

Table of Contents

Part I. Introduction to Distributed Systems and Computer-Supported Cooperative Work

1. Fundamental Principles of Distributed Systems	3
1.1 Introduction	4
1.2 Transparency	5
1.2.1 Levels of transparency	6
1.2.2 Transparency levels of existing systems	10
1.2.3 Problems with transparency in CSCW	10
1.3 Mechanisms for Communication	11
1.3.1 Information sharing	12
1.3.2 Message exchange	12
1.3.3 Bidirectional communication	16
1.3.4 Producer-consumer interaction	18
1.4 Client-Server Model	19
1.4.1 Terms and definitions	21
1.4.2 Client-server communication	23
1.4.3 Processing requests for service operations	24
1.5 Remote Procedure Call (RPC)	29
1.5.1 RPC properties	31
1.5.2 Mediation and brokering	38
1.5.3 Asynchronous RPC	39
1.5.4 Failure semantics of remote procedure calls	41
1.6 Object-Oriented Distributed Systems	43
1.6.1 Definitions	43
1.6.2 Object distribution	45
1.6.3 Object mobility	46
1.6.4 Common Object Request Broker Architecture (CORBA)	50
1.6.5 Tuple space	53
1.6.6 Linear Objects	54
1.7 Distributed Applications	59
1.7.1 Group communication	60
1.7.2 Design of distributed applications	65
1.7.3 Distributed applications in ODP	71

1.7.4	Resource allocation	74
1.7.5	History of highly influential distributed systems	78
1.7.6	Caching	82
1.8	Further Reading	85
2.	Computer-Supported Cooperative Work	87
2.1	Introduction	88
2.2	Background for Team Support	89
2.3	Terminology	90
2.4	CSCW in Practice – Scenarios	95
2.4.1	Support of face-to-face meetings	95
2.4.2	Support of distributed electronic meetings	98
2.4.3	Support in between meetings	100
2.5	Application Domains and their Characteristics	103
2.5.1	Software design and development	103
2.5.2	Teaching environment	104
2.5.3	Telecooperation	105
2.5.4	Further examples for teamwork	106
2.6	Interpretation of CSCW	107
2.6.1	CSCW: Work	109
2.6.2	CSCW: Cooperative Work	109
2.6.3	CSCW: Supported Cooperative Work	111
2.6.4	CSCW: Computer-Supported Cooperative Work	112
2.7	History of the Most Important CSCW Systems	112
2.8	Groupware Classification	118
2.8.1	Time space taxonomy	118
2.8.2	Application level classification	119
2.8.3	Classification according to the 3C model	125
2.8.4	More classification models	126
2.9	Design of Groupware	126
2.9.1	Possible aspects	126
2.9.2	Criteria for the acceptance of groupware systems	128
2.9.3	Why groupware systems sometimes fail	128
2.9.4	Benefits and risks of groupware	130
2.9.5	Development methodology of groupware systems	130
2.9.6	Methods for studying groups	134
2.9.7	The Portland experiment	136
2.9.8	Lotus Notes	139
2.10	Further Reading	140

Part II. Basic Concepts of Computer-Supported Cooperative Work

3. Concepts of Asynchronous and Synchronous Cooperation	145
3.1 Group Processes	146
3.1.1 Group process models	150
3.1.2 Group communication	152
3.1.3 Concurrency control	155
3.1.4 Roles of group members	158
3.2 Cluster Model	158
3.2.1 Direct point-to-point connection	159
3.2.2 Indirect communication links	160
3.3 Strategies for the Distribution of Information Units	163
3.3.1 Direct point-to-point connection	163
3.3.2 Cluster hierarchy	163
3.3.3 Broadcast flooding	165
3.3.4 Routing	167
3.4 Structures of Asynchronous Group Interaction	167
3.4.1 Linear model (Emisari)	167
3.4.2 Comb model (Confer, Usenet)	168
3.4.3 Branch model (Parti)	169
3.5 Management of Shared Context	170
3.5.1 The concept WYSIWIS	172
3.5.2 Relaxed forms of WYSIWIS	172
3.5.3 Telepointing	175
3.5.4 Group awareness	175
3.6 Groupware Architectures	178
3.6.1 Centralized architectures	178
3.6.2 Replicated architectures	180
3.7 Further Reading	182
4. Concurrency Control	185
4.1 Introduction	186
4.1.1 Motivation	186
4.1.2 Classification of concurrency control approaches	187
4.2 Optimistic Concurrency Control	188
4.3 Centralized Control	189
4.3.1 Control unit	189
4.3.2 Token-passing	190
4.4 Decentralized Control: Overview	191
4.5 Simple Locking Schemes	191

4.6	Floor-passing Schemes	194
4.6.1	Explicit floor-passing scheme	195
4.6.2	Implicit floor-passing with coordination unit	195
4.6.3	Implicit floor-passing with distributed coordination	196
4.7	Transactions	197
4.8	Operation Transformation	201
4.8.1	Sites	201
4.8.2	Group Outline Viewing Editor (Grove)	202
4.8.3	The Grove algorithm: distributed Operational Transformation (dOPT)	206
4.8.4	Correctness of the Grove algorithm	208
4.9	Further Reading	209
5.	Replication and Concurrency Control	211
5.1	Introduction	212
5.2	Voting Schemes	218
5.2.1	Majority consensus	220
5.2.2	Weighted voting	224
5.2.3	Write-all-read-any	226
5.2.4	Voting with witnesses	227
5.2.5	Available-copy	239
5.2.6	Dynamic voting	245
5.2.7	Voting-class	259
5.2.8	Multidimensional voting	261
5.2.9	Hierarchical Voting	263
5.3	Additional Schemes with Decentralized Control	266
5.3.1	Coding scheme	267
5.3.2	Grid protocol	274
5.4	Regeneration	279
5.5	Further Reading	280

Part III. Application Classes of Computer-Supported Cooperative Work

6.	Communication Systems and Shared Information Spaces	285
6.1	Email Systems	286
6.1.1	Message transfer agent	287
6.1.2	User agents	288
6.1.3	Message envelope	289
6.1.4	Email address	290
6.1.5	Groupware characteristics of an email system	290
6.2	Video Conferencing	291
6.2.1	Aspects in the usage of video conferencing	291
6.2.2	Conference management	293

6.3	Shared Information Spaces	295
6.3.1	General definitions	295
6.3.2	History of hypertext systems	296
6.3.3	Architecture of hypertext systems	301
6.3.4	Dexter reference model	307
6.3.5	Navigation in hypertext networks	309
6.3.6	Trellis model	315
6.3.7	IBIS method	315
6.3.8	Campiello – Information spaces and communities	318
6.3.9	Case studies: cooperative nature of information search activities	322
6.4	Further Reading	325
7.	Workflow Management, Conversation and Coordination Systems	327
7.1	Introduction	328
7.1.1	The history of workflow management	330
7.1.2	Terminology	331
7.1.3	Goals, barriers and features	333
7.1.4	Taxonomy	335
7.2	Conversation Model	337
7.2.1	Definition of speech act	338
7.2.2	Conversation networks	340
7.2.3	Conversation systems	341
7.2.4	The Coordinator	343
7.2.5	The office procedure system Domino	344
7.2.6	The activity management system Tacts	346
7.3	Coordination Models	350
7.3.1	The coordination theory according to Malone	352
7.3.2	Customer-performer model	353
7.4	Workflow Modeling	354
7.4.1	Aspect-oriented workflow model	355
7.4.2	Process grammar	358
7.5	Execution Environments for Workflows	360
7.6	Further Developments	361
7.6.1	Problems and open issues	362
7.6.2	Workflow Management Coalition (WfMC)	363
7.6.3	Adaptive workflow	364
7.6.4	Workflow life cycle	368
7.7	Further Reading	372

8. Workgroup Computing	373
8.1 Electronic Meeting Support	374
8.1.1 Architectures for electronic meeting systems	376
8.1.2 General characteristics of electronic meeting systems ..	378
8.1.3 Design alternatives for meeting rooms	379
8.2 Distributed Document Systems	382
8.2.1 Cooperative document creation	383
8.2.2 Group editors – overview	387
8.2.3 The group editor Iris	387
8.2.4 DistEdit	389
8.2.5 User interface layer of a group editor	390
8.2.6 Access layer of a group editor	394
8.2.7 Architecture of a distributed group editor	397
8.2.8 Document structure	401
8.2.9 Logical views of the document structure	402
8.2.10 Structure editor	404
8.2.11 Versioning/history management	406
8.3 Undo in Distributed Group Editors	407
8.3.1 Basic concepts	408
8.3.2 Simple undo	409
8.3.3 Selective undo according to Prakash and Knister	409
8.3.4 Selective undo (extended version)	412
8.4 Further Reading	413
9. Multiagent Systems	415
9.1 Introduction	416
9.2 Characteristics and Classification	418
9.3 Modeling	424
9.3.1 Distributed problem solving	425
9.3.2 Agent model	425
9.3.3 Conceptual framework	426
9.3.4 Layer concept	427
9.4 Cooperation among Agents	430
9.4.1 Cooperation by (semi) structured messages	430
9.4.2 Cooperation strategies	433
9.4.3 Cooperation methods	434
9.4.4 Communication types	436
9.5 The Contract Net Protocol	438
9.5.1 Basic concepts of the contract net protocol	438
9.5.2 Task announcement phase	439
9.5.3 Bid creation phase	440
9.5.4 Bid selection phase	441
9.5.5 Task assignment phase	443
9.5.6 Task execution phase	443
9.5.7 Assessment of the contract net protocol	443

9.6	Agent-based Information Brokering	444
9.6.1	Systems of agent-based information brokering	445
9.6.2	Constraint-Based Knowledge Brokers	452
9.6.3	Protocols	459
9.6.4	Agent processing	463
9.7	Distributed Meeting Scheduling	469
9.7.1	Formal definition of the meeting scheduling problem . .	471
9.7.2	Scheduling process	473
9.7.3	Scheduling model	473
9.7.4	Strategies	475
9.8	Actor Model	476
9.8.1	Actor definition	476
9.8.2	Generic actor system	477
9.8.3	Example for an actor system	478
9.9	Further Reading	479
	References	481
	List of Figures	509
	List of Tables	515
	Index	517