

sendmail  
*Second Edition*

Bryan Costales  
*with Eric Allman*

**O'REILLY\***  
*Beijing • Cambridge • Koln • Paris • Sebastopol • Taipei • Tokyo*

# Table of Contents

<i>Preface</i> .....	<i>xv</i>
<i>1: A Tutorial</i> .....	<i>/</i>
<i>1: Introduction</i> .....	<i>3</i>
1.1 MUA Versus MTA.....	4
1.2 Why Is sendmail So Complex?.....	4
1.3 Three Important Parts.....	5
1.4 Run sendmail by Hand.....	6
1.5 The Header.....	8
1.6 The Body.....	8
1.7 The Envelope.....	9
1.8 Things to Try.....	10
<i>2: Have a V8</i> .....	<i>13</i>
2.1 Get the Source.....	13
2.2 Read the Documents.....	14
2.3 What's What in src.....	15
2.4 Preliminaries.....	16
2.5 Build.....	19
2.6 Test It.....	20
2.7 Things to Try.....	21

3:	<i>The Roles of sendmail</i> .....	23
3.1	Role in the Filesystem.....	23
3.2	Role in Local Delivery.....	27
3.3	Role in Network Transport.....	29
3.4	Role as a Daemon.....	30
3.5	Things to Try.....	31
4:	<i>How to Run sendmail</i> .....	33
4.1	Become a Mode (-b).....	34
4.2	Verbose (-v).....	39
4.3	Debugging (-d).....	43
4.4	Things to Try.....	44
5:	<i>The sendmailcf File</i> .....	47
5.1	Overview.....	47
5.2	The Minimal File.....	49
5.3	A Quick Tour.....	50
5.4	Things to Try.....	55
6:	<i>The Mail Hub and Delivery Agents</i> .....	57
6.1	The client.cf File.....	59
6.2	Define a Mail Delivery Agent.....	59
6.3	The local Delivery Agent.....	61
6.4	Add the Missing Parts to Mhub.....	66
6.5	Things to Try.....	67
7:	<i>Macros</i> .....	69
7.1	Overview.....	69
7.2	Defining Macros.....	71
7.3	Predefined Macros.....	72
7.4	Things to Try.....	75
8:	<i>Addresses and Rules</i> .....	77
8.1	A Fictional Network.....	77
8.2	Why Rules?.....	81
8.3	Rule Sets.....	83
8.4	Rules.....	85
8.5	The Workspace.....	86
8.6	The Flow of Addresses Through Rules.....	87

<i>Table</i>	<i>of</i>	<i>Contents</i>	<i>vii</i>
8.7	Wildcard Operators.....		89
8.8	Things to Try.....		94
<b>9:</b>	<b><i>Rule Set 0</i></b> .....		<b>95</b>
9.1	Introducing Rule Set 0.....		96
9.2	The RHS Triple.....		96
9.3	Testing Rule Set 0.....		99
9.4	The error Delivery Agent.....		100
9.5	Things to Try.....		101
<b>10:</b>	<b><i>Rule Set 3</i></b> .....		<b>103</b>
10.1	Why Preprocess?.....		104
10.2	Rule Set 3.....		105
10.3	Missing Addresses.....		108
10.4	Nested Angle Brackets.....		109
10.5	Details of Rule Flow.....		111
10.6	Things to Try.....		113
<b>//:</b>	<b><i>Rule Sets 1 and S=</i></b> .....		<b>115</b>
11.1	Flow of the Sender's Address.....		115
11.2	Rule Set S=.....		116
11.3	All Mail from the Hub.....		117
11.4	Rule Set Hubset.....		117
11.5	Testing So Far.....		120
11.6	Handling user@thishost.....		121
11.7	Rule Set 1.....		123
11.8	Things to Try.....		124
<b>12:</b>	<b><i>Class</i></b> .....		<b>127</b>
12.1	The Class Command.....		128
12.2	The File Form of Class.....		135
12.3	Things to Try.....		138
<b>13:</b>	<b><i>Setting Options</i></b> .....		<b>139</b>
13.1	Options: An Overview.....		139
13-2	Required Options.....		140
13-3	Testing the Options.....		146
13.4	Sending Mail.....		147
13.5	Things to Try.....		148

---

<i>14: Headers, Precedence, and Trust</i> .....	<i>149</i>
14.1 Headers.....	149
14.2 Headers Versus Delivery Agent Flags.....	153
14.3 Headers Learned So Far.....	155
14.4 Precedence.....	156
14.5 Sending Real Mail.....	157
14.6 Trusted User.....	158
14.7 Things to Try.....	159
<i>15: Install and Test the client.cf File</i> .....	<i>161</i>
15.1 Test the Configuration File.....	161
15.2 The Real Queue Directory.....	163
15.3 MX Records.....	164
15.4 Hub Accepts Mail for Client.....	166
15.5 Prevent the Daemon from Running.....	169
15.6 Install the client.cf File.....	170
15.7 Things to Try.....	171
<i>16: The nullmc File and m4</i> .....	<i>173</i>
16.1 The cf/cf Directory.....	173
16.2 The null.mc File.....	174
16.3 Run m4.....	175
16.4 Test the Result.....	176
16.5 Qualify All Addresses?.....	177
16.6 Things to Try.....	178
<i>17: The Hub's Complex Rules</i> .....	<i>179</i>
17.1 Rule Set 3.....	180
17.2 Rule Set 96.....	185
17.3 Rule Set 0.....	187
17.4 Rule Set 4.....	188
17.5 Things to Try.....	189
<i>//: Build and Install</i> .....	<i>191</i>
<i>18: Compile and Install sendmail</i> .....	<i>193</i>
18.1 To Use or Not to Use.....	193
18.2 Vendor Versus Compiling.....	194
18.3 Obtain the Source.....	195

18.4	Tuning Makefile.....	198
18.5	Run Make.....	203
18.6	Install sendmail.....	204
18.7	Pitfalls.....	205
18.8	Alphabetized Reference.....	206
<b>19: V8 m4 Configuration.....</b>		<b>241</b>
19-1	The m4 Preprocessor.....	241
19.2	Build with m4.....	244
19-3	The Minimal me File.....	246
19-4	m4 Macros by Function.....	251
19.5	Pitfalls.....	256
19-6	Alphabetized m4 Macros.....	256
<b>20: The checkcompatQ Cookbook.....</b>		<b>285</b>
20.1	How checkcompatO Works.....	286
20.2	The Cookbook.....	288
20.3	Alphabetized V8.8 Subroutines.....	297
<b>III: Administration</b>		<b>303</b>
<b>21: DNS and sendmail.....</b>		<b>305</b>
21.1	Overview.....	305
21.2	How sendmail Uses DNS.....	309
21.3	Set Up MX Records.....	314
21.4	How to Use nslookup.....	320
21.5	Prepare for Disaster.....	322
21.6	Pitfalls.....	326
<b>22: Security.....</b>		<b>327</b>
22.1	Why root?.....	327
22.2	The Environment.....	329
22.3	SMTP Probes.....	330
22.4	The Configuration File.....	333
22.5	Permissions.....	338
22.6	The Aliases File.....	343
22.7	Forged Mail.....	344
22.8	Security Features.....	347
22.9	Pitfalls.....	355

<b>23: <i>The Queue</i></b> .....	<b>357</b>
23.1 Overview of the Queue.....	358
23.2 Parts of a Queued Message.....	359
23.3 A Bogus qf File (V8 only): Qf.....	364
23.4 Printing the Queue.....	366
23.5 How the Queue Is Processed.....	369
23.6 Cause the Queue to Be Processed.....	371
23.7 Process Alternate Queues.....	376
23.8 Pitfalls.....	378
23.9 The qf File Internals.....	379
<b>24: <i>Aliases</i></b> .....	<b>393</b>
24.1 The aliases(5) File.....	393
24.2 Forms of Alias Delivery.....	397
24.3 Write a Delivery Agent Script.....	402
24.4 Special Aliases.....	404
24.5 The Aliases Database.....	408
24.6 Prevent Aliasing with -n.....	411
24.7 Pitfalls.....	413
<b>25: <i>Mailing Lists and %forward</i></b> .....	<b>415</b>
25.1 Internal Mailing Lists.....	415
25.2 include: Mailing Lists.....	416
25.3 Defining a Mailing List Owner . . . •.....	420
25.4 Exploder Mailing Lists.....	421
25.5 Problems with Mailing Lists.....	422
25.6 Packages That Help.....	425
25.7 The User's V.forward File.....	426
25.8 Pitfalls.....	432
<b>26: <i>Logging and Statistics</i></b> .....	<b>435</b>
26.1 Logging with syslog.....	435
26.2 Statistics.....	446
26.3 Signaling the Daemon.....	449
26.4 Log Transactions with -X.....	453
26.5 Pitfalls.....	454

<b>IV:Reference</b> .....	<b>457</b>
<b>27: The Configuration File</b> .....	<b>459</b>
27.1 Overall Syntax.....	460
27.2 Comments.....	461
27.3 V8 Comments.....	461
27.4 Continuation Lines.....	462
27.5 The V Configuration Command.....	462
27.6 Pitfalls.....	464
<b>28: Rules</b> .....	<b>465</b>
28.1 Overview.....	465
28.2 Tokenizing Rules.....	469
28.3 The Workspace.....	472
28.4 The Behavior of a Rule.....	472
28.5 The LHS.....	473
28.6 The RHS.....	475
28.7 Pitfalls.....	486
<b>29: Rule Sets</b> .....	<b>487</b>
29.1 The S Configuration Command.....	487
29.2 Rule Sets and m4.....	492
29.3 The Sequence of Rule Sets.....	494
29.4 Rule Set 3.....	496
29.5 Rule Set 4.....	500
29.6 Rule Set 0.....	501
29.7 Rule Set 5.....	505
29.8 Rule Set 2.....	506
29.9 Rule Set 1.....	507
29.10 The check_... Rule Sets.....	507
29.11 Pitfalls.....	513
<b>30: Delivery Agents</b> .....	<b>515</b>
30.1 Configuration File Syntax.....	515
30.2 The Symbolic Name.....	516
30.3 m4 Configuration Syntax.....	517
30.4 The Equates.....	519
30.5 Internally Defined Names.....	538
30.6 How Executed.....	542

30.7	Pitfalls.....	544
30.8	Alphabetized F= Flags.....	545
<b>31:</b>	<b>Defined Macros.....</b>	<b>569</b>
31.1	Preassigned Macros.....	570
31.2	Command-Line Definitions.....	570
31.3	Configuration File Definitions.....	572
31.4	Macro Names.....	574
31.5	Macro Expansion: \$ and \$&.....	576
31.6	Macro Conditionals: \$?, \$ I, and \$.....	580
31.7	Categories of Macros.....	581
31.8	Macros with the m4 Technique.....	582
31.9	Pitfalls.....	583
31.10	Alphabetized Reference.....	584
<b>32:</b>	<b>Class Macros.....</b>	<b>609</b>
32.1	Class Configuration Commands.....	609
32.2	Access Class in Rules.....	613
32.3	Class with m4.....	617
32.4	Pitfalls.....	618
32.5	Alphabetized Reference.....	619
<b>33-</b>	<b>Database Macros.....</b>	<b>625</b>
33.1	Enable at Compile Time.....	626
33.2	Create Files with makemap.....	627
33.3	The K Configuration Command.....	630
33.4	Use Maps with \$( and \$) in Rules.....	638
33.5	The User Database.....	642
33.6	Database Maps and m4.....	645
33.7	Pitfalls.....	646
33-8	Alphabetized Reference.....	647
<b>34:</b>	<b>Options.....</b>	<b>663</b>
34.1	Command-Line Options.....	664
34.2	Configuration-File Options.....	667
34.3	Configuring with V8 m4 Options.....	668
34.4	Alphabetical Table of All Options.....	671
34.5	Option Argument Types.....	673
34.6	Interrelating Options.....	676

34.7	Pitfalls.....	679
34.8	Alphabetized Reference.....	680
<b>35:</b>	<b><i>Headers</i></b> .....	<b>773</b>
35.1	The H Configuration Command.....	773
35.2	Header Names.....	775
35.3	Header Field Contents.....	776
35.4	?flags? in Header Definitions.....	780
35.5	Header Behavior in conf.c.....	781
35.6	Headers by Category.....	784
35.7	Forwarding with Resent-Headers.....	788
35.8	Precedence.....	790
35.9	Pitfalls.....	791
35.10	Alphabetized Reference.....	792
<b>36:</b>	<b><i>The Command Line</i></b> .....	<b>811</b>
36.1	Alternative argv[0] Names.....	811
36.2	Command-Line Switches.....	815
36.3	List of Recipient Addresses.....	817
36.4	Processing the Command Line.....	817
36.5	sendmail's exit() Status.....	819
36.6	Pitfalls.....	827
36.7	Alphabetized Reference.....	828
<b>37:</b>	<b><i>Debugging with -d</i></b> .....	<b>845</b>
37.1	The Syntax of -d.....	845
37.2	Debugging Behavior.....	847
37.3	Interpreting the Output.....	847
37.4	Pitfalls.....	850
37.5	Reference in Numerical Order.....	850
<b>38:</b>	<b><i>Rule-Set Testing with -bt</i></b> .....	<b>949</b>
38.1	Overview.....	949
38.2	Configuration Lines.....	951
38.3	Dump a Macro.....	953
38.4	Show an Item.....	955
38.5	Complex Actions Made Simple.....	957
38.6	Process-Specified Addresses.....	966
38.7	Add Debugging for Detail.....	970

38.8	Batch Rule-Set Testing.....	971
38.9	Pitfalls.....	972
<b><i>V: Appendixes.....</i></b>		<b><i>973</i></b>
<b><i>A:</i></b>	<b><i>The client.cf File.....</i></b>	<b><i>975</i></b>
<b><i>B:</i></b>	<b><i>Host Status File Internals.....</i></b>	<b><i>977</i></b>
<b><i>C:</i></b>	<b><i>The Berkeley DB Database.....</i></b>	<b><i>981</i></b>
<b><i>D:</i></b>	<b><i>Sun Enhancements.....</i></b>	<b><i>985</i></b>
	<b><i>Bibliography.....</i></b>	<b><i>991</i></b>
	<b><i>Index.....</i></b>	<b><i>997</i></b>