
CONTENTS

1	Introduction.....	1
	<i>S. Mauw & G.J. Veltink</i>	
1.1	Aim and Scope.....	1
1.2	Formal Methods.....	2
1.3	Computer Networks.....	3
1.3.1	LANs & WANs.....	4
1.3.2	Network Structure.....	4
1.3.3	OSI Reference Model.....	4
1.3.4	Terminology.....	6
1.4	Overview.....	6
1.5	Bibliographical Notes.....	7
2	Algebraic Specifications in PSF.....	9
	<i>G.J. Veltink</i>	
2.1	Introduction.....	9
2.2	ACP.....	9
2.3	The History of PSF.....	10
2.4	PSF: Syntax and Semantics.....	11
2.4.1	Basic Operators.....	11
2.4.1.1	Action Relations.....	11
2.4.1.2	The Example.....	12
2.4.1.3	Identifier Names, Lexical Conventions.....	12
2.4.1.4	Comments.....	12
2.4.1.5	Atoms & Processes.....	13
2.4.1.6	Deadlock.....	14
2.4.1.7	Sequential Composition.....	14
2.4.1.8	Recursion.....	14
2.4.1.9	Alternative Composition.....	15
2.4.1.10	Integrating Components.....	16

Cambridge University Press

978-0-521-08812-1 - Algebraic Specification of Communication Protocols

Edited by S. Mauw and G. J. Veltink

Table of Contents

[More information](#)

vi

Contents

2.4.1.11	Sets.....	17
2.4.1.12	Communication.....	17
2.4.1.13	Parallel Composition.....	17
2.4.1.14	Encapsulation.....	18
2.4.1.15	The Internal Step.....	18
2.4.1.16	Abstraction.....	19
2.4.1.17	Summary of the Process Part of PSF.....	20
2.4.2	Modularization.....	20
2.4.2.1	Modules.....	21
2.4.2.2	Exports.....	21
2.4.2.3	Hidden Objects.....	22
2.4.2.4	Importing Modules & Renaming Objects.....	22
2.4.3	Data Modules & Parameterization.....	24
2.4.3.1	Sorts & Functions.....	24
2.4.3.2	Equations.....	25
2.4.3.3	Initial Algebra Semantics.....	25
2.4.3.4	Parameterization of Actions and Processes.....	26
2.4.3.5	Overloading of Identifiers.....	27
2.4.3.6	Variables.....	28
2.4.3.7	Generalized Alternative and Parallel Composition.....	28
2.4.3.8	Parameterization of a Module.....	29
2.4.3.9	Conditional Expressions.....	30
2.4.3.10	Binding of Parameters.....	31
2.5	The PSF Standard Library.....	33
2.5.1	Booleans.....	34
2.5.2	Naturals.....	34
2.5.3	Bits.....	34
2.5.4	Queues.....	35
2.5.5	Tables.....	35
2.5.6	Data.....	36
2.6	The PSF-Toolkit.....	36
2.6.1	The PSF Compiler.....	38
2.6.2	Term Rewriting.....	38
2.6.3	The Term Rewriter.....	39
2.6.4	The Simulator.....	40
2.6.5	The Proof Assistant.....	41
2.6.6	Calculating Initial Algebras.....	42
2.6.7	Generating Transition Systems.....	43
2.6.8	Equivalence Testing.....	44
2.6.9	Implementation & Acknowledgements.....	45
2.7	Summary.....	45
2.8	Bibliographical Notes.....	46
3	Simple Protocols.....	47
	<i>J.J. van Wamel</i>	
3.1	Introduction.....	47

3.2	General Description.....	48
3.3	Alternating Bit Protocol.....	50
3.3.1	Description of the ABP.....	50
3.3.2	Specification of the ABP in PSF.....	51
3.3.2.1	Frames	51
3.3.2.2	Sender.....	52
3.3.2.3	Message Channel.....	53
3.3.2.4	Receiver.....	53
3.3.2.5	Acknowledgement Channel.....	54
3.3.2.6	ABP	55
3.3.2.7	Simulation of the ABP.....	56
3.3.2.8	Remark on the Specification of the Channels.....	56
3.4	Positive Acknowledgement with Retransmission Protocol	56
3.4.1	Description of the PAR-Protocol.....	57
3.4.2	Specification of the PAR-Protocol in PSF.....	58
3.4.2.1	Frames	58
3.4.2.2	Sender.....	59
3.4.2.3	Timer	60
3.4.2.4	Message Channel.....	60
3.4.2.5	Receiver.....	61
3.4.2.6	Acknowledgement Channel.....	62
3.4.2.7	PAR	62
3.5	Concurrent Alternating Bit Protocol.....	63
3.5.1	Description of the CABP	63
3.5.2	Specification of the CABP in PSF	64
3.5.2.1	Frames	64
3.5.2.2	Sender.....	65
3.5.2.3	Message Channel.....	65
3.5.2.4	Receiver.....	66
3.5.2.5	Acknowledgement Sender.....	67
3.5.2.6	Acknowledgement Channel.....	67
3.5.2.7	Acknowledgement Receiver.....	68
3.5.2.8	CABP	68
3.6	Summary.....	69
3.7	Bibliographical Notes.....	70
4	Sliding Window Protocols	71
	<i>J.J. Brunekreef</i>	
4.1	Introduction.....	71
4.1.1	General Description of a Sliding Window Protocol	71
4.2	The 'One Bit' Protocol.....	73
4.2.1	General Introduction.....	73
4.2.2	Specification of the 'One Bit' Protocol	76
4.2.2.1	Frames	77
4.2.2.2	Sides.....	77
4.2.2.3	The Interface Message Processor	78

4.2.2.4	The Timer.....	79
4.2.2.5	The Channel.....	80
4.2.2.6	The 'One Bit' protocol.....	82
4.3	The 'Pipelining with Go Back n' Protocol.....	83
4.3.1	General Introduction.....	83
4.3.2	Specification of the 'Pipelining' protocol.....	85
4.3.2.1	Frame Numbers.....	85
4.3.2.2	Frames.....	86
4.3.2.3	Windows.....	87
4.3.2.4	Timers.....	87
4.3.2.5	Channel States.....	88
4.3.2.6	The Interface Message Processor.....	88
4.3.2.7	The Timer.....	90
4.3.2.8	The Channel.....	92
4.3.2.9	The 'Pipelining' protocol.....	93
4.4	The 'Nonsequential Receive with Selective Repeat' Protocol.....	94
4.4.1	General Introduction.....	94
4.4.2	Specification of the 'Nonsequential Receive' Protocol.....	99
4.4.2.1	Maximum Buffer Size.....	99
4.4.2.2	Frames.....	99
4.4.2.3	Timers.....	100
4.4.2.4	The Interface Message Processor.....	101
4.4.2.5	The Timer.....	104
4.4.2.6	The Channel.....	106
4.4.2.7	The 'Nonsequential Receive' Protocol.....	106
4.5	The External Behaviour of an SWP.....	108
4.5.1	The Communication between SWP and Hosts.....	108
4.5.2	The Performance of the three Protocols.....	111
4.6	Summary.....	111
4.7	Bibliographical Notes.....	112
5	The Amoeba Transaction Protocol.....	113
	<i>J.J. Brunekreef</i>	
5.1	Introduction.....	113
5.2	A General Description of the Amoeba Transaction Protocol.....	114
5.2.1	The Transaction Layer.....	114
5.3	Specification of the Amoeba Transaction Protocol.....	119
5.3.1	Amoeba Data.....	120
5.3.2	Messages.....	120
5.3.3	Maximum Number of Retransmissions.....	121
5.3.4	Channel States.....	122
5.3.5	The Client.....	122
5.3.6	The Server.....	123
5.3.7	The Transaction Protocol - the Client Part.....	125
5.3.8	The Transaction Protocol - the Server Part.....	127
5.3.9	The Channels.....	130

Contents

ix

5.3.10	The Amoeba Transaction Protocol	131
5.3.11	The Communication between Client and Server	132
5.4	Summary	133
5.5	Bibliographical Notes	133
6	Two Simple Protocols for Local Area Networks	135
	<i>J.J. Brunekreef</i>	
6.1	Introduction	135
6.2	The Logical Link Control Interface	137
6.2.1	General Description	137
6.2.2	A Specification of the LLC Interface	138
6.2.2.1	Network Data	139
6.2.2.2	Network Parameters	140
6.2.2.3	LLC Data	140
6.2.2.4	The Logical Link Control Interface	141
6.3	A Simple Token Ring Protocol: STR	142
6.3.1	General Description	142
6.3.2	A Specification of the STR Protocol	143
6.3.2.1	STR Data	144
6.3.2.2	Frames	145
6.3.2.3	The Simple Token Ring Protocol	145
6.3.2.4	The Simple Token Ring Network	148
6.3.2.5	A Simple Token Ring Station	149
6.4	A Simple CSMA/CD Protocol: SEN	150
6.4.1	General Description	150
6.4.2	A Specification of the SEN Protocol	151
6.4.2.1	SEN Data	152
6.4.2.2	Frames	153
6.4.2.3	The Simple Ethernet Protocol - Transmitting Part	153
6.4.2.4	The Simple Ethernet Protocol - Receiving Part	155
6.4.2.5	The Simple Ethernet Protocol	156
6.4.2.6	The Medium	156
6.4.2.7	The Simple Ethernet Network	158
6.4.2.8	A Simple Ethernet Station	159
6.5	Summary	160
6.6	Bibliographical Notes	160
7	The Token Ring Protocol	161
	<i>H. Jacobsson & S. Mauw</i>	
7.1	Introduction	161
7.2	Token Ring Network, an Introduction	161
7.3	Specification of a Token Ring	164
7.4	The Specification	165
7.4.1	Data Specification	166
7.4.1.1	Bytes	166
7.4.1.2	Symbols	166

Cambridge University Press

978-0-521-08812-1 - Algebraic Specification of Communication Protocols

Edited by S. Mauw and G. J. Veltink

Table of Contents

[More information](#)

x

Contents

7.4.1.3	Octets.....	167
7.4.1.4	Fields.....	168
7.4.1.5	SDU.....	169
7.4.1.6	Port Names.....	169
7.4.1.7	Utilities.....	170
7.4.2	Process Specification.....	170
7.4.2.1	Ports.....	171
7.4.2.2	Frame Reception.....	172
7.4.2.3	Token Transmission.....	173
7.4.2.4	Frame Transmission.....	174
7.4.2.5	Ring Interfaces.....	175
7.4.2.6	Buffers.....	176
7.4.2.7	Token Ring.....	176
7.5	Summary.....	177
7.6	Bibliographical Notes.....	178
A	The PSF Library.....	179
A.1	Introduction.....	179
A.2	The Library.....	179
A.2.1	Booleans.....	179
A.2.2	Naturals.....	180
A.2.3	Bits.....	181
A.2.4	Data.....	182
A.2.5	Queues.....	182
A.2.6	Tables.....	183
B	Syntax of PSF.....	185
B.1	Context-free Syntax.....	185
B.2	Lexical Syntax.....	188
	References.....	189
	Module Index.....	193
	Subject Index.....	195