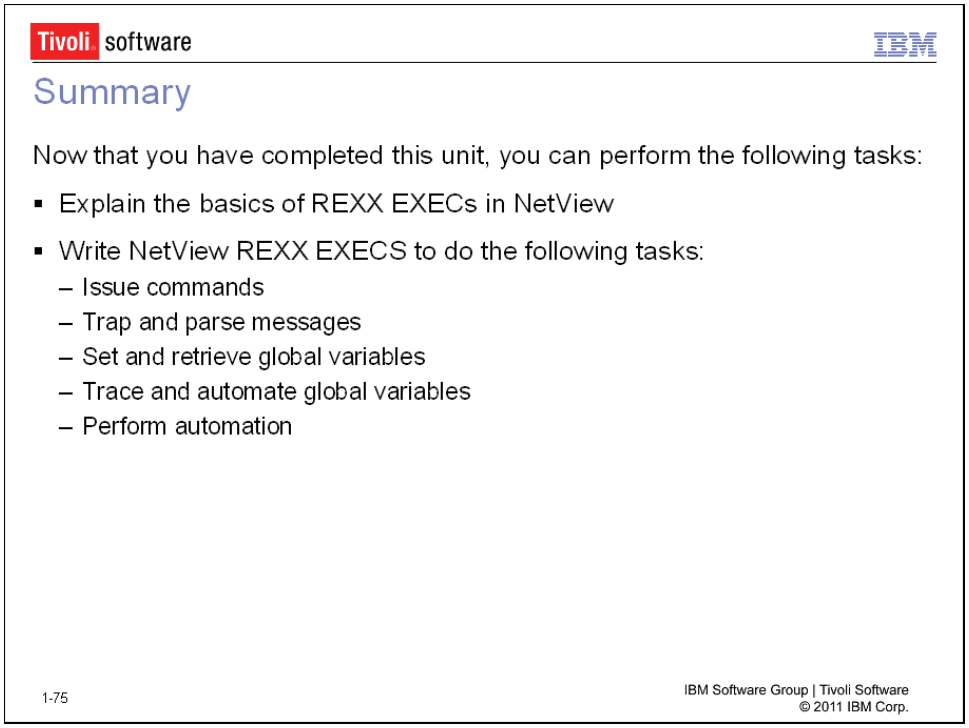
EXECs, their keywords, and their keyword values can be secured by using two NetView functions:

- AUTHCHK(): Checks keywords and keyword values.
- AUTHCHKX(): Checks command, keywords, and keyword values.

Documentation is in the *IBM Tivoli NetView for z/OS Programming: REXX and the NetView Command List Language* manual

Your system administrator can create entries in the NetView Command Authorization Table (CAT) or a SAF product to authorize users to the EXEC, keywords, and keyword values. For more information, see the *IBM Tivoli NetView for z/OS Security Reference*.

Summary



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  Training anywhere, any time, that saves you money and travel
  ibm.com/training/us/tivoli/wbt
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  Modules supporting new and experienced learners with fully animated multimedia clips, step-by-step audio, and companion text
  ibm.com/software/tivoli/education/multimedialibrary
- *IBM Education Assistant*
  More specific, granular web-based training with individual presentations on specific topics
  www-01.ibm.com/software/info/education/assistant/
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