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1 Introduction

The name pies (pronounced ‘p-yes’) stands for ‘Program Invocation and Execution Supervisor’. This utility starts and controls execution of external programs. In this document these programs will be referred to as components. Each component is a stand-alone program, which is executed in the foreground.

Upon startup, pies reads the list of components from its configuration file, starts them, and remains in the background, controlling their execution. Each component is defined by the name of the external program to be run and its arguments (command line). The program is normally run directly (via exec), but you can instruct pies to run it via sh -c as well.

The standard output and standard error streams of a component can be redirected to a file or to an arbitrary syslog channel.

The way of handling each component, and in particular the action to be taken upon its termination is determined by the component’s mode.

A respawn component is restarted each time it terminates. If it terminates too often, pies puts it to sleep for certain time and logs that fact. This prevents badly configured components from taking too much resources and allows administrator to take measures in order to fix the situation. More specific action can be configured, depending on the exit code of the component.

An inetd-style components is not started. Instead, pies opens a socket associated with it and listens for connections on that socket. When a connection arrives, pies runs this component to handle it. The connection is bound to the component’s ‘stdin’ and ‘stdout’ streams. The ‘stderr’ stream can be redirected to a file or to syslog, as described above. This mode of operation is similar to that of the inetd utility.

Yet another type of components supported by pies are pass-style or meta1-style components. As the name suggests, this type is designed expressly as a support for MeTA1 components, namely smtps. This type can be regarded as a mixture of the above two. For each meta1-style component pies opens a socket and starts the component executable program. Once the program is running, pies passes it the file descriptor of that socket, through another preconfigured UNIX-style socket. Further handling of the socket is the responsibility of the program itself.

An accept component is basically handled as ‘inetd’, except that after binding to the socket pies immediately starts the program, without waiting for actual connections.

Finally, two special component modes are available. Startup components are run right after pies startup, prior to running any other components. Their counterpart, shutdown components are run before program termination, after all other components have finished.

Any number of components of all types can be handled simultaneously.

Components are started in the order of their appearance in the configuration file and terminated in reverse order. This order can be modified by declaring component prerequisites or dependents. This is described in the following chapter.

---

1 See http://www.meta1.org
As an exception, this order is reversed for the components read from MeTA1 configuration files, either included by `include-meta1` statement (see Section 3.9 [include-meta1], page 37) or expressly supplied in the command line (see [config syntax], page 5).
2 Inter-Component Dependencies

A component ‘A’ may depend on another components, say ‘B’ and ‘C’, i.e. require them to be running at the moment of its startup. Components ‘B’ and ‘C’ are called prerequisites for ‘A’, while ‘A’ is called a dependency or dependent component of ‘B’, ‘C’.

Before restarting any component, pies verifies if it is a prerequisite for any other components. If so, it first terminates its dependencies, restarts the component, and then starts its dependencies again, in the order of their appearance in the configuration file.
3 Pies Configuration File

Pies reads its settings and component definitions from one or more configuration files. The default configuration file is named `pies.conf` and is located in the system configuration directory (in most cases `/etc` or `/usr/local/etc`, depending on how the package was compiled). This file uses the native Pies configuration syntax. Apart from this format, the program also understands configuration files in `inetd` and `meta1` formats.

Alternative configuration files may be specified using `--config-file` (`-c` command line option), e.g.:

```
pies --config-file filename
```

Any number of such options may be given. The files named in `--config-file` options are processed in order of their appearance in the command line. By default, Pies expects configuration files in its native format. This, however, can be changed by using the `--syntax=format` command line option. This option instructs Pies that any configuration files given after it have are written in the specified format. Valid formats are:

- `'pies'` Pies native configuration file format.
- `'inetd'` Inetd-style configuration format.
- `'meta1'` MeTA1-style format.
- `'inittab'` Format of the `/etc/inittab` file (see Chapter 6 [Init Process], page 51).

The configuration file format set by the `--syntax` option remains in effect for all `--config-file` options that follow it, up to the end of the command line or the next occurrence of the `--syntax` option. This means that you can instruct Pies to read several configuration files of various formats in a single command line, e.g.:

```
pies --config-file /etc/pies.conf \
   --syntax=inetd --config-file /etc/inetd.conf \
   --syntax=meta1 --config-file /etc/meta1/meta1.conf
```

The rest of this chapter concerns the Pies native configuration file format. You can receive a concise summary of all configuration directives any time by running `pies --config-help`. The use of inetd configuration files is covered in Section 3.8 [inetd], page 36, and the use of meta1 configuration files is described in Section 3.9 [include-meta1], page 37.

If any errors are encountered in the configuration file, the program reports them on the standard error and exits with status 78.

To test the configuration file without actually starting the server, the `--lint` (`-t`) command line option is provided. It causes Pies to check its configuration file and exit with status 0 if no errors were detected, and with status 78 otherwise.

Before parsing, configuration file is preprocessed using `m4` (see Section 3.2 [Preprocessor], page 8). To see the preprocessed configuration without actually parsing it, use `-E` command line option.
3.1 Configuration File Syntax

The configuration file consists of statements and comments.

There are three classes of lexical tokens: keywords, values, and separators. Blanks, tabs, newlines and comments, collectively called white space are ignored except as they serve to separate tokens. Some white space is required to separate otherwise adjacent keywords and values.

3.1.1 Comments

Comments may appear anywhere where white space may appear in the configuration file. There are two kinds of comments: single-line and multi-line comments. Single-line comments start with ‘#’ or ‘//’ and continue to the end of the line:

# This is a comment
// This too is a comment

The following constructs, appearing at the start of a line are treated specially: ‘#include’, ‘#include_once’, ‘#line’, ‘# num’ (where num is a decimal number). These are described in detail in Section 3.2 [Preprocessor], page 8.

Multi-line or C-style comments start with the two characters ‘/*’ (slash, star) and continue until the first occurrence of ‘*/’ (star, slash).

Multi-line comments cannot be nested.

3.1.2 Statements

A simple statement consists of a keyword and value separated by any amount of whitespace. The statement is terminated with a semicolon (‘;’).

Examples of simple statements are:

    pidfile /var/run/pies.pid;
    source-info yes;
    debug 10;

A keyword begins with a letter and may contain letters, decimal digits, underscores (‘_’) and dashes (‘-’). Examples of keywords are: ‘group’, ‘control-file’.

A value can be one of the following:

number A number is a sequence of decimal digits.

boolean A boolean value is one of the following: ‘yes’, ‘true’, ‘t’ or ‘1’, meaning true, and ‘no’, ‘false’, ‘nil’, ‘0’ meaning false.

unquoted string An unquoted string may contain letters, digits, and any of the following characters: ‘_’, ‘-’, '.', '/', ':'.

quoted string A quoted string is any sequence of characters enclosed in double-quotes (‘”’). A backslash appearing within a quoted string introduces an escape sequence, which is replaced with a single character according to the following rules:
Sequence | Replaced with
--- | ---
\a | Audible bell character (ASCII 7)
\b | Backspace character (ASCII 8)
\f | Form-feed character (ASCII 12)
\n | Newline character (ASCII 10)
\r | Carriage return character (ASCII 13)
\t | Horizontal tabulation character (ASCII 9)
\v | Vertical tabulation character (ASCII 11)
\ | A single backslash (‘\’)
" | A double-quote.

Table 3.1: Backslash escapes

In addition, any occurrence of ‘\’ immediately followed by a newline character (ASCII 10) is removed from the string. This allows to split long strings over several physical lines, e.g.:

"a long string may be\nsplit over several lines"

If the character following a backslash is not one of those specified above, the backslash is ignored and a warning is issued.

**Here-document**

*Here-document* is a special construct that allows to introduce strings of text containing embedded newlines.

The `<<word` construct instructs the parser to read all the following lines up to the line containing only `word`, with possible trailing blanks. Any lines thus read are concatenated together into a single string. For example:

```
<<EOT
A multiline
string
EOT
```

Body of a here-document is interpreted the same way as double-quoted string, unless `word` is preceded by a backslash (e.g. ‘`<<\EOT’) or enclosed in double-quotes, in which case the text is read as is, without interpretation of escape sequences.

If `word` is prefixed with – (a dash), then all leading tab characters are stripped from input lines and the line containing `word`. Furthermore, if – is followed by a single space, all leading whitespace is stripped from them. This allows to indent here-documents in a natural fashion. For example:

```
<<< TEXT
All leading whitespace will be
ignored when reading these lines.
TEXT
```

It is important that the terminating delimiter be the only token on its line. The only exception to this rule is allowed if a here-document appears as the
last element of a statement. In this case a semicolon can be placed on the same line with its terminating delimiter, as in:

```c
help-text <<-EOT
    A sample help text.
EOT;
```

A **list** is a comma-separated list of values. Lists are delimited by parentheses. The following example shows a statement whose value is a list of strings:

```
dependents (pmult, auth);
```

In any case where a list is appropriate, a single value is allowed without being a member of a list: it is equivalent to a list with a single member. This means that, e.g. `dependents auth;` is equivalent to `dependents (auth);`.

A **block statement** introduces a logical group of another statements. It consists of a keyword, followed by an optional value, and a sequence of statements enclosed in curly braces, as shown in the example below:

```
component multiplexor {
    command "pmult";
}
```

The closing curly brace may be followed by a semicolon, although this is not required.

### 3.2 Preprocessor

Before parsing, configuration file is preprocessed. This goes in three stages. First, include directives are expanded. An **include directive** begins with a `#` sign at the beginning of a line, followed by the word `include` or `include_once`. Any amount of whitespace is allowed between the `#` and the word. The entire text up to the end of the line is removed and replaced using the following rules:

**#include file**

The contents of the file `file` is included.

If `file` contains wildcard characters (`*`, `[`, `]` or `?`), it is interpreted as shell globbing pattern and all files matching that pattern are included, in lexicographical order. If no matching files are found, the directive is replaced with an empty line.

Otherwise, the named file is included. Unless `file` is an absolute file name, it will be searched relative to the current working directory. An error message will be issued if it does not exist.

**#include_once file**

Same as `#include`, except that, if the `file` has already been included, it will not be included again.

The obtained material is then passed to external preprocessor. By default, **pies** uses GNU **m4**. This powerful macro processor is described in *GNU M4 macro processor*. For the rest of this subsection we assume the reader is sufficiently acquainted with the **m4** macro processor.
The external preprocessor is invoked with the following two flags: `-s` flag, instructing it to include line synchronization information in its output, and `-P`, which changes all `m4` built-in macro names by prefixing them with `m4_`.

The following command line options are passed to `m4` verbatim:

```
--define=sym [=value]
-D symbol [=value]
```

Define symbol `sym` as having `value`, or empty, if the `value` is not given.

```
--undefine=sym
-U sym
```

Undefine symbol `sym`.

The `--include-directory=dir` or `-I dir` option causes the option `-I dir` to be appended to the preprocessor command line. This option modifies the `m4` include search path (see Section “Search Path” in GNU M4 macro processor).

Finally, the following two options are appended:

```
-I $prefix/share/pies/include
-I $prefix/share/pies/1.8/include
```

(where `$prefix` stands for installation prefix chosen when the package was built. Normally it is `/usr`). This step can be disabled using the `--no-include` option.

These provide the default search path.

The name of the source file is appended to the command line, and the constructed command is executed via `$SHELL -c` and its output is then passed to the configuration parser. When parsing, the following constructs appearing at the beginning of a line are handled specially:

```
#line num
#line num "file"
```

This line causes the parser to believe, for purposes of error diagnostics, that the line number of the next source line is given by `num` and the current input file is named by `file`. If the latter is absent, the remembered file name does not change.

```
# num "file"
```

This is a special form of `#line` statement, understood for compatibility with the C preprocessor.

```
#warning "text"
```

Emits `text` as a warning.

```
#error "text"
```

Emits `text` as an error message. Further parsing continues, but will end with failure.

```
#abend "text"
```

Emits `text` as an error message and stops further processing immediately.

If `#error` or `#abend` is encountered, the effect is the same as if syntax error has been detected. If it occurs at `pies` startup, the program will terminate abnormally. If it occurs as part of the reload sequence in a running instance of `pies`, the configuration file will be rejected and old configuration will remain in effect.
3.2.1 Using M4

Editor's note:
This node is to be written.

This subsection gives some tips on using the default preprocessor.

3.2.2 Using Custom Preprocessor

The default preprocessor can be changed (or even disabled) at compile time as well as
on the runtime. When invoked with the --help option pies reports, among others, the
preprocessor it is configured to use and the default include search path.

To disable preprocessing, use the --no-preprocessor command line option.

To change the default preprocessor at runtime, use the --preprocessor option. Its
argument is the initial preprocessor command line. Depending on the pies command line,
it can be further modified by appending new options as described in [additional preprocessor
options], page 9.

When selecting another preprocessor, please bear in mind that pies assumes that the
preprocessor program understands the following three options:

-D name[=value]
Define the preprocessor symbol name.

-I dir      Add the directory dir to the preprocessor search path for include files.

-U name     Undefine the preprocessor symbol name.

pies never passes -D and -U options, except as if these were passed to it in the command
line. However, it normally adds one or more -I options to configure the default search path.

If the preprocessor of your choice doesn’t support some or any of these options, there
are several possible solutions.

• If the preprocessor doesn’t support -D and -U options, don’t pass them in the pies
command line.

• If it does not support the -I option, run pies with the --no-include option or create
a wrapper script which will consume all -I options without affecting the preprocessor
command line.

For an example of using alternative preprocessor, See Section 7.2 [xenv], page 58.

3.3 The component Statement

component   [Config]

The component statement defines a new component:

    component tag {
    ...
    }
The component is identified by its tag, which is given as argument to the component keyword. Component declarations with the same tags are merged into a single declaration.

The following are the basic statements which are allowed within the component block:

\[
\text{mode mode} \quad [\text{Config: component}]
\]

Declare the type (style) of the component. Following are the basic values for mode:

- **exec**
- **respawn** Define a ‘respawn’ component (see [respawn], page 1). This is the default.
- **inetd**
- **nostartaccept** Define an ‘inetd-style’ component (see [inetd-style], page 1).
- **pass**
- **pass-fd** Define a ‘meta1-style’ component (see [meta1-style], page 1).
- **accept** Define a ‘accept-style’ component (see [accept-style], page 1).
- **startup** The component is run right after startup. Prior to starting any other components, pies will wait for all startup components to terminate.
- **shutdown** These components are started as a part of program shutdown sequence, after all regular components have terminated. See [shutdown sequence], page 39, for a detailed discussion.

When run as init process (see Chapter 6 [Init Process], page 51), the following modes are also allowed:

- **boot** The process will be executed during system boot. The ‘runlevel’ settings are ignored.
- **bootwait** The process will be executed during system boot. No other components will be started until it has terminated. The ‘runlevel’ settings are ignored.
- **ctrlaltdel** The process will be executed when pies receives the SIGINT signal. Normally this means that the CTRL-ALT-DEL combination has been pressed on the keyboard.
- **kbrequest** The process will be executed when a signal from the keyboard handler is received that indicates that a special key combination was pressed on the console keyboard.
- **once** The process will be executed once when the specified runlevel is entered.
- **ondemand** The process will be executed when the specified ondemand runlevel is called (‘a’, ‘b’ and ‘c’). No real runlevel change will occur (see [Ondemand runlevels], page 52). The process will remain running across any eventual runlevel changes and will be restarted whenever it terminates, similarly to respawn components.
powerfail
The process will be executed when the power goes down. Pies will not wait for the process to finish.

powerfailnow
The process will be executed when the power is failing and the battery of the external UPS is almost empty.

clearpowerokwait
The process will be executed as soon as pies is informed that the power has been restored.

clearpowerwait
The process will be executed when the power goes down. Pies will wait for the process to finish before continuing.

sysinit
The process will be executed during system boot, before any boot or bootwait entries. The ‘runlevel’ settings are ignored.

wait
The process will be started once when the specified runlevel is entered. Pies will wait for its termination before starting any other processes.

command string
Command line to run. string is the full command line. Its first word (in the shell sense) is the name of the program to invoke.

program name
Full file name of the program to run. When supplied, pies will execute the program name instead of the first word in the command statement. The latter, however, will be passed to the running program as argv[0].

flags (flag-list)
Define flags for this component. The flag-list is a comma-separated list of flags. Valid flags are:

disable This component is disabled, i.e. pies will parse and remember its settings, but will not start it.

nullinput
Do not close standard input. Redirect it from /dev/null instead. Use this option with commands that require their standard input to be open (e.g. pppd nodetach).

precious
Mark this component as precious. Precious components are never disabled by pies, even if they respawn too fast.

shell
Run command as /bin/sh -c "$command". Use this flag if command contains shell-specific features, such as I/O redirections, pipes, variables or the like. You can change the shell program using the program statement. For example, to use Korn shell:

    component X {
        flags shell;
        program "/bin/ksh";
command "myprog $HOME";
}

expandenv

Expand environment variables in the 'command' statement prior to running it. When used together with the 'shell' flag, this flag produces a warning and has no effect. See Section 3.3.5 [Early Environment Expansion], page 18, for a detailed discussion.

wait

This flag is valid only for 'inetd' components. It has the same meaning as 'wait' in inetd.conf file, i.e. it tells pies to wait for the server program to return. See Appendix A [inetd configuration], page 73.

tcpmux

This is a TCPMUX component. See Section 3.3.9.2 [TCPMUX], page 24.

tcpmuxplus

This is a TCPMUX+ component. See Section 3.3.9.2 [TCPMUX], page 24.

internal

This is an internal inetd component. See Section 3.3.9.1 [builtin], page 23.

sockenv

This inetd component wants socket description variables in its environment. See Section 3.3.9.3 [sockenv], page 25.

resolve

When used with 'sockenv', the LOCALHOST and REMOTEHOST environment variables will contain resolved host names, instead of IP addresses.

siggroup

This flag affects the behavior of pies when a stopped process fails to terminate within a predefined timeout (see [shutdown-timeout], page 39. Normally pies would send the 'SIGKILL' signal to such a process. If this flag is set, pies would send 'SIGKILL' to the process group of this process instead.

sigterm sig

Defines signal which should be sent to terminate this component. The default is SIGTERM. The argument sig is either the name of a signal defined in /usr/include/signal.h, or 'SIG+n', where n is signal number.

The following subsections describe the rest of 'component' substatements.

3.3.1 Component Prerequisites

Prerequisites (see [component prerequisite], page 3) for a component are declared using the following statement:

prerequisites tag-list

The argument is either a list of component tags or one of the following words:

all

Declare all components defined so far as prerequisites for this one.

none

No prerequisites. This is the default.

If you wish, you can define dependents, instead of prerequisites:

dependents tag-list

Declare dependents for this component. var-list is a list of component tags.
3.3.2 Component Privileges

The following statements control privileges the component is executed with.

**user user-name**  
Start component with the UID and GID of this user.

**group group-list**  
Retain supplementary groups, specified in `group-list`.

**allgroups bool**  
Retain all supplementary groups of which the user (as given with `user` statement) is a member. This is the default for components specified in `meta1.conf` file (see Section 3.9 [include-meta1], page 37).

3.3.3 Resources

**limits string**  
Impose limits on system resources, as defined by the `string` argument. It consists of commands, optionally separated by any amount of whitespace. A command is a single command letter followed by a number, that specifies the limit. The command letters are case-insensitive and coincide with those used by the shell `ulimit` utility:

<table>
<thead>
<tr>
<th>Command</th>
<th>The limit it sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>max address space (KB)</td>
</tr>
<tr>
<td>C</td>
<td>max core file size (KB)</td>
</tr>
<tr>
<td>D</td>
<td>max data size (KB)</td>
</tr>
<tr>
<td>F</td>
<td>maximum file size (KB)</td>
</tr>
<tr>
<td>M</td>
<td>max locked-in-memory address space (KB)</td>
</tr>
<tr>
<td>N</td>
<td>max number of open files</td>
</tr>
<tr>
<td>R</td>
<td>max resident set size (KB)</td>
</tr>
<tr>
<td>S</td>
<td>max stack size (KB)</td>
</tr>
<tr>
<td>T</td>
<td>max CPU time (MIN)</td>
</tr>
<tr>
<td>U</td>
<td>max number of processes</td>
</tr>
<tr>
<td>P</td>
<td>process priority -20..20 (negative = high priority)</td>
</tr>
</tbody>
</table>

Table 3.2: Limit Command Letters

For example:

```
limits T10 R20 U16 P20
```

Additionally, the command letter ‘L’ is recognized. It is reserved for future use (‘number of logins’ limit) and is ignored in version 1.8.

**umask number**  
Set the umask. The `number` must be an octal value not greater than ‘777’. The default umask is inherited at startup.

**max-instances n**  
Sets the maximum number of simultaneously running instances of this component.
3.3.4 Environment

Normally all components inherit the environment of the master pies process. You can modify this environment using the env statement. It has two variants: compound and legacy. The legacy one-line statement was used in pies versions up to 1.3 and is still retained for backward compatibility. It is described in Section 3.3.4.1 [env legacy syntax], page 16. This subsection describes the modern compound syntax.

The env statement can also be used in global context, in which case it modifies environment for the master pies program, i.e. the environment that will be inherited by all components (see Section 3.10 [Global Configuration], page 38). The global env is available only in compound syntax described here.

```plaintext
env { ... }
```

The compound env statement has the following syntax:

```plaintext
env {
    clear;
    keep pattern;
    set "name=value";
    eval "value";
    unset pattern;
}
```

Statements inside the env block define operations that modify the environment. The clear and keep statements are executed first. Then, the set and unset statements are applied in the order of their appearance in the configuration.

**clear**

Clears the environment by removing (unsettting) all variables, except those listed in keep statements, if such are given (see below). The clear statement is always executed first.

**keep pattern**

Declares variables matching pattern (a globbing pattern) as exempt from clearing. This statement implies clear.

For example, the following configuration fragment removes from the environment all variables except ‘HOME’, ‘USER’, ‘PATH’, and variables beginning with ‘LC_’:

```plaintext
env {
    clear;
    keep HOME;
    keep USER;
    keep PATH;
    keep "LC_*";
}
```

**keep "name=value"**

Retains the variable name, if it has the given value. Note, that the argument must be quoted.
set "name=value" [env]
Assigns value to environment variable name. The value is subject to variable expansion using the same syntax as in shell. The set and unset (see below) statements are executed in order of their appearance. For example

```plaintext
env {
    set "MYLIB=$HOME/lib";
    set "LD_LIBRARY_PATH=$LD_LIBRARY_PATH:${LD_LIBRARY_PATH:+:}$MYLIB";
}
```

eval "value" [env]
Perform variable expansion on value and discard the result. This is useful for side-effects. For example, to provide default value for the LD_LIBRARY_PATH variable, one may write:

```plaintext
env {
    eval "${LD_LIBRARY_PATH:=/usr/local/lib}";
}
```

unset pattern [env]
Unset environment variables matching pattern. The following will unset the LOGIN variable:

```plaintext
unset LOGIN;
```
The following will unset all variables starting with 'LD_':

```plaintext
unset "LD_*";
```
Notice, that patterns containing wildcard characters must be quoted.

### 3.3.4.1 env: legacy syntax.

Up to version 1.3 pies implemented the one-line variant of the env statement. The use of this legacy syntax is discouraged. It is supported for backward compatibility only and will be removed in future versions. This subsection describes the legacy syntax.

```
env args
Set program environment.
Arguments are a whitespace-delimited list of specifiers. The following specifiers are understood:

- (a dash) Clear the environment. This is understood only when used as a first word in args.

  The modern syntax equivalent is:

  ```plaintext
  env {
      clear;
  }
  ```

- name Unset the environment variable name. The modern syntax equivalent is

  ```plaintext
  env {
      unset name;
  }
  ```
-name=val
Unset the environment variable name only if its value is val. The modern syntax equivalent is:

```
env {
    unset "name=val";
}
```

name Retain the environment variable name. The modern syntax equivalent is

```
env {
    keep name;
}
```

name=value Define environment variable name to have given value. The modern syntax equivalent is:

```
env {
    keep "name=value";
}
```

name+=value Retain variable name and append value to its existing value. If no such variable is present in the environment, it is created and value is assigned to it. However, if value begins with a punctuation character, this character is removed from it before the assignment. This is convenient for using this construct with environment variables like PATH, e.g.:

```
PATH+=:/sbin
```

In this example, if PATH exists, ‘:/sbin’ will be appended to it. Otherwise, it will be created and ‘/sbin’ will be assigned to it.

In modern syntax, use shell variable references, e.g.:

```
env {
    set "PATH=${PATH}:${PATH:+:}/sbin";
}
```

name+=value Retain variable name and prepend value to its existing value. If no such variable is present in the environment, it is created and value is assigned to it. However, if value ends with a punctuation character, this character is removed from it before assignment.

In modern syntax, use shell variable references, e.g. instead of doing

```
env PATH=/sbin:
```

use

```
env {
    set "PATH=${PATH:+:}/sbin";
}
```
3.3.5 Early Environment Expansion

By default any references to environment variables encountered in the command statement are not expanded. If you need to expand them, there are two flags (see [flags], page 12) at your disposal: ‘shell’ and ‘expandenv’.

The ‘shell’ flag instructs pies to pass the command line specified by the command statement as the argument to the ‘/bin/sh -c’ command (or another shell, if specified by the ‘program’ statement). This naturally causes all references to the environment variables to be expanded, as in shell. The overhead is that two processes are run instead of the one: first the shell and second the command itself, being run as its child. This overhead can be eliminated by using the exec statement before the command, to instruct the shell to replace itself with the command without creating a new process.

Use this flag if the command you use in the component definition is a shell built-in, a pipe or another complex shell statement.

Another way to expand environment variables in the command line is by specifying the ‘expandenv’ flag. This flag instructs pies to expand any variable references the same way that the Bourne shell would expand them, but without actually invoking the shell.

A variable reference has the form ‘$variable’ or ‘${variable}’, where variable is the variable name. The two forms are entirely equivalent. The form with curly braces is normally used if the variable name is immediately followed by an alphanumeric symbol, which will otherwise be considered part of it. This form also allows for specifying the action to take if the variable is undefined or expands to an empty value:

$\{variable:=word\}

Use Default Values. If variable is unset or null, the expansion of word is substituted. Otherwise, the value of variable is substituted.

$\{variable:=word\}

Assign Default Values. If variable is unset or null, the expansion of word is assigned to variable. The value of variable is then substituted.

$\{variable:?word\}

Display Error if Null or Unset. If variable is null or unset, the expansion of word (or a message to that effect if word is not present) is output to the current logging channel. Otherwise, the value of variable is substituted.

$\{variable:+word\}

Use Alternate Value. If variable is null or unset, nothing is substituted, otherwise the expansion of word is substituted.

When the two flags are used together, the preference is given to ‘shell’, and a warning message to that effect is issued.

Also, please note, that whichever option you chose the environment variables available for expansion are those inherited by the parent shell and modified by the env statement (see Section 3.3.4 [Environment], page 15).

3.3.6 Actions Before Startup

The statements described in this subsection specify actions to perform immediately before starting the component:
chdir dir
Change to the directory dir.

remove-file file-name
Remove file-name. This is useful, for example, to remove stale UNIX sockets or pid-files, which may otherwise prevent the component from starting normally.
As of version 1.8 only one remove-file may be given.

pass-fd-timeout number
Wait number of seconds for the ‘pass-fd’ socket to become available (see Section 3.3.10 [Meta1-Style Components], page 26). Default is 5 seconds.

3.3.7 Exit Actions
The default behavior of pies when a ‘respawn’ component terminates is to restart it. Unless the component terminates with 0 exit code, a corresponding error message is issued to the log file. This behavior can be modified using return-code statement:

return-code
  return-code codes {
    ...
  }

The codes argument is a list of exit codes or signal names. Exit codes can be specified either as decimal numbers or as symbolic code names from the table below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Numeric value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX_OK</td>
<td>0</td>
</tr>
<tr>
<td>EX_USAGE</td>
<td>64</td>
</tr>
<tr>
<td>EX_DATAERR</td>
<td>65</td>
</tr>
<tr>
<td>EX_NOINPUT</td>
<td>66</td>
</tr>
<tr>
<td>EX_NOUSER</td>
<td>67</td>
</tr>
<tr>
<td>EX_NOHOST</td>
<td>68</td>
</tr>
<tr>
<td>EX_UNAVAILABLE</td>
<td>69</td>
</tr>
<tr>
<td>EXSOFTWARE</td>
<td>70</td>
</tr>
<tr>
<td>EX_OSERR</td>
<td>71</td>
</tr>
<tr>
<td>EX_OFILE</td>
<td>72</td>
</tr>
<tr>
<td>EX_CANTCREAT</td>
<td>73</td>
</tr>
<tr>
<td>EX_IOERR</td>
<td>74</td>
</tr>
<tr>
<td>EX_TEMPFAIL</td>
<td>75</td>
</tr>
<tr>
<td>EX_PROTOCOL</td>
<td>76</td>
</tr>
<tr>
<td>EX_NPERM</td>
<td>77</td>
</tr>
<tr>
<td>EX_CONFIG</td>
<td>78</td>
</tr>
</tbody>
</table>

Table 3.3: Standard Exit Codes

If the component exits with an exit code listed in codes or is terminated on a signal listed in codes, pies executes actions specified in that 'return-code' block. The actions are executed in the order of their appearance below:

exec command

Execute the supplied external command. Prior to execution, all file descriptors are closed. The command inherits the environment from the main pies process with the following additional variables:

PIES_VERSION
The pies version number (1.8).

PIES_MASTER_PID
PID of the master pies process.

PIES_COMPONENT
Tag of the terminated component (see Section 3.3 [Component Statement], page 10).

PIES_PID PID of the terminated component.

PIES_SIGNAL
If the component terminated on signal, the number of that signal.

PIES_STATUS
Program exit code.

action 'disable | restart'

If 'restart' is given, restart the component. This is the default. Otherwise, mark the component as disabled. Component dependents are stopped and marked as disabled as well. Once disabled, the components are never restarted, unless their restart is requested by the administrator.

notify email-string

Send an email notification to addresses in email-string. See Section 3.4 [Notification], page 30, for a detailed discussion of this feature.

message string

Supply notification message text to use by notify statement. See Section 3.4 [Notification], page 30, for a detailed discussion of this feature.

Any number of return-code statements are allowed, provided that their codes do not intersect.

The return-code statements can also be used outside of component block. In this case, they supply global actions, i.e. actions applicable to all components. Any return-code statements appearing within a component block override the global ones.
3.3.8 Output Redirectors

Output redirectors allow to redirect the standard error and/or standard output of a component to a file or syslog facility.

stderr type channel
stdout type channel

Redirect standard error (if stderr) or standard output (if stdout) to the given channel.

The type of redirection is specified by type argument:

file Redirect to a file. In this case channel gives the full name of the file. For example:
stderr file /var/log/component/name.err;

syslog Redirect to syslog. The channel parameter is either the syslog facility and priority separated by dot or the priority alone, in which case the facility will be taken from the syslog statement (see [syslog], page 38).

Example:
stdout syslog local1.info;
stderr syslog err;

Valid facilities are: 'user', 'daemon', 'auth', 'authpriv', 'mail', 'cron', 'local0' through 'local7' (all names case-insensitive).

Valid priorities are: 'emerg', 'alert', 'crit', 'err', 'warning', 'notice', 'info', 'debug'.

3.3.9 Inetd-Style Components

Inetd-style components are declared using mode inetd statement. The 'component' declaration must contain a 'socket' statement:

socket url

Define a socket to listen on. Allowed values for url are:

inet[+proto]://ip:port

Listen on IPv4\(^1\) address ip (may be given as a symbolic host name), on port port. Optional proto defines the protocol to use. It must be a valid protocol name as given in /etc/protocols. Default is 'tcp'.

local[+proto]://file:[args]
file[+proto]://file:[args]
unix[+proto]://file:[args]

Listen on the UNIX socket file file, which is either an absolute or relative file name, as described above. The proto part is as described above. Optional arguments, args, control ownership and file mode of file. They are a list of assignments, separated by semicolons. The following values are allowed:

user User name of the socket owner.

---

\(^1\) Support for IPv6 will be added in future versions.
group Owner group of the socket, if it differs from the user group.

mode Socket file mode (octal number between ‘0’ and ‘777’).

umask Umask to use when creating the socket (octal number between ‘0’ and ‘777’).

For example:

```
socket
 "unix:///var/run/socket;user=nobody;group=mail;mode=770";
```

The file part may be a relative file name, provided that the chdir statement is used for this component (see Section 3.3.6 [Actions Before Startup], page 18).

**socket-type type**  
[Config: component]  
Sets the socket type. Allowed values for type are: ‘stream’, ‘dgram’, ‘raw’, ‘rdm’, ‘seqpacket’. Default is ‘stream’. Notice that some socket types may not be implemented by all protocol families, e.g. ‘seqpacket’ is not implemented for ‘inet’.

**max-rate n**  
[Config: component]  
Specifies the maximum number of times the component can be invoked in one minute; the default is unlimited. A rate of ‘0’ stands for ‘unlimited’.

**max-instances n**  
[Config: component]  
Sets the maximum number of simultaneously running instances of this component. It is equivalent to the maximum number of simultaneously opened connections.

**max-instances-message text**  
[Config: component]  
Text to send back if max-instances is reached. This is valid only for TCP sockets.

**max-ip-connections number**  
[Config: component]  
Maximum number of connections that can be opened simultaneously from a single IP address.

**max-ip-connections-message text**  
[Config: component]  
Textual message to send in reply to an incoming TCP connection from the IP address that has already reached max-ip-connections limit.

**acl { ... }**  
[Config: component]  
Set access control list for this component. This is valid only for ‘inetd’ and ‘accept’ components. See Section 3.5 [ACL], page 32, for a detailed description of access control lists.

**access-denied-message text**  
[Config: component]  
Textual message to send in reply to an incoming TCP connection that has been denied by ACL settings.
3.3.9.1 Built-in Inetd Services

Built-in or internal services are such inetd-style components that are supported internally by pies and do not require external programs. In pies version 1.8 those are:


A definition of a built-in service component must have the **internal** flag (see [flags], page 12) set. It may not contain command or program statements, as built-in services do not need external programs. Instead, a service declaration must be present:

```plaintext
[Config: component]

service name

Set the built-in service name. Its argument is one of the keywords listed in the above table.

For example, the following component declaration defines a standard TCP-based echo service:

```plaintext
component echo {
    socket "inet://0.0.0.0:echo";
    service echo;
    flags internal;
}
```

It corresponds to the following inetd.conf line:

```plaintext
echo stream tcp nowait root internal
```

Another built-in services are defined in the same manner, replacing ‘echo’ in the service field with the corresponding service name.

The ‘qotd’ service reads the contents of the qotd file and sends it back to the client. By default the ‘qotd’ file is located in the local state directory and named instance.qotd (where instance is the name of the pies instance; see [instances], page 65). This default location can be changed using the following statement:

```plaintext
qotd-file file-name

Set the name of the ‘quotation-of-the-day’ file.
```
The text read from the 'qotd' file is preprocessed, by replacing each LF character (ASCII 10) with two characters: CR (ASCII 13) followed by LF. The resulting text is truncated to 512 characters.

The use of ‘tcpmux’ services is covered below.

### 3.3.9.2 TCPMUX Services

TCPMUX allows to use multiple services on a single well-known TCP port using a service name instead of a well-known number. It is defined in RFC 1078 ([http://tools.ietf.org/html/rfc1078](http://tools.ietf.org/html/rfc1078)). The protocol operation is as follows. The master TCPMUX component listens on a certain TCP port (usually on port 1) for incoming requests. After connecting to the master, the client sends the name of the service it wants, followed by a carriage-return line-feed (CRLF). Pies looks up this name in the list of services handled by the master (subordinate services) and reports with ‘+’ or ‘-’ followed by optional text and terminated with the CRLF, depending on whether such service name is found or not. If the reply was ‘+’, pies then starts the requested component. Otherwise, it closes the connection.

TCPMUX service names are case-insensitive. The special service ‘help’ is always defined; it outputs a list of all the subordinate services, one name per line, and closes the connection.

The master TCPMUX service is declared as a usual built-in service, e.g.:

```plaintext
component tcpmux-master {
    socket "inet://0.0.0.0:1";
    service tcpmux;
    flags internal;
}
```

Any number of subordinate services may be defined for each master. A subordinate server component definition must contain at least the following statements:

- `service name` [Config: component]
  
  Sets the name of the subordinate service. The name will be compared with the first input line from the client.

- `tcpmux-master name` [Config: component]
  
  Sets the name of the master TCPMUX service.

- `flags list` [Config: component]
  
  The `flags` statement (see [flags], page 12) must contain at least one of the following flags:

  - `tcpmux` A “dedicated” TCPMUX subordinate service. When invoked, it must output the ‘+ CRLF’ response itself.
  - `tcpmuxplus` Simple service. Before starting it, pies will send the ‘+ CRLF’ reply.

- `command command-line` [Config: component]
  
  The command line for handling this service.

For example:

```plaintext
component scp-to {
```
service scp-to;
flags (tcpmuxplus, sockenv);
tcpmux-master tcpmux;
command "/usr/sbin/in.wydawca";
}

For TCPMUX services, access control lists are handled in the following order. First, the global ACL is checked. If it rejects the connection, no further checks are done. Then, if the master TCPMUX service has an ACL, that ACL is consulted. If it allows the connection, the subordinate is looked up. If found, its ACL (if any) is consulted. Only if all three ACLs allow the connection, is the service started.

A similar procedure applies for other resources, such as limits, umask, env, user, group, etc.

### 3.3.9.3 Socket Environment Variables

If the ‘sockenv’ flag is set (see [flags], page 12), the following environment variables are set prior to executing the command:

- **PROTO** Protocol name.
- **SOCKTYPE** Socket type. See [socket-type], page 22, for a list of possible values.
- **LOCALIP** IP address of the server which is handling the connection.
- **LOCALPORT** Local port number.
- **LOCALHOST** Host name of the server. This variable is defined only if the ‘resolve’ flag is set (see [flags], page 12).
- **REMOTEIP** IP address of the remote party (client).
- **REMOTEPORT** Port number on the remote side.
- **REMOTEHOST** Host name of the client. This variable is defined only if the ‘resolve’ flag is set (see [flags], page 12).

The variables whose names begin with REMOTE are defined only for TCP connections.

### 3.3.9.4 Exit Actions in Inetd Components

Exit actions (see Section 3.3.7 [Exit Actions], page 19) work for ‘inet-style’ components. The only difference from ‘respawn’ components is that the ‘restart’ action is essentially ignored, as it makes no sense to start an ‘inet-style’ component without a communication socket.

A common use of return-code statement is to invoke an external program upon the termination of a component. For example, the following configuration snippet configures an FTP server and ensures that a special program is invoked after closing each FTP connection:

```plaintext
component ftp {
    return-code EX_OK {
```
exec "/sbin/sweeper --log";
}
mode inetd;
socket "inet://0.0.0.0:21";
umask 027;
program /usr/sbin/in.ftpd
command "ftpd -ll -C -t180";
}

This approach may be used to process FTP uploads in real time.

### 3.3.10 Meta1-Style Components

Meta1-style components are declared using `mode pass` statement. For such components, you must declare both a socket to listen on (see [inetd-socket], page 21, and a UNIX socket name to pass the file descriptor to the component. The latter is defined using `pass-fd-socket` statement:

```
pass-fd-socket file-name          [Config: component]
```

The argument is an absolute or relative file name of the socket file. In the latter case, the `chdir` `dir` statement must be used for this component (see Section 3.3.6 [Actions Before Startup], page 18), and the socket will be looked under `dir`.

This socket file is supposed to be created by the component binary upon its startup.

### 3.3.11 Component Visibility ACLs

Pies control interface allows certain users to list and modify components of a running pies instance. Two access control lists define who can list and modify the particular component.

```
list-acl name                      [Config: component]
list-acl { ... }                  [Config: component]
```

This list controls who can get listing of this component (see [piesctl list], page 44).

In the first form, `name` refers to the name of an already defined global ACL (see [defacl], page 32).

The second form defines new unnamed ACL. The syntax is described in detail in Section 3.5 [ACL], page 32.

```
admin-acl name                     [Config: component]
admin-acl { ... }                 [Config: component]
```

This list controls who can stop, restart or otherwise modify this component (see Section 5.4 [components], page 44).

As above, two forms are available: the first one for using an already defined named ACL, and the second one, for defining a new ACL in place.

### 3.3.12 Component Syntax Summary

This subsection summarizes the `component` statements. For each statement, a reference to its detailed description is provided.

```
component tag {
    # Component execution mode.
```
# See Section 3.3 [Component Statement], page 10.
mode modename;

# Full name of the program.
# See Section 3.3 [Component Statement], page 10.
program name;
# Command line.
# See Section 3.3 [Component Statement], page 10.
command string;

# List of prerequisites.
# See Section 3.3.1 [Prerequisites], page 13.
prerequisites (compnames);
# List of components for which this one is a prerequisite.
# See Section 3.3.1 [Prerequisites], page 13.
dependents (compnames);

# List of flags.
# See [flags], page 12.
flags (flags);

# For init components: runlevels in which to start this
# component.
# See Section 6.1 [Runlevels], page 52.
runlevels string;

# Listen on the given url.
# See Section 3.3.9 [Inetd-Style Components], page 21.
socket url;

# Set socket type.
# See Section 3.3.9 [Inetd-Style Components], page 21.
socket-type ‘stream | dgram | raw | rdm | seqpacket’;

# Service name for built-in inetd component.
# See Section 3.3.9.1 [builtin], page 23.
service string;

# Tag of master TCPMUX component, for subordinate components.
# See Section 3.3.9.2 [TCPMUX], page 24.
tcpmux-master string;

# Pass fd through this socket.
# See Section 3.3.10 [Meta1-Style Components], page 26.
pass-fd-socket socket-name;
# Wait number of seconds for pass-fd socket to become available.
# See Section 3.3.6 [Actions Before Startup], page 18.
pass-fd-timeout number;

# Maximum number of running instances.
# See Section 3.3.3 [Resources], page 14.
# See Section 3.3.9 [Inetd-Style Components], page 21.
max-instances number;

# For ‘inetd’ components:
# Text to send back if max-instances is reached.
# See Section 3.3.9 [Inetd-Style Components], page 21.
max-instances-message text;

# Maximum number of times an inetd component can be invoked in
# one minute.
# See Section 3.3.9 [Inetd-Style Components], page 21.
max-rate number;

# For ‘inetd’ components:
# Max. number of simultaneous connections from a single IP address.
# See Section 3.3.9 [Inetd-Style Components], page 21.
max-ip-connections number;

# For ‘inetd’ components:
# Text to send back if max-ip-connections is reached.
# See Section 3.3.9 [Inetd-Style Components], page 21.
max-ip-connections-message text;

# For ‘inetd’ components:
# Text to send back if access is denied by ACL.
# See Section 3.3.9 [Inetd-Style Components], page 21.
access-denied-message text;

# ACL for administrative (read-write) access to this component.
# See Section 3.3.11 [Visibility], page 26.
admin-acl name;
# or:
admin-acl { ... }

# ACL for read-only access to this component.
# See Section 3.3.11 [Visibility], page 26.
list-acl name;
# or:
list-acl { ... }

# ACL for this component.
# See Section 3.5 [ACL], page 32.
acl name;
# or:

```
acl { ... }
```

# Redirect program’s standard output to the given
# file or syslog priority.
# See Section 3.3.8 [Output Redirectors], page 21.
```
stdout 'file | syslog' channel;
```

# Redirect program’s standard error to the given
# file or syslog priority.
# See Section 3.3.8 [Output Redirectors], page 21.
```
stderr 'file | syslog' channel;
```

# Run with this user privileges.
# See Section 3.3.2 [Component Privileges], page 14.
```
user user-name;
```

# Retain supplementary group.
# See Section 3.3.2 [Component Privileges], page 14.
```
group group-name;
```

# Retain all supplementary groups of which user is a member.
# See Section 3.3.2 [Component Privileges], page 14.
```
allgroups bool;
```

# Set system limits.
# See Section 3.3.3 [Resources], page 14.
```
limits string;
```

# Force this umask.
# See Section 3.3.3 [Resources], page 14.
```
umask number;
```

# Set program environment.
# See Section 3.3.4 [Environment], page 15.
```
env { ... }
```

# Change to this directory before executing the component.
# See Section 3.3.6 [Actions Before Startup], page 18.
```
chdir dir;
```

# Remove file-name before starting the component.
# See Section 3.3.6 [Actions Before Startup], page 18.
```
remove-file file-name;
```

# Actions:
# See Section 3.3.7 [Exit Actions], page 19.
```
return-code exit-code-list {
    # Action to take when a component finishes with this return code.
    action 'disable | restart';
    # Notify these addresses when then component terminates.
3.4 Notification

Pies provides a notification mechanism, which can be used to send email messages when components terminate. The exact contents of such notifications and the list of their recipients may depend on the exit code which the component returned. Notification is configured by ‘notify’ and ‘message’ statements in a ‘return-code’ block.

**notify email-string** [Config: return-code]
Send email notification to each address from `email-string`. The latter is a comma-separated list of email addresses, e.g.:

```
notify "root@localhost,postmaster@localhost";
```

**message string** [Config: return-code]
Supply the email message text to be sent. `String` must be a valid RFC 822 message, i.e. it must begin with message headers, followed by an empty line and the actual message body.

The message may contain variable data in the form of variable references. A variable is an entity that holds some data describing the event that occurred. Meta-variables are referenced using the following construct:

```
${name}
```

where `name` is the name of the variable. Before actually sending the message, each occurrence of this construct is removed from the text and replaced by the actual value of the referenced variable. For example, the variables ‘component’ and ‘retcode’ expand to the name of the exited component and its exit code, correspondingly. Supposing that ‘component’ is ‘ftpd’ and ‘retcode’ is 76, the following fragment:

```
Subject: ${component} exited with code ${retcode}
```

will become:

```
Subject: ftpd exited with code 76
```

The table below lists all available variables and their expansions:
Table 3.4: Notification Variables

The ‘termination’ variable is set so as to facilitate its use with the ‘retcode’ variable. Namely, its value is ‘exited with’, if the component exited and ‘terminated on signal’, if it terminated on a signal. Thus, using

\[
\text{${termination} \text{ ${retcode}}$
\]

results in a correct English sentence. This message, however, cannot be properly internationalized. This will be fixed in the future versions.

If message statement is not given, the following default message is used instead:

From: <>
X-Agent: ${canonical_program_name} (${package} ${version})
Subject: Component ${component} ${termination} ${retcode}.

Notification messages are sent using an external program, called mailer. By default it is /usr/sbin/sendmail. You can change it using the following configuration statement:

mailer-program prog

Use prog as a mailer program. The mailer must meet the following requirements:

1. It must read the message from its standard input.
2. It must treat the non-optional arguments in its command line as recipient addresses.

For example, the following statement instructs pies to use exim as a mailer:

\[
\text{mailer-program /usr/sbin/exim;}
\]

By default, the mailer program is invoked as follows:

\[
\text{/usr/sbin/sendmail -oi -t rcpts}
\]

where rcpts is a whitespace-separated list of addresses supplied in the ‘notify’ statement.

The mailer command may be altered using ‘mailer-command-line’ statement:

mailer-command-line string

Set mailer command line. Notice, that string must include the command name as well. The ‘mailer-program’ statement supplies the full name of the binary which will
be executed, while the first word from the `mailer-command-line` argument gives the string it receives as `argv[0]`.

The example below shows how to use this statement to alter the envelope sender address:

```
mailer-command-line "sendmail -f root@domain.com -oi -t";
```

### 3.5 Access Control Lists

*Access control lists*, or ACLs for short, are lists of permissions that control access to `inetd`, `accept` and `meta1`-style components.

An ACL is defined using `acl` block statement:

```
call acl block statement:

[Config]

acl
  acl {
    definitions
  }
```

This statement is allowed both in global context and within a `component` block. If both are present, the global-level ACL is consulted first, and if it allows access, the component ACL is consulted. As a result, access is granted only if both lists allow it.

A *named ACL* is an access control list which is assigned its own name. Named ACLs are defined using the `deacl` statement:

```
deacl name block statement:

[Config]
deacl name {
  definitions
}
```

The `name` parameter specifies a unique name for that ACL. Named ACLs are applied only if referenced from another ACL (either global or a per-component one, or any named ACL, referenced from these). See [acl-ref], page 32, below.

In both forms, the part between the curly braces (denoted by `definitions`), is a list of *access control statements*. There are two types of such statements:

```
allow [user-group] sub-acl host-list
allow any

[Config: acl]
```

Allow access to the component.

```
deny [user-group] sub-acl host-list
deny any

[Config: acl]
```

Deny access to the component.

All parts of an access statement are optional, but at least one of them must be present. The `user-group` part is reserved for future use and is described in more detail in Appendix B [User-Group ACLs], page 77.

The `sub-acl` part, if present, allows to branch to another ACL. The syntax of this part is:

```
_acl name
```
where \textit{name} is the name of an ACL defined previously in ‘\texttt{defacl}’ statement.

The \textit{host-list} group allows to match client addresses. It consists of the \texttt{from} keyword followed by a list of \textit{address specifiers}. Allowed address specifiers are:

\begin{itemize}
    \item \texttt{addr} Matches if the client IP equals \texttt{addr}. The latter may be given either as an IP address or as a host name, in which case it will be resolved and the first of its IP addresses will be used.
    \item \texttt{addr/netlen} Matches if first \texttt{netlen} bits from the client IP address equal to \texttt{addr}. The network mask length, \texttt{netlen}, must be an integer number in the range from 0 to 32. The address part, \texttt{addr}, is as described above.
    \item \texttt{addr/netmask} The specifier matches if the result of logical AND between the client IP address and \texttt{netmask} equals to \texttt{addr}. The network mask must be specified in “dotted quad” form, e.g. ‘255.255.255.224’.
    \item \texttt{filename} Matches if connection was received from a UNIX socket \texttt{filename}, which must be given as an absolute file name.
\end{itemize}

The special form ‘\texttt{allow any}’ means to allow access unconditionally. Similarly, ‘\texttt{deny any}’, denies access unconditionally. Normally, one of these forms appears as the last statement in an ACL definition.

To summarize, the syntax of an access statement is:

\begin{verbatim}
    allow|deny [acl name] [from addr-list]
\end{verbatim}

where square brackets denote optional parts.

When an ACL is checked, its entries are tried in turn until one of them matches, or the end of the list is reached. If a matched entry is found, its command verb, \texttt{allow} or \texttt{deny}, defines the result of the ACL check. If the end of the list is reached, the result is ‘\texttt{allow}’, unless explicitly specified otherwise (using the [acl-any], page 33.)

For example, the following ACL allows access for anybody coming from networks ‘192.168.10.0/24’ and ‘192.168.100.0/24’, or any connection that matches the named ACL ‘\texttt{my-nets}’ (which is defined elsewhere in the configuration file). Access is denied for anybody else:

\begin{verbatim}
    acl {
        allow from (192.168.10.0/24, 192.168.100.0/24);
        allow acl "my-nets";
        deny all;
    }
\end{verbatim}

\section*{3.6 The Control Statement}

The \texttt{control interface} provides a method for communication with the running \texttt{pies} instance. It is used by the \texttt{piesctl} utility to query information about the instance and components it is currently running and to send it commands for controlling its operation (see Chapter 5 [piesctl], page 43). By default the UNIX socket \texttt{/tmp/pies.ctl} is used for this purpose. If \texttt{pies} was started with the \texttt{--instance=\textit{name}} option, the socket is named \texttt{/tmp/\textit{name}.ctl}. 
Whatever its name, the socket will be owned by the user pies runs as (see Section 3.11 [Pies Privileges], page 39) and will have access rights of 0500, allowing only that user to read and write to it. When pies is used as init process, the default socket name is /dev/init.ctl.

**control**

The `control` statement configures the control interface and limits access to it:

```plaintext
control {
    socket url;
    acl { ... }
    admin-acl { ... }
    user-acl { ... }
    realm name;
}
```

**socket url**

URL of the control socket. The `url` argument is a string of the following syntax:

- **inet://ip:port**
  - Listen on IPv4 address `ip` (may be given as a symbolic host name), on port `port`.
- **local://file[:args]**
- **file://file[:args]**
- **unix://file[:args]**
  - Listen on the UNIX socket file `file`, which is either an absolute or relative file name. Optional arguments `args` control ownership and file mode of `file`. They are a semicolon-separated list of assignments to the following variables:
    - `user` User name of the socket owner.
    - `group` Owner group of the socket, if it differs from the `user` group.
    - `mode` Socket file mode (octal number between ‘0’ and ‘777’).
    - `umask` Umask to use when creating the socket (octal number between ‘0’ and ‘777’).

**idle-timeout n**

Disconnect any control session that remains inactive for `n` seconds. This statement is reserved for use in the future. Currently (as of version 1.8) it is a no-op.

The control interface is protected by three access control lists (See Section 3.5 [ACL], page 32, for a discussion of their syntax).

**acl name**

Controls who can connect to the interface. The first form refers to a named ACL that must have been defined earlier by `defacl` statement (see [defacl], page 32). Use the second form to define a new ACL in place.
Control interface provides two kinds of operations: read-only (such as getting information about running components) and write operations (such as stopping or restarting components).

The **user-acl** controls read access. Access to particular components can also be controlled individually, using the per-component **list-acl** statement (see Section 3.3.11 [Visibility], page 26).

**admin-acl** controls write access to the **pies** instance itself and to the components for which no specific **admin-acl** statements are supplied (see Section 3.3.11 [Visibility], page 26).

In particular, whoever passes **admin-acl** can issue commands for stopping the instance and reloading its configuration.

When checking whether the user has a particular kind of access to a component, first the corresponding ACL from the **control** section is checked. If it allows access, then the per-component ACL is tried. If it allows access too, then the operation is permitted.

**realm**

Defines the realm for basic authentication. Default value is ‘pies’.

### 3.7 User Identities for Accessing Control Interface

Privileges for using and performing various commands over the control interface can be distributed among several users. For example, it is possible to grant some users the rights to only view the component listing, or even to further limit their rights to only see the components they are authorized to know about. Another user may be able to stop or restart components and so on. This privilege separation requires **pies** to have a notion of user and be able to authenticate it.

**Identity provider** is an abstract mechanism that **pies** uses to obtain information about the user trying to authenticate himself for accessing a particular control function. As of version 1.8, this mechanism is considered experimental. That means, that although being fully functional, it can change considerably in future releases.

**Identity provider** supports two operations: authenticating a user, and checking if he is a member of particular group. It is defined in the configuration file using the **identity provider** statement.

**identity-provider**

Defines an identity provider. It is a block statement:

```plaintext
identity-provider name {
  type type;
  ...
}
```

The provider **name** is used in diagnostic messages.

---

**user-acl**

**name**

**admin-acl**

**name**

**realm**

**name**
The only required substatement is **type**, which defines the type of the provider. Rest of statements (represented by . . . above) depends on the type.

Pies version 1.8 supports identity providers of two types: ‘**system**’ and ‘**pam**’.

The ‘**system**’ identity provider uses system user database for authentication and system group database for checking group membership. It is declared using the following statement:

```plaintext
identity-provider name {
    type system;
}
```

Obviously, to use the system identity provider for authentication, **pies** must be run as root.

The ‘**pam**’ identity provider uses the Pluggable Authentication Modules (PAM) for authentication, and system group database for checking group membership.

```plaintext
identity-provider name {
    type pam;
    service srv;
}
```

The ‘**service**’ statement defines the name of PAM service to use for authentication. If absent, the name ‘**pies**’ is used.

Any number of different identity providers can be declared in the configuration file. When authenticating the user, they will be tried in turn until the one is found where authentication succeeds. Subsequent group membership checks will then use this identity provider.

### 3.8 Using inetd Configuration Files

In addition to its native configuration file format, GNU **pies** is able to read configuration files of several other widely-used utilities. One of these is **inetd**. The simplest way to use such configuration files is by including them to your main **pies.conf** using the **include-inetd** statement:

```plaintext
include-inetd file
```

[Config]
Read components from **inetd**-style configuration file **file**. The argument may also be a directory, in which case all regular files from that directory are read and parsed as **inetd**-style configuration files.

The components read from **file** are appended to the **pies** list of components in order of their appearance.

For example, the following statement reads components from the standard **inetd** configuration file:

```plaintext
include-inetd /etc/inetd.conf;
```

Any number of **include-inetd** may be specified. For example, the following reads the contents of the /etc/inetd.conf configuration file and all files from the /etc/inetd.d directory:

```plaintext
include-inetd /etc/inetd.conf;
include-inetd /etc/inetd.d;
```
Another way to read *inetd* configuration files is to supply them in the command line, like this:

```
pies --syntax=inetd --config-file /etc/inetd.conf
```

Notice the `--syntax` option (see [config syntax], page 5). It informs *pies* that the following files are in *inetd* format. Of course, several configuration file may be given:

```
pies --syntax=inetd
    --config-file /etc/inetd.conf --config-file /etc/inetd.d
```

A special option is provided that instructs *pies* to behave as *inetd*:

```
--inetd   Read configuration from `sysconfdir/inetd.conf` and make sure *pies* state files (see Section 3.12 [State Files], page 40) do not conflict with those from other *pies* instances.
```

The GNU *Pies* package also provides a wrapper that allows to use *pies* instead of *inetd*. It is built if the package is configured with the `--enable-inetd` option. The wrapper is then installed in `sbindir` as *inetd*, possibly replacing the system binary of that name.

The command line usage of the *inetd* wrapper is entirely compatible with that of the usual *inetd* utility, i.e.:

```
inetd [option] [config [config...]] [-- pies-options]
```

Options are:

- `-d`  Increase debug level.
- `-R rate`  Set maximum rate (see [max-rate], page 22).

For convenience, the following additional options are understood:

- `-t`  Parse configuration file or files and exit. See [lint], page 5.
- `-s`  Display info about the running instance. See [pies-status], page 65.
- `-S`  Stop the running instance.

Finally, any additional options *pies* understands may be given to *inetd* after the `--` separator.

### 3.9 Using MeTA1 Configuration File

MeTA1 is a mail transfer agent of new generation, designed to replace Sendmail in the future ([http://www.meta1.org](http://www.meta1.org)). It has a modular structure, each module being a component responsible for a particular task. The components are configured in the MeTA1 configuration file `/etc/meta1/meta1.conf`.

*Pies* can take a list of components directly from MeTA1 configuration file:

```
include-meta1 file   [Config]
```

Parse file as MeTA1 configuration file and incorporate components defined there into the current component list.

For example:

```
include-meta1 /etc/meta1/meta1.conf;
```
Thus, you can use **pies** instead of the default MeTA1 program manager **mcp**. This is particularly useful if you use ‘Mailfromd’ ([http://mailfromd.software.gnu.org.ua](http://mailfromd.software.gnu.org.ua)) to control the mail flow.

To ensure compatibility with MeTA1, the components read from its configuration file are started in the reverse order (i.e. from last to first), and stopped in the order of their appearance in file.

The following **pies** statements are silently applied to all MeTA1 components:

```
allgroups yes;
stderr file compname.log
chdir queue-dir
```

Here, `compname` stands for the name of the component, and `queue-dir` stands for the name of MeTA1 queue directory. The latter is `/var/spool/meta1` by default. It can be changed using the following statement:

```
metal-queue-dir dir
```

[Config]

Set name of MeTA1 queue directory.

To override any default settings for a MeTA1 component, add a **command** section with the desired settings after including `meta1.conf`. For example, here is how to redirect the standard error of the `smtps` component to `local1.debug` syslog channel:

```
include-meta1 /etc/meta1/meta1.conf

component smtps {
    stderr syslog local1.debug;
}
```

### 3.10 Global Configuration

The statements described in this section affect **pies** behavior as a whole.

```
env { . . . }  [Config]
```

Modifies the environment for the running **pies** instance. The modified environment will be inherited by all processes started by **pies** in the course of its normal operation. See Section 3.3.4 [Environment], page 15, for a detailed discussion of the `env` statement syntax.

```
syslog { . . . }  [Config]
```

This block statement configures logging via syslog. It has the following substatements:

```
dev address  [Config: syslog]
```

Address of the socket the syslog daemon is listening on. By default, `/dev/log` is used. The `address` argument is either the file name of the UNIX socket file or IPv4 address of the syslog collector optionally followed by the colon and port number (or symbolic service name). If the port number is not supplied, the ‘syslog’ port (UDP) from `/etc/services` is used.

```
facility string  [Config: syslog]
```

tag string
Prefix syslog messages with this string. By default, the program name is used.

umask number
Set the default umask. The number must be an octal value not greater than ‘777’. The default umask is inherited at startup.

limits arg
Set global system limits for all pies components. See Section 3.3.3 [Resources], page 14, for a detailed description of arg.

return-code { ... }
Configure global exit actions. See Section 3.3.7 [Exit Actions], page 19, for a detailed description of this statement.

shutdown-timeout number;
Wait number of seconds for all components to shut down. Default is 5 seconds.

The normal shutdown sequence looks as follows:
1. Compute shutdown sequence that takes into account dependencies between components, so as to ensure that dependent components stop before their prerequisites. This sequence can be viewed using the --list-shutdown-sequence option.
2. For each stage in the shutdown sequence, send the termination signal to each component marked for that stage. By default, SIGTERM is used, but it can be changed for each component using the sigterm configuration statement (see [sigterm], page 13). Wait for the signalled components to terminate. If any of them remain running after shutdown-timeout seconds, send them the SIGKILL signal.
3. If any shutdown components are defined, start them and wait for their termination. If any components are left running after shutdown-timeout seconds, terminate them by sending the SIGKILL signal.

3.11 Pies Privileges
Normally, pies is run with root privileges. If, however, you found such an implementation for it, that requires another privileges, you may change them using the following three statements:

user user-name
Start pies with the UID and GID of this user.

group group-list
Retain the supplementary groups, specified in group-list.

allgroups bool
Retain all supplementary groups the user (as given with user statement) is a member of.

An example of such implementation is using pies to start jabberd components: http://www.gnu.org.ua/software/pies/example.php?what=jabberd2.
3.12 State Files

Pies uses several files to keep its state information. The directory which hosts these files is called state directory, it is usually /var/pies or /usr/local/var/pies. The state directory can be configured at run time:

```
state-directory dir [Config]
    Set the program state directory.
```

The table below describes the files kept in the state directory. The instance in this table stands for the pies instance name (see [instances], page 65). Usually, it is ‘pies’.

```
instance.pid
    The PID file. It keeps the PID number of the running pies instance.

instance.qotd
    The Quotation-of-the-day file. It is used by the ‘qotd’ built-in service (see [qotd], page 23).
```

The following statements allow to redefine state file names. Use them only if the defaults do not suit your needs, and neither the state-directory statement nor the --instance option can help:

```
pidfile file [Config]
    Sets the PID file name.

qotd-file file-name [Config]
    Sets the name of the ‘quotation-of-the-day’ file.
```

The following statements are retained for compatibility with earlier pies versions. They are silently ignored:

```
control-file arg [Config]
stat-file arg [Config]
```
4 Pies Debugging

The amount of debugging information produced by pies is configured by the following statements:

**debug level**

Set debugging level. The level must be a non-negative decimal integer. In version 1.8 the following debugging levels are used:

1. Log all basic actions: starting and stopping of components, received incoming TCP connections, sending mails. Notify about setting limits. Log pre-startup actions (see Section 3.3.6 [Actions Before Startup], page 18).
2. Log setting particular limits. Log the recomputed alarms.
4. Dump execution environments
6. Debug the parser of MeTA1 configuration grammar.
7. Debug the lexical analyzer of MeTA1 configuration file.

**source-info bool**

This statement decides whether debugging messages should contain source information. To enable source information, use:

```
source-info yes;
```

This feature is designed for pies developers.
5 Communicating with Running pies Instances

The `piesctl` tool allows you to communicate with the running `pies` program. The invocation syntax is:

```
piesctl [options] command [args...]
```

The `command` determines the operation to perform. The following sections describe available commands in detail.

5.1 piesctl id – Return Info About the Running Instance

The `id` subcommand returns information about the `pies` instance organized as key-value pairs. When invoked without arguments, the following data are returned:

- **package**: Canonical package name.
- **version**: Version of `pies`.
- **instance**: Instance name (see [instances], page 65).
- **binary**: Full pathname of the `pies` executable file.
- **argv**: Command line arguments supplied upon its startup.
- **PID**: Process ID.

For example:

```
$ piesctl id
package: GNU Pies
version: 1.8
instance: pies
binary: /usr/sbin/pies
argv: /usr/sbin/pies --config-file=/etc/pies/pies.conf
PID: 15679
```

To request a subset of these data, give the items of interest as command line arguments:

```
$ piesctl id binary PID
binary: /usr/sbin/pies
PID: 15679
```

5.2 Instance Management

Two subcommands are provided for stopping and restarting `pies`.

- **shutdown** [piesctl]
  Stop the running `pies` instance

- **reboot** [piesctl]
  Restart `pies` instance. Upon receiving this command, `pies` will restart itself with the same command line arguments. Naturally, this means that all running components will be restarted as well.

These subcommands do nothing when init process is selected.
5.3 piesctl config – Configuration Management

**config file list**
List currently loaded configuration files.

**config file clear**
Clear configuration file list

**config file add syntax file**
Add file to the list of configuration files. *syntax* specifies its syntax: ‘pies’, ‘inetd’, ‘meta1’, or ‘inittab’.

**config file del[ete] name [name...]**
Remove listed names from the list of configuration files.

**config reload**
Reload configuration.

5.4 Component Management

**list [condition]**
List configured components. When used without arguments, all components are listed. Otherwise, only processes matching *condition* are listed.

Each output line contains at least two columns. The first column lists the tag of the component. The second one contains *flags*, describing the type and status of the component. The first flag describes the type:

<table>
<thead>
<tr>
<th>Flag</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>SysV init ‘ctrlaltdel’ component</td>
</tr>
<tr>
<td>A</td>
<td>Accept-style component</td>
</tr>
<tr>
<td>B</td>
<td>SysV init ‘boot’ component</td>
</tr>
<tr>
<td>C</td>
<td>Respawn component</td>
</tr>
<tr>
<td>c</td>
<td>SysV init ‘once’ component</td>
</tr>
<tr>
<td>D</td>
<td>SysV init ‘ondemand’ component</td>
</tr>
<tr>
<td>E</td>
<td>Command being executed</td>
</tr>
<tr>
<td>F</td>
<td>SysV init ‘powerfail’ component</td>
</tr>
<tr>
<td>f</td>
<td>SysV init ‘powerwait’ component</td>
</tr>
<tr>
<td>I</td>
<td>Inetd-style component</td>
</tr>
<tr>
<td>i</td>
<td>SysV init ‘sysinit’ component</td>
</tr>
<tr>
<td>k</td>
<td>SysV init ‘krequest’ component</td>
</tr>
<tr>
<td>n</td>
<td>SysV init ‘powerfailnow’ component</td>
</tr>
<tr>
<td>o</td>
<td>SysV init ‘powerokwait’ component</td>
</tr>
<tr>
<td>P</td>
<td>Pass-style component</td>
</tr>
<tr>
<td>R</td>
<td>Output redirector</td>
</tr>
<tr>
<td>W</td>
<td>SysV init ‘wait’ component</td>
</tr>
<tr>
<td>w</td>
<td>SysV init ‘bootwait’ component</td>
</tr>
</tbody>
</table>

The second flag is meaningful only for components. Its values are:
Flag  | Meaning
-----|-------
-     | Disabled component
f     | A finished ‘once’ component
L     | Inetd listener
R     | Running component
S     | Component is stopping
s     | Component is sleeping
T     | Component is stopped

The next column lists the PID (for running components) or socket address (for Internet listeners), or the string ‘N/A’ if neither of the above applies.

If the component is sleeping, the time of its scheduled wake-up is listed in the next column.

Rest of line shows the component command line.

```
$ piesctl list
smtps/stderr R 4697
pmult/stderr R 4677
pmult/stdout R 4676
pmult  CR 4678 /usr/local/sbin/pmult
smar   CR 4680 smar -f /etc/meta1/meta1.conf -d 100
qmgr   CR 4691 qmgr -f /etc/meta1/meta1.conf
smtpc  CR 4696 smtpc -f /etc/meta1/meta1.conf
smtps  PR 4698 smtps -d100 -f /etc/meta1/meta1.conf
finger IL inet+tcp://0.0.0.0:finger /usr/sbin/in.fingerd -u
eklogin IL inet+tcp://0.0.0.0:eklogin /usr/sbin/klogind -k -c -e
kshell IL inet+tcp://0.0.0.0:kshell /usr/sbin/kshd -k -c
eklogin IR 13836 /usr/local/sbin/klogind -k -c -e
```

Use *condition* to select the components to list. In its simplest form, *condition* is one of the following *terms*:

- **all**: Selects all processes, including internal services, such as output redirectors.
- **active**: Selects only active components.
- **component tag**: Selects the component with the given tag. See Section 3.3 [Component Statement], page 10.
- **type arg**: Selects processes of the given type. Argument is ‘component’, to select only components, ‘command’, to select commands or ‘redirector’ to select output redirectors. When `piesctl list` is used without arguments, type `component` is assumed.
- **mode arg**: Selects components of the given mode (see Section 3.3 [Component Statement], page 10). E.g. to list ‘inetd’ components:

  `piesctl list mode inetd`
status arg

Selects processes with the given status. Argument is one of:

- **finished**: Component is finished.
- **listener**: Component is an inet listener.
- **running**: Component is running.
- **sleeping**: Component is sleeping.
- **stopped**: Component is stopped.
- **stopping**: Component has been sent the SIGTERM signal and *pies* is waiting for it to terminate.

A term may be preceded by the word ‘not’ to indicate negation of the condition. For example, the following command will list inactive components:

```
piesctl list not active
```

Furthermore, terms can be combined in logical expressions using boolean ‘and’ and ‘or’ operators:

```
piesctl list type component and not mode inetd
```

Conjunction (‘and’) has higher precedence than disjunction (‘or’). In complex expressions parentheses can be used to alter the precedence:

```
piesctl list type component \ 
  and \( status running or status sleeping \)
```

Notice that parentheses must be escaped to prevent them from being interpreted by the shell.

The following summarizes the syntax of *condition* in BNF:

```
<condition> ::= <disjunction>
<disjunction> ::= <conjunction> | <conjunction> "or" <disjunction>
<conjunction> ::= <unary> | <unary> "and" <conjunction>
<unary> ::= <term> | "not" <condition> | "(" <condition> ")"
<term> ::= "all" | "active" | <keyword> <value>
<keyword> ::= "type" | "mode" | "status" | "component"
<value> ::= <word> | <quoted-string>
<word> ::= <printable> | <word> <printable>
<printable> ::= "A" - "Z" | "a" - "z" | "0" - "9" | 
                    ":" | ":*" | ":." | "@" | "[" | "]" | ":-" | ":/"
<quote-string> ::= "" | <string> ""
<word> ::= <char> | <string> <char>
<char> ::= <any character except "" and ""> | "\" | "\"
```

**stop condition**

Stop components matching *condition*.

**start condition**

Start components matching *condition*.

**restart condition**

Restart components.
5.5 Init Process Management

The `piesctl telinit` command communicates with `pies` instance running as `init` process (PID 1). See Section 6.5 [piesctl telinit], page 55, for a detailed discussion.

5.6 Piesctl Command Line Options

- `c file`
- `--config-file=file`
  
  Read configuration from file instead of the default `/etc/piesctl.conf`. See Section 5.7 [piesctl.conf], page 48, for its description.

- `d`
- `--dump`
  
  Dump obtained responses verbatim. This is useful mainly for debugging purposes.

- `i inst`
- `--instance=inst`
  
  Talk to `pies` instance inst.

- `--no-netc`
- `-N`
  
  Don’t read `~/.netrc` file.

- `u url`
- `--url=url`
  
  Specifies the URL of the communication socket. See [piesctl url], page 48, for a description of allowed URL forms.

- `v`
- `--verbose`
  
  Enable verbose diagnostics.

  Before parsing, configuration file is preprocessed using external command defined at build time (normally `m4`). The following options control this feature:

- `E`
  
  Show preprocessed configuration on stdout and exit.

- `--no-preprocessor`
  
  Disable the use of the external preprocessor.

- `--preprocessor=cmd`
  
  Use the command cmd as the external preprocessor, instead of the default `m4`.

- `--define=sym[=value]`
- `-D symbol[=value]`
  
  Define symbol sym as having value, or empty, if the value is not given.

- `--include-directory=dir`
- `-I dir`
  
  Add directory dir to the list of directories to be scanned for preprocessor include files.

- `--undefine=sym`
- `-U sym`
  
  Undefined symbol sym.
Finally, the following options can be used to obtain on-line assistance:

- `--config-help`
  Show a terse reference to configuration file syntax and exit.

- `-h`
  `-help`
  Display command line help summary.

- `--usage`
  Give a short usage message

- `-V`
  `--version`
  Show program version.

### 5.7 Configuration for piesctl

The configuration file `/etc/piesctl.conf` helps the `piesctl` tool to determine the URL of the control socket. This file is not mandatory, and its absence is not considered an error. Its syntax is similar to that of `/etc/pies.conf`. The following statements are defined:

- **socket url**
  [piesctl.conf]
  Sets the default socket URL.

- **source ip**
  [piesctl.conf]
  Sets the default source IP address. This is used if the control socket is of ‘inet’ type.

- **instance name**
  [piesctl.conf]
  Configures socket URL and (optionally) source address to use when communicating with the `pies` instance `name` (i.e., when invoked as `piesctl -i name`):

  ```
  instance name {
    # Socket URL for that instance.
    socket url;
    # Source IP address.
    source ip;
  }
  ```

Valid values for `url` in the above statements are:

- **inet://ip:port**
  Use the IPv4 address `ip` (may be given as a symbolic host name), on port `port`.

- **local://file**
- **file://file**
- **unix://file**
  Use the UNIX socket file `file`.

The following algorithm is used to determine the name of the communication socket:

1. If the `--url (-u)` option is given, use its argument.
2. Determine the instance name (`inst`). If the `--instance (-i)` is given, `inst` is its argument. Otherwise, assume `inst='pies'`.
3. If configuration file `/etc/piesctl.conf` exists, read it. On success:
   a. See if the `instance inst` statement is present and has `socket` substatement. If so, the argument to `socket` gives the socket URL.
b. Otherwise, if global `socket` statement is present, its argument gives the URL.

4. Otherwise, suppose that `piesctl` is run on the same box where the target instance of `pies` is running, and see if the file `/etc/inst.conf` exists. If so, parse it as `pies` configuration file and look for `control` block statement. If it has `socket` statement, take its argument as the URL. See Section 3.6 [control], page 33.

5. If socket URL is not determined by these steps, assume `/tmp/inst.ctl`. 
6 Init – parent of all processes

Pies can be executed directly by the kernel as a program responsible for starting all other processes (a process with PID 1). In this case it becomes also the parent of all processes whose natural parents have died and is responsible for reaping those when they die.

When invoked this way, pies reads its configuration from two files: /etc/inittab and /etc/pies.init. The former has traditional syntax (see [inittab], page 52) and is retained for compatibility with another ‘init’ daemons, and the latter is in native pies format (see Section 3.1 [Syntax], page 6). Either of the files or even both of them can be missing.

The startup process passes through several states. Transition between states is controlled by runlevel, which also defines the set of components that must be executed. Startup states are:

- **sysinit**  
  System initialization state. This state marks the beginning of the startup process. Only root partition is mounted, and is usually read-only. Pies uses console to output diagnostic messages.
  
  Normally, the configuration instructs pies to execute at this point the system initialization script, which checks and mounts the necessary local file systems, initializes devices and loads kernel modules.
  
  The system then passes to ‘boot’ state, unless the default runlevel is ‘S’, in which case the ‘single’ state is selected.

- **boot**  
  Upon entering the ‘boot’ state, pies attempts to log the ‘reboot’ login record into the system utmp/wtmp files and executes entries marked with boot and bootwait types. It then enters the ‘normal’ state.

- **single**  
  This is a fallback state for single-user system. It is entered only if the ‘S’ runlevel has been selected initially. Normally, this state is used for system maintenance. The configuration usually provides a component which executes a single-user shell when entering this state. If it does not, pies executes ‘/sbin/sulogin’.

- **normal**  
  Upon entering this state, pies assumes that components executed previously have brought the system to such condition where normal communication means can already be used. This means that the file systems have been mounted read-write and the syslog daemon is operating. Therefore pies opens its communication channels and redirects its diagnostic output to syslog facility ‘daemon’.
  
  Then it starts components scheduled for the default runlevel and begins its normal operation.

Pies communication channels are:

- **/dev/initctl**  
  A FIFO file for communication using legacy protocol (using telinit).

- **/dev/init.ctl**  
  UNIX socket for communication using piesctl.
6.1 Runlevels

Runlevel determines the set of components to be run in normal state. It is a decimal digit from ‘0’ to ‘9’ or letter ‘S’. Traditionally, runlevels are assigned as follows:

- **0**: System halt.
- **1**: Single user mode.
- **S**: Multiuser mode.
- **3**: Multiuser with X11.

Additionally, three special runlevels ‘a’, ‘b’ and ‘c’ can be used to start on-demand components without actually changing the runlevel. Once started, on-demand components persist through eventual runlevel changes.

6.2 Init Process Configuration

The two configuration files are read in this order: /etc/inittab first, then /etc/pies.init. The /etc/inittab file is a simple line-oriented file. Empty lines and lines beginning with ‘#’ are ignored (except if ‘#’ is followed by the word ‘pies’, see below). Non-empty lines consist of 4 fields separated by colons:

```
id:runlevels:mode:command
```

where

- **id**: Component identifier. A string uniquely identifying this component.
- **runlevels**: List of the runlevels for which the component should be run. Runlevels are listed as a contiguous string of characters, without any whitespace or delimiters.
- **mode**: Component execution mode.
- **command**: Command to be executed and its arguments.

Component execution modes are:

- **respawn**: The basic execution mode. A respawn component is restarted each time it terminates. If it is restarted more than 10 times in 2 minutes, pies puts it in sleeping state for the next 5 minutes.
- **off**: Disabled component. The entry is ignored.
- **boot**: The process will be executed during system boot. The ‘runlevel’ settings are ignored.
- **bootwait**: The process will be executed during system boot. No other components will be started until it has terminated. The ‘runlevel’ settings are ignored.
- **sysinit**: The process will be executed during system boot, before any boot or bootwait entries. The ‘runlevel’ settings are ignored.
- **once**: The process will be executed once when the specified runlevel is entered.
- **wait**: The process will be started once when the specified runlevel is entered. Pies will wait for its termination before starting any other processes.
Chapter 6: Init – parent of all processes

**ctrlaltdel**

The process will be executed when pies receives the SIGINT signal. Normally this means that the CTRL-ALT-DEL combination has been pressed on the keyboard.

**kbrequest**

The process will be executed when a signal from the keyboard handler is received that indicates that a special key combination was pressed on the console keyboard.

**ondemand**

The process will be executed when the specified ondemand runlevel is called (‘a’, ‘b’ and ‘c’). No real runlevel change will occur (see [Oondemand runlevels], page 52). The process will remain running across any eventual runlevel changes and will be restarted whenever it terminates, similarly to respawn components.

**powerfail**

The process will be executed when the power goes down. Pies will not wait for the process to finish.

**powerfailnow**

The process will be executed when the power is failing and the battery of the external UPS is almost empty.

**powerokwait**

The process will be executed as soon as pies is informed that the power has been restored.

**powerwait**

The process will be executed when the power goes down. Pies will wait for the process to finish before continuing.

The special mode ‘initdefault’ declares the default runlevel. In the ‘initdefault’ entry, the runlevels field must consist of exactly one runlevel character. Rest of fields are ignored. For example, the following instructs pies that the default runlevel is ‘3’:

```
id:3:initdefault:
```

If no ‘initdefault’ entry is present, pies will ask the user to input the desired default runlevel upon entering the normal state.

Inittab must contain at least one entry with ‘S’ in runlevels field. This entry is used for system maintenance and recovery. If it is absent, pies adds the following default entry implicitly:

```
~~:S:wait:/sbin/sulogin
```

As an exception to traditional syntax, the ‘#’ followed by the word ‘pies’ (with any amount of white space in between) introduce a pragmatic comment that modifies the behavior of the configuration parser. The following such comments are understood:

**#pies pragma debug n**

Set debugging level n (a decimal number). See Chapter 4 [Pies Debugging], page 41.
#pies pragma next syntax file
After parsing /etc/inittab, read configuration from file file, assuming syntax (see [config syntax], page 5). Multiple ‘next’ pragmas are allowed, the named files will be processed in turn.

The default set up is equivalent to specifying

```plaintext
#pies pragma next pies /etc/pies.init
```

#pies pragma stop
Stop parsing after this line. The remaining material is ignored.

Both the traditional /etc/inittab and pies-native /etc/pies.init files are entirely equivalent, excepting that, naturally, the latter is more flexible and gives much more possibilities in defining the system behavior. The declaration of a component in /etc/pies.init can contain all the statements discussed in Section 3.3 [Component Statement], page 10. The only difference is that runlevels to start the component is must be specified:

```plaintext
runlevels string
```

Specifies the runlevel to start the component in. The string argument is a string of runlevel characters.

For example, the inittab entry discussed above is equivalent to the following statement in pies.init file:

```plaintext
component id {
    mode mode;
    runlevels runlevels;
    command command;
}
```

The default runlevel is specified in /etc/pies.init using the following construct:

```plaintext
initdefault rl
```

Declare the default runlevel. The argument is the runlevel name. E.g.

```plaintext
initdefault 3;
```

If both /etc/inittab and /etc/pies.init are present, the latter can declare components with the same id as the ones declared in the former. In that case, the two entries will be merged, the latter one overriding the former. Thus, /etc/pies.init can be used to complement definitions in inittab. Consider, for example the following inittab entry:

```plaintext
upd:3:respawn:/usr/libexec/upload
```

If pies.init contains the following:

```plaintext
component upd {
    user nobody;
    stderr syslog local1;
}
```

the result will be equivalent to:

```plaintext
component upd {
    mode respawn;
    runlevels 3;
```
command /usr/libexec/upload;
user nobody;
stderr syslog local1;
}

6.3 Init Command Line

The runlevel to run in can be given as argument in the command line:
/sbin/pies 1

Apart from this, the following command line arguments are recognized:

- `s`
  single   Initialize default runlevel ‘S’.
- `b`
  emergency   Run emergency shell /sbin/sulogin, prior to initialization.

6.4 Init Environment

Programs run from pies init process inherit a basic environment consisting of the following variables:

PREVLEVEL=L
  Previous runlevel, or letter ‘N’ if the runlevel hasn’t been changed since startup.

RUNLEVEL=L
  Current runlevel.

CONSOLE=device
  Pathname of the console device file.

INIT_VERSION="GNU Pies 1.8"
  Version of pies.

PATH=/bin:/usr/bin:/sbin:/usr/sbin
  Once the system is booted up, the environment can be controlled using the piesctl telinit environ (or pies -T -e) command.

6.5 piesctl telinit

piesctl telinit runlevel
  Report the runlevel and state of the process 1.

piesctl telinit runlevel n
  Switch to runlevel n.

piesctl telinit environ list [NAME]
  List the environment. If NAME is given, list only the value of that variable.

piesctl telinit environ set NAME=VALUE
  Set variable NAME to VALUE. The environment is capable to hold at most 32 variables.
piesctl telinit environ unset NAME

Unset variable NAME.

6.6 The Telinit Command

When given the -T (--telinit) option, pies emulates the behavior of the traditional telinit command. This is a legacy way of communicating with the init process. The commands are sent via named pipe /dev/initctl. When the -T option is given, the rest of command line after it is handled as telinit options. The following command:

    pies -T [-t n] r

tells init process to switch to runlevel r. Possible values for r are:

- 0 to 9    Instructs init to switch to the specified runlevel.
- S or s    Tells init to switch to the single user mode.
- a, b, or c Tells init to enable on-demand components with the specified runlevel. The actual runlevel is not changed.
- Q or q    Tells init to rescan configuration files.

The -t (--timeout) option sets the time to wait for processes to terminate after sending them the SIGTERM signal. Any processes that remain running after n seconds will be sent the SIGKILL signal. The default value is 5 seconds.

This usage is equivalent to the piesctl telinit runlevel command (see Section 6.5 [piesctl telinit], page 55).

The -e (--environment) option modifies the init process environment. Its argument is either a variable assignment ‘name=value’ to set a variable, or the name of a variable to unset it. Several -e options can be given to process multiple variables in a single command. Note, however, that given n -e options, the total length of their arguments is limited to 367 - n bytes.

This option provides a limited subset of the functionality offered by the piesctl telinit environ command.

The table below summarizes all options available in telinit mode:

- **-t n**    Wait n seconds for processes to terminate after sending them the SIGTERM signal. Any processes that remain running after that time will be sent the SIGKILL signal. The default value is 5 seconds.
- **-e var=value**    Define environment variable var as having value value.
- **-e var**    Unset environment variable var.
7 Using Pies as Entrypoint for Docker Container

Another use for pies is as an entrypoint in a docker container. This is similar to the init mode described in the previous chapter in that pies runs with PID 1. However, in this case pies uses its regular configuration file.

When started with PID 1 from a docker container, pies tries to detect the fact automatically and switch to the entrypoint mode. As of version 1.8, this detection might fail in containers run under Kubernetes. For such cases, use the --no-init option to inform pies that it should run in entrypoint mode.

The following Dockerfile fragment illustrates how to configure pies to be run from a container:

    COPY pies.conf /etc
    ENTRYPOINT [ "/usr/sbin/pies", "--foreground", "--stderr" ]

It is supposed, of course, that the configuration file pies.conf is available in the same directory as Dockerfile.

It is a common practice to supply configuration settings via the environment variables. To implement it in pies.conf, use either expandenv or shell flag (see Section 3.3.5 [Early Environment Expansion], page 18). For example:

    flags expandenv;
    command "syslogd -n -R $LOGHOST";

This will expand the environment variable LOGHOST and pass its value as one of the arguments to syslog. The usual shell syntax is supported. For example, to provide a default value for the -R option above (in case LOGHOST is empty or undefined), use:

    flags expandenv;
    command "syslogd -n -R ${LOGHOST:-172.19.255.255}";

Quite often a need arises to expand environment variables in other parts of the configuration file and to conditionally exclude portions of configuration, depending on whether a particular variable is set. The following sections describe two approaches to solving this problem.

7.1 Expanding Environment Variables in GNU m4

Configuration preprocessing (see Section 3.2 [Preprocessor], page 8) can be used to conditionally enable parts of the pies.conf file, depending on the value of an environment variable. The technique described below assumes that you use GNU m4 as preprocessor.

Define the following two M4 macros:

CF_WITH_ENVAR name text  [M4 macro]
    Expands the environment variable name within text. The macro does so by temporarily redefining the symbol name to the value of the environment variable name and expanding text.

The definition of the macro is:

    m4_define('CF_WITH_ENVAR',m4_dnl
    'm4_pushdef('$1',m4_esyscmd(printf "$'1"'))m4_dnl
    $2''m4_dnl

    m4_popdef('CF_WITH_ENVAR')

...
This macro allows you to use environment expansion where it is not normally supported. Consider, for example, this fragment:

```c
component {
    CF_WITH_ENVAR('WORKDIR', 'chdir "WORKDIR";')
}
```

If you set `WORKDIR=/var/wd` prior to invoking `pies`, it will actually expand to

```c
component {
    chdir "/var/wd";
}
```

See Section 3.3.6 [Actions Before Startup], page 18, for details about the `chdir` statement.

**CF_IF_ENVAR name if-set if-unset**       [M4 macro]

If the environment variable `name` is defined and has a non-empty value, expand `if-set`, otherwise expand `if-unset`. Expand each occurrence of `name` in `if-set` to the actual value of the environment variable.

Following is the definition of this macro:

```c
m4_define('CF_IF_ENVAR',m4_dnl
     'CF_WITH_ENVAR('$1','m4_ifelse($1,'',$3,$2)')')
```

This macro makes it possible to conditionally enable configuration file fragments depending on whether some environment variable is defined. E.g.:

```c
CF_IF_ENVAR('LOGHOST',
component logger {
    command "syslogd -n -R LOGHOST;
}
')
```

Place both macros in a single file and include it at the top of your `pies.conf` using the `m4_include` command (see Section 3.2.1 [m4], page 10).

### 7.2 Using xenv

Another way to expand environment variables in the configuration file is to use `xenv`. `xenv` is a specialized preprocessor that expands environment variables in its input. It is also able to conditionally include parts of text depending on whether the environment variable is defined. The program is described in [https://www.gnu.org.ua/software/xenv/](https://www.gnu.org.ua/software/xenv/).

To use `xenv` as preprocessor, start `pies` as follows:

```bash
pies --foreground --stderr --preprocessor="xenv -s"
```

The `-s` option instructs `xenv` to emit synchronization lines, that inform `pies` about actual location of configuration statements in case when the expansion adds or removes portions of text spanning several lines.
You can also combine the functionality of m4 and xenv by running

pies --foreground --stderr --preprocessor="xenv -s -m"

In this case xenv will automatically feed its output to the standard input of m4, started for this purpose.

By default, xenv uses the shell syntax to expand the variables. For example, in the following configuration file fragment, ‘$WORKDIR’ will expand to the actual value of the WORKDIR environment variable:

```
component {
    chdir "$WORKDIR";
    ...
}
```

There are two ways to conditionally include portions of text. The first one is to use the ‘${X:+W}’ construct. For example:

```
component {
    ${WORKDIR:+chdir "$WORKDIR";}
    ...
}
```

Another way is to use the xenv ‘$$ifset’ (or ‘$$ifdef’) statement:

```
component {
    $$ifset WORKDIR
        chdir "$WORKDIR";
    $$endif
    ...
}
```

The difference between ‘$$ifset X’ and ‘$$ifdef X’ is the same as between ‘${X:+W}’ and ‘${X+W}’, i.e. ‘$$ifset’ tests whether the variable is set and not-null, and ‘$$ifdef’ tests only whether it is set, no matter its value.

xenv extends the shell syntax by providing a ternary operator. The construct ‘${X|A|B}’ expands to ‘A’ if the variable X is set and to ‘B’ otherwise (as usual, placing the colon before first ‘|’ checks if the variable is set and not null). This allows for writing compact conditionals:

```
component syslogd {
    mode respawn;
    command "/sbin/syslogd -n ${LOGHOST:|-R $LOGHOST|-O /proc/1/fd/1}"
}
```

In this example syslogd is instructed to relay messages to the IP address specified by the LOGHOST variable and to send messages to the container stdout otherwise.

Using shell indirection operator ‘$’ can be confusing in parts of pies configuration file that deal with environment variables by themselves. The common point of confusion is using env and command statements when shell or expandenv flag is set. For example:
component X {
  env {
    set "HOME=/var/lib/nobody";
  }
  flags shell;
  command "marb -C $HOME";
}

Here, the intent is to pass ‘/var/lib/nobody’ as the command line argument to marb. However, if pies was started with xenv as preprocessor, the reference ‘$HOME’ will be expanded by xenv at the early stage to whatever value the HOME variable had at pies startup. Consequently, when it comes to launching the ‘X’ component, the intended expansion won’t take place.

There are three options to handle such cases:

1. Escape the ‘$’

   Use backslash to suppress expansion by xenv:
   
   ```
   component X {
     env {
       set "HOME=/var/lib/nobody";
     }
     flags shell;
     command "marb -C \$HOME";
   }
   ```

2. Use the verbatim operator

   This allows to reproduce the desired part of text verbatim. There are two verbatim operators: inline operator ‘$[...]’ and block operator ‘$$verbatim ... $$end’. Examples:

   ```
   component X {
     env {
       set "HOME=/var/lib/nobody";
     }
     flags shell;
     $[command "marb -C $HOME"];  
   }
   ```

   or

   ```
   component X {
     env {
       set "HOME=/var/lib/nobody";
     }
     flags shell;
     $$verbatim
       command "marb -C $HOME"
     $$end
   }
   ```
3. Change the indirection operator

The indirection operator ‘$’ can be changed either globally, by using the -S option, or locally by using the ‘$$sigil’ statement. E.g.:

```
$$sigil @
# From this point on, $ looses its special meaning in xenv.
```

```plaintext
component X {
    env {
        set "HOME=/var/lib/nobody";
    }
    flags shell;
    command "marb -C $HOME @FILE";
}
```

In the command line of this example, @FILE will be expanded by xenv when processing the configuration file, and $HOME will be expanded by shell (to the value ‘/var/lib/nobody’, set by the env statement) when pies will start the command.
8 Configuration Examples

In this section we provide several examples of working pies configuration files.

8.1 Simplest Case: Using Pies to Run Pmult

The example below runs pmult (see Section “pmult” in Mailfromd Manual) utility with the privileges of ‘meta1’ user. Both standard error and standard output are redirected to the syslog facility ‘mail’, priorities ‘err’ and ‘info’, correspondingly.

```bash
component pmult {
    command "/usr/local/sbin/pmult";
    user meta1s;
    stderr syslog mail.err;
    stdout syslog mail.info;
}
```

8.2 Using Pies to Run Pmult and MeTA1

The example below is a working configuration file for running pmult and all components of MeTA1, configured in /etc/meta1/meta1.conf. The global return-code statement is used to configure pies behavior for some exit codes.

```bash
# Sample pies configuration for running pmult and MeTA1
#
# Special handling for exit codes that mean the program was
# incorrectly used or misconfigured.
return-code (EX_USAGE, EX_CONFIG) {
    action disable;
    notify "root";
    message <<- EOT
    From: Pies <>
    X-Agent: ${canonical_program_name} (${package} ${version})
    Subject: Component ${component} disabled.
    Component "${component}" has terminated with code ${retcode},
    which means it encountered some configuration problem.
    I will not restart it automatically. Please fix its configuration
    and restart it manually at your earliest convenience.
    To restart, run ‘${program_name} -R ${component}’
    ---
    Wuff-wuff,
    Pies
    EOT;
}
```

```bash
component pmult {
    command "/usr/local/sbin/pmult";
```
8.3 Running Pies as Inetd

This configuration file allows to run pies instead of initd. It starts two services: 'ftp' and 'pop3d', and restricts access to them to two local subnets:

```plaintext
acl {
    allow from 10.10.10.0/24;
    allow from 192.168.10.0/27;
    deny from any;
}

debug 3;

component ftp {
    mode inetd;
    socket "inet://0.0.0.0:21";
    umask 027;
    program /usr/sbin/ftpd
    command "ftpd -l -C";
}

component pop3d {
    mode inetd;
    socket "inet://0.0.0.0:110";
    program "/usr/sbin/pop3d"
    command "pop3d --inetd";
}
```

The following is almost equivalent configuration in inetd format:

```
ftp stream tcp nowait root /usr/sbin/ftpd ftpd -l -C
pop3 stream tcp nowait root /usr/sbin/pop3d pop3d --inetd
```

This configuration is “almost” equivalent, because the inetd format has no way of specifying ACLs and setting the umask.
9 Command Line Usage

When run without arguments, pies parses and loads the configuration file, detaches itself from the controlling terminal (becomes a daemon), and starts all components. Before actually starting up, it ensures that no another copy is already running, by looking for a PID file and verifying that the PID listed there is alive and responding. If another copy is running, pies refuses to start up.

It is often necessary to run several copies of pies with different configuration files. To support such usage, pies provides a notion of instance. Pies instance is an independent invocation of pies that uses a separate configuration file and separate state files (see Section 3.12 [State Files], page 40). Instances are created using the --instance option:

--instance=name
Read configuration from sysconfdir/name.conf, use name as the base name for state files (i.e., they become name.pid, name.clt, etc.) and tag all syslog messages with name.

For example, the following invocations create three instances of pies:

pies
pies --instance/inetd
pies --instance=mta

The first instance uses the default configuration and state files. The second one reads configuration from /etc/inetd.conf, and the third one reads it from /etc/mta.conf.

After startup, you can verify the status of the running process using the --status option.

$ pies --status
smtps/stderr R 4697
pmult/stderr R 4677
pmult/stdout R 4676

pmult CR 4678 /usr/local/sbin/pmult
smar CR 4680 smar -f /etc/meta1/meta1.conf -d 100
qmgr CR 4691 qmgr -f /etc/meta1/meta1.conf
smtpc CR 4696 smtpc -f /etc/meta1/meta1.conf
smtps PR 4698 smtps -d100 -f /etc/meta1/meta1.conf
finger IL inet+tcp://0.0.0.0:finger /usr/sbin/in.fingerd -u
eklogin IL inet+tcp://0.0.0.0:eklogin /usr/sbin/klogind -k -c -e
kshell IL inet+tcp://0.0.0.0:kshell /usr/sbin/kshd -k -c
eklogin IR 13836 /usr/local/sbin/klogind -k -c -e

See [piesctl list], page 44, for a description of the output format.

You can restart any component by using the --restart-component (-R) option, e.g.:

$ pies -R pmult smtps

To stop all running components and shut down pies, use the --stop (-S) command line option:

$ pies --stop

If you modified the configuration file, you can instruct pies to read it again using the --reload (-r) command line option.
The --status, --restart-component, --stop, and --reload options actually run the piesctl command, which provides a powerful tool for managing pies. See Chapter 5 [piesctl], page 43, for a detailed description.

Two options are provided for verifying inter-component dependencies. The --dump-depmap option prints on the standard output the dependency map. This map is a square matrix with rows representing dependents and columns representing prerequisites. An ‘X’ sign is placed on each crossing which corresponds to the actual dependency. For example:

```
$ pies --dump-depmap
Dependency map:
   0 1 2 3 4
  0
  1
  2 X
  3 X
  4 X X

Legend:
  0: pmult
  1: smar
  2: qmgr
  3: smtpc
  4: smtps
```

This example corresponds to the configuration file shown in Section 8.2 [Hairy Pies], page 63. To illustrate how to read it, consider the 4th row of the table. According to the legend, number 4 means ‘smtps’ component. There are two ‘X’ marks: in columns 1 and 2. This means that ‘smtps’ depends on ‘smar’ and ‘qmgr’.

You can also list prerequisites explicitly:

```
$ pies --trace-prereq
qmgr: smar
smtpc: qmgr
smtps: smar qmgr
```

To list prerequisites for a particular component, give its name in the command line:

```
$ pies --trace-prereq smtps
smtps: smar qmgr
```

Any number of components can be given in the command line.

A counterpart option --trace-depend lists dependencies. Its usage is similar to the described above:

```
$ pies --trace-depend
smtps
smtpc
qmgr: smtps, smtpc
smar: smtps, qmgr
$ pies --trace-depend qmgr
qmgr: smtps, smtpc
```
10 Pies Invocation

This section summarizes pies command line options.

--config-file=file
-c file  Read configuration from file, instead of the default /etc/pies.conf.
See Chapter 3 [Configuration], page 5.

--config-help
Show configuration file summary. See Chapter 3 [Configuration], page 5.

--define=sym[=value]
-D symbol[=value]
Define symbol sym as having value, or empty, if the value is not given. See
Section 3.2 [Preprocessor], page 8.

--debug=level
-x level  Set debug verbosity level. See Chapter 4 [Pies Debugging], page 41, for a
description of level.

--dump-depmap
Dump dependency map. See [dump-depmap], page 66.

-E
Preprocess configuration file and exit. See Section 3.2 [Preprocessor], page 8.

--force
Force startup even if another instance may be running.

--foreground
Remain in foreground.

--help
Display a short usage summary and exit.

--inetd
-i Run in inetd-compatibility mode. It is roughly equivalent to pies
--instance/inetd --syntax/inetd. See Section 3.8 [inetd], page 36.

--include-directory=dir
-I dir  Add directory dir to the list of directories to be scanned for preprocessor include
files.

--instance=name
Define the name of the pies instance. See [instances], page 65.

--lint
-t

--no-init
Don’t assume init mode (see Chapter 6 [Init Process], page 51) if running with
PID 1. See Chapter 7 [Docker Entrypoint], page 57.

--list-shutdown-sequence
List components in order of shutdown sequence. Each line lists the sequence
stage number and the component name. See [shutdown sequence], page 39, for
a detailed discussion of its meaning.
--no-preprocessor
Disable the use of the external preprocessor.
See Section 3.2 [Preprocessor], page 8.

--preprocessor=cmd
Use the command cmd as the external preprocessor, instead of the default m4.
See Section 3.2 [Preprocessor], page 8.

--source-info
Show source info with debugging messages. See [source-info], page 41.

--status
-s Start piesctl list to obtain information about the running processes. See [piesctl list], page 44.

--stderr
Log to standard error.

--stop
-S Stop the running instance. This is equivalent to running piesctl shutdown.

--syntax=type
Define the syntax for parsing the configuration files specified by any --config-file options that follow this one. Possible values for type are:

pies Native pies configuration. See Chapter 3 [Configuration], page 5.
inetd ‘Inetd’-style configuration files. See [inetd.conf], page 71.
meta1 ‘meta1’-style configuration files. See Section 3.9 [include-meta1], page 37.
inittab ‘Inittab’ file. See Chapter 6 [Init Process], page 51.

See [config syntax], page 5, for a detailed description of this option.

--syslog
Log to syslog. This is the default.

--telinit
-t Emulate the telinit legacy interface. The rest of command line following this option is processed as telinit options. See Section 6.6 [telinit command], page 56, for a detailed description of these.

--trace-depend
List dependencies for components named in the command line. Without arguments, dependencies for each component are listed. See [trace-depend], page 66.

--trace-prereq
List prerequisites for components named in the command line. Without arguments, prerequisites for each component are listed. See [trace-prereq], page 66.

--rate=r
Set maximum connection rate (connections per second) for inetd-style components. See [inetd component rate], page 22.

-r
--reload
--hup Reread the configuration files. This is equivalent to running piesctl config reload (see [config reload], page 44).
-R
--restart-component
Restart components named in the command line. See [pies-restart], page 65.

--version
Display program version and license information and exit.

--undefine=sym
-U sym Undefine symbol sym. See Section 3.2 [Preprocessor], page 8.

--usage Display a short summary of available options and exit.
11 How to Report a Bug

Send bug-reports and suggestions to bug-pies@gnu.org.ua.

If you think you’ve found a bug, please be sure to include maximum information needed to reliably reproduce it, or at least to analyze it. The information needed is:

- Version of the package you are using.
- Compilation options used when configuring the package.
- Run-time configuration (pies.conf file and the command line options used).
- Detailed description of the bug.
- Conditions under which the bug appears.
Appendix A  Inetd.conf Format

This appendix describes the format of inetd compatible configuration files. See Section 3.8 [inetd], page 36, for the discussion on how to use such files with GNU pies.

The inetd configuration file has line oriented format. Comments are denoted by a ‘#’ at the beginning of a line. Empty lines and comments are ignored. Each non-empty line must be either a service definition, or address specification.

Service definition consists of at least 6 fields separated by any amount of the white space. These fields are described in the following table (optional parts are enclosed in square brackets):

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[service-node:]service-name</td>
<td>The service-name entry is the name of a valid service in the file /etc/services. For built-in services (see Section 3.3.9.1 [builtin], page 23), the service name must be the official name of the service (that is, the first entry in /etc/services), or a numeric representation thereof. For TCPMUX services, the value of the 'service name' field consists of the string ‘tcpmux’ followed by a slash and the locally-chosen service name (see Section 3.3.9.2 [TCPMUX], page 24). Optionally, a plus sign may be inserted after the slash, indicating that pies must issue a ‘+’ response before starting this server. The ‘service-name’ part corresponds to component tag in pies.conf (see Section 3.3 [Component Statement], page 10). For built-in components, it corresponds to the service statement (see Section 3.3.9.1 [builtin], page 23).</td>
</tr>
<tr>
<td>socket type</td>
<td>The socket type should be one of ‘stream’, ‘dgram’, ‘raw’, ‘rdm’, or ‘seqpacket’. TCPMUX services must use ‘stream’. This field corresponds to the socket-type statement in pies.conf. See [socket-type], page 22.</td>
</tr>
<tr>
<td>protocol</td>
<td>The protocol must be a valid protocol as given in /etc/protocols. Examples might be ‘tcp’ or ‘udp’. TCPMUX services must use ‘tcp’.</td>
</tr>
</tbody>
</table>

Optional ‘service-node’ prefix is allowed for internet services. When present, it supplies the local addresses inetd should listen on for that service. ‘Service-node’ consists of a comma-separated list of addresses. Both symbolic host names and numeric IP addresses are allowed. Symbolic hostnames are looked up in DNS service. If a hostname has multiple address mappings, a socket is created to listen on each address. A special hostname ‘*’ stands for INADDR_ANY.
The ‘service-node’ prefix and ‘socket-type’ field correspond to the socket statement in pies.conf. See [inetd-socket], page 21.

For example, the following line:

    10.0.0.1:ftp dgram udp wait root ftppd

is equivalent to

    socket inet+udp://10.0.0.1:ftp;
    socket-type dgram;

wait/nowait[.max-rate]

The ‘wait/nowait’ entry specifies whether the invoked component will take over the socket associated with the service access point, and thus whether pies should wait for the server to exit before listening for new service requests. Datagram servers must use ‘wait’, as they are always invoked with the original datagram socket bound to the specified service address. These servers must read at least one datagram from the socket before exiting. If a datagram server connects to its peer, freeing the socket so that pies can go on receiving further messages from the socket, it is said to be a multi-threaded server; it should read one datagram from the socket and create a new socket connected to the peer. It should fork, and the parent should then exit to allow pies to check for new service requests to spawn new servers. Datagram servers which process all incoming datagrams on a socket and eventually time out are said to be single-threaded. Examples of such servers are comsat and talkd. tftpd is an example of a multi-threaded datagram server.

Servers using stream sockets generally are multi-threaded and use the ‘nowait’ entry. Connection requests for these services are accepted by pies, and the server is given only the newly-accepted socket connected to a client of the service. Most stream-based services and all TCPMUX services operate in this manner. For such services, the invocation rate may be limited by specifying optional ‘max-rate’ suffix (a decimal number), e.g.: ‘nowait.15’.

Stream-based servers that use ‘wait’ are started with the listening service socket, and must accept at least one connection request before exiting. Such a server would normally accept and process incoming connection requests until a timeout. Datagram services must use ‘nowait’. The only stream server marked as ‘wait’ is identd (see Section “identd” in identd manual).

user

The user entry contains the name of the user as whom the component should run. This allows for components to be given less permission than root.

This corresponds to the user statement in pies.conf. See Section 3.3.2 [Component Privileges], page 14.
Appendix A: \texttt{Inetd.conf} Format

program

The program entry contains the full file name of the program which is to be executed by \texttt{pies} when a request arrives on its socket. For built-in services, this entry should be \texttt{internal}.

It is common usage to specify \texttt{/usr/sbin/tcpd} in this field.

This field corresponds to the \texttt{program} statement in \texttt{pies.conf}. See Section 3.3 [Component Statement], page 10.

server program arguments

The server program arguments should be just as arguments normally are, starting with \texttt{argv[0]}, which is the name of the program. For built-in services, this entry must contain the word \texttt{internal}, or be empty.

This corresponds to the \texttt{command} statement. See Section 3.3 [Component Statement], page 10.

\textsl{Address specification} is a special statement that declares the \texttt{service-node} part (see above) for all the services declared below it. It consists of a host address specifier followed by a colon on a single line, e.g.:

\begin{verbatim}
127.0.0.1,192.168.0.5:
\end{verbatim}

The address specifier from such a line is remembered and used for all further lines lacking an explicit host specifier. It remains in effect until another address specification or end of the configuration is encountered, whichever occurs first.

The following address specification:

\begin{verbatim}
*
\end{verbatim}

causes any previous default address specifier to be forgotten.

An example of \texttt{inetd.conf} file with various services follows:

\begin{verbatim}
ftp stream tcp nowait root /usr/libexec/ftpd ftpd -l
ntalk dgram udp wait root /usr/libexec/ntalkd ntalkd
tcpmux stream tcp nowait root internal
tcpmux/+scp-to stream tcp nowait guest /usr/sbin/in.wydawca wydawca
tcpmux/docref stream tcp nowait guest /usr/bin/docref docref
\end{verbatim}
Appendix B User-Group ACLs

This appendix describes the ‘user-group’ extension for GNU Pies ACLs. This extension is reserved for the future use.

The user-group ACL statement specifies which users match this entry. Allowed values are the following:

- **all** All users.
- **authenticated** Only authenticated users.
- **group group-list** Authenticated users which are members of at least one of groups listed in group-list.

For example, the following statement defines an ACL which allows access for any user connected via local UNIX socket /tmp/pies.sock or coming from a local network ‘192.168.10.0/24’. Any authenticated users are allowed, provided that they are allowed by another ACL ‘my-nets’ (which should have been defined before this definition). Users coming from the network ‘10.10.0.0/24’ are allowed if they authenticate themselves and are members of groups ‘pies’ or ‘users’. Access is denied for anybody else:

```plaintext
acl {
    allow all from (/tmp/pies.sock, "192.168.10.0/24");
    allow authenticated acl "my-nets";
    allow group ("pies", "users") from "10.10.0.0/24";
    deny all;
}
```
Appendix C Control API

This appendix describes control API used to communicate with the running pies daemon via the control interface (see Section 3.6 [control], page 33). This API is used by piesctl (see Chapter 5 [piesctl], page 43).

The API is designed as a REST service and uses HTTP. Queries are sent to pies endpoints, each of which serves a distinct purpose. Data are serialized using the JSON format.

The sections below describe in detail each endpoint and associated with it request types.

C.1 /instance

This endpoint controls the state of the running pies instance and accepts the following HTTP requests: GET, DELETE, POST (or PUT).

GET /instance
Retrieves information about the current instance. The response body is a JSON object with the following attributes:

- ‘PID’ PID of the running daemon.
- ‘argv’ Array of the command line arguments. ‘argv[0]’ is the program name.
- ‘binary’ Name of the pies binary.
- ‘instance’ The instance name. See instances, page 65.
- ‘package’ Package name (the string ‘GNU Pies’).
- ‘version’ Package version

Any of these can be used in the URI to request the information about that particular attribute, e.g.:

GET /instance/argv ⇒ {"argv":"pies", "-x2"}

DELETE /instance/PID
Stops the current pies instance.

PUT /instance/PID
Restart the current pies instance.

POST /instance/PID
Restart the current pies instance.

C.2 /conf

The ‘/conf’ endpoint allows the client to inspect and change the configuration of the running pies instance.

C.2.1 /conf/files

GET /conf/files
Return list of configuration files. On success, a JSON array is returned. Each array element is an object with two attributes:
string file
   Pathname of the configuration file.

string syntax
   Configuration file syntax (see Section 3.1 [Syntax], page 6).

For example:
   GET /conf/files ⇒
   ["file":"/etc/pies.conf", "syntax":"pies"],
   {"file":"/etc/inetd.conf", "syntax":"inetd"}]

POST /conf/files
   Adds a new configuration file. The body must be a JSON object with 'file' and 'syntax' attributes, as described above. The 'file' value must contain a pathname of a configuration file written in a syntax supplied by the 'syntax' attribute (see Section 3.1 [Syntax], page 6).

   This request returns 201 code on success. To actually parse and load the added configuration file, send a 'PUT' request to '/conf/runtime' (see Section C.2.2 [/conf/runtime], page 80).

DELETE /conf/files/true
   Clears all previously configured configuration files. Responds with:
       
   DELETE /conf/files/[list]
   Removes files named in the list from the list of configuration files.

   The 'DELETE' response is 200 on success. To actually update the configuration of the running process, send a 'PUT' request to '/conf/runtime' (see Section C.2.2 [/conf/runtime], page 80).

C.2.2 /conf/runtime
   This is a write-only URI. The only request supported is 'PUT /conf/runtime'. It initiates reloading of the pies configuration. Usually, this request is sent after one or more 'POST' and/or 'DELETE' requests to '/conf/files', in order to finalize the changes applied to the configuration.

C.3 /programs
   A request sent to this URI selects one or more components and applies operation defined by the request type to all of them.

   Components are selected using a query in the form of JSON object (a selector). Valid selectors are:
   
   'null'
   'false'  Matches nothing.
   'true'    Matches all components.
   '{ "op": "component", "arg": tag }'
       Matches component with the given tag (see [tag], page 10).
Appendix C: Control API

`{ "op": "type", "arg": "component" }`
Matches all components.

`{ "op": "type", "arg": "command" }`
Matches all commands.

`{ "op": "mode", "arg": mode }`
Matches all components with the given mode. See [component mode], page 11.

`{ "op": "active" }`
Matches all active components.

`{ "op": "status", "arg": status }`
Matches all components with the given status (one of ‘stopped’, ‘running’, ‘listener’, ‘sleeping’, ‘stopping’, ‘finished’). See [component status], page 82, for a discussion of these values.

`{ "op": "not", "arg": condition }`
Negates condition, which is any valid selector.

`{ "op": "and", "arg": array }`
Returns the result of logical conjunction on the array of selectors.

`{ "op": "or", "arg": array }`
Returns the result of logical disjunction on the array of selectors.

For example, the following selector matches all components that are in ‘running’ state, excepting components of ‘inetd’ mode:

```json
{ "op": "and",
  "arg": [ { "op": "type", "arg": "component" },
           { "op": "not", "arg": { "op": "mode", "arg": "inetd" } } ]
}
```

The following requests are supported:

GET /programs?selector [Request]
GET /programs/tag [Request]

This request returns information about components matched by selector (see below for the ‘/programs/tag variant’. The response is a JSON array of descriptions. If no component matches the selector, empty array is returned. Each description is a JSON object with the following attributes:

**string type** [Attr]
Type of the described entity: ‘component’ for an instance of a configured component, and ‘command’ for a command run as a part of exit action (see Section 3.3.7 [Exit Actions], page 19), including mailer invocations (see Section 3.4 [Notification], page 30).

**string mode** [Attr]
Mode of the entity. See [component mode], page 11.
string status  
Entity status. Possible values are:
- finished A ‘once’ or ‘startup’ component has finished.
- listener Component is an inetd listener.
- running Component is running.
- sleeping Component has been put to sleep because of excessive number of failures (see [respawn], page 1).
- stopped Component is stopped.
- stopping Component is being stopped (a SIGTERM was sent).

boolean active  
Whether this component is active. By default, all components are active, unless marked with a ‘disable’ flag (see [flags], page 12) or administratively stopped.

integer PID  
PID of the running process.

string URL  
(for ‘inetd’ components) URL of the socket the component is listening on.

string service  
(for ‘tcpmux’ components) TCMUX service name. See Section 3.3.9.2 [TCP-MUX], page 24.

string master  
(for ‘tcpmux’ components) Tag of master TCMUX component. See Section 3.3.9.2 [TCPMUX], page 24.

string runlevels  
For inittab components, the string of runlevels this component is configured to run in. See Chapter 6 [Init Process], page 51.

integer wakeup-time  
If component is in the ‘sleeping’ state, this attribute gives the number of seconds after which an attempt will be made to restart it.

array argv  
Component command line split into words.

string command  
Component command.

DELETE /programs?selector  
Delete components matched by the selector. On success returns:

{ "status": "OK" }

On failure, returns

{ "status": "ER", "message": text }

where text is a textual human-readable description of the failure.
PUT /programs?selector  [Request]
PUT /programs/tag  [Request]
  Start components matched by selector.
POST /programs  [Request]
  Restart components. The selector is supplied in the request content.

Wherever a selector is passed via query parameters, a simplified form with component tag passed as query path is also allowed. For example:

GET /programs/tag

is a shortcut for:

{ "op":"and",
  "arg": [ {"op":"type", "arg":"component"},
            {"op":"component", "arg":tag } ] }

C.4 /alive

This entry point accepts only ‘GET’ requests. The URI must not be empty and must not include sub-directories (parts separated with slashes). It is treated as the name of the component to return the status of. E.g. querying ‘/alive/foo’ returns the status of the component named ‘foo’. The status is returned as HTTP status code:

200  The component is up and running. For regular components that means that the corresponding program is running. For ‘inetd’ components that means that the listener is listening on the configured socket.
403  No component specified.
404  There is no such component.
503  The component is not running. This means that it has failed, or has been stopped administratively or (for ‘once’ and ‘startup’ components) that it has run once and finished.

If the component has failed, the ‘Retry-After:’ HTTP header contains the number of seconds after which pies will retry starting this component.

C.5 /runlevel

This URI is active when pies runs as init process (see Chapter 6 [Init Process], page 51). It supports two requests:

GET /runlevel  [Request]
  Returns the current state of the program as a JSON object with the following attributes:

  string runlevel  [Attr]
    Current runlevel. See Section 6.1 [Runlevels], page 52.

  string prevlevel  [Attr]
    Previous runlevel (‘N’ if none).
string bootstate
  Boot state. See [startup states], page 51.

string initdefault  
  Default runlevel.

PUT /runlevel/{"runlevel":L}  
  Initiates transition from the current runlevel to runlevel L (see Section 6.1 [Runlevels], page 52).

C.6 /environ

This URI is active when pies runs as init process (see Chapter 6 [Init Process], page 51). It manipulates the program initial environment, i.e. the environment that all programs inherit. See Section 6.4 [Init Environment], page 55.

GET /environ/  
  Returns entire environment formatted as a JSON array of strings. On success, the 200 response is returned:
  
  ["RUNLEVEL=3", "CONSOLE=/dev/tty", ...]

GET /environ/var  
  Returns the value of the environment variable var, if such is defined. On success, the 200 response carries the object:
  
  { "status":"OK", "value":string }

  If the variable var is not defined, a 404 response is returned. On error, a 403 response is returned. In both cases, the response body is the usual pies diagnostics object:
  
  { "status":"ER", "message":text }

DELETE /environ/var  
  Deletes from the environment the variable var. On success, responds with HTTP 200:
  
  { "status":"OK" }

  Error responses are the same as for ‘GET’.

PUT /environ/name=value  
  Initializes environment variable name to value. See ‘GET’ for the possible responses.
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Concept Index

This is a general index of all issues discussed in this manual

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