



# Index

**Note:** Italicized page locators indicate figures/tables.

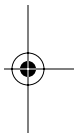
## A

- Abstract data types, 22
- Abstract factory pattern, 217
- Abstract interface document, part of the HLA, 255
- Abstraction(s), 8, 16, 74, 106, 112, 113, 142, 149, 223, 275, 277, 377, 388
  - choosing, for connectors, 114–115
  - “levels of”, as undesirable phrase, 95–97
- Abstract machine, 93
- Access dependency, UML, 88
- Accessors. *See* Data accessors
- Access programs, 247, 248, 251
- Access rights, 225
- Account Server-Backup, reliability for system provided by, 106
- Accuracy, 2, 297–298
- ACM, Web site of special-interest group on hypertext, hypermedia, and the Web, 378
- Acme, 143, 165, 375
- Acronyms
  - conventions for, 322
  - lists of, 316, 323, 328, 340
- Action, in HPSM, 135
- Active design reviews, 336, 338, 340, 341
- Activity diagrams, 99
- Actors, 227, 240
  - definition of, 223
  - element interactions with, 225
  - and error handling, 234
  - and multiple interfaces, 242
  - and resource semantics, 230
  - and resource usage restrictions, 231
  - in use case diagrams, 198
  - and XML, 256
- Adage, 375
- Ada packages, 22
- Adaptation data, 214
- Adapter pattern, 217
- ADL. *See* Architecture description language
- ADML, 165
- Adornments, document, 315
- Aesop, 375
- Aggregate modules, 45, 66
- Aggregation, depiction in UML, 56, 57
- Air traffic control subsystem, 62, 63
- Air traffic control system, segmented layers diagram, 91
- Alexander, Christopher, 218
- Allen, R. J., 23, 123
- Allocated-to relation, 168, 174
  - in ECS, 388
  - and deployment style, 170
  - and implementation style, 177
  - and work assignment style, 180
- Allocation view, 48, 312
- Allocation viewtype, xxxi, xxxii, 18, 20, 21, 30, 35, 38–39, 183, 289, 300
  - and C4ISR system architecture view, 361
  - control flow diagrams represented using, 367
  - data flow diagrams represented in, 365
  - deployment style of, 167, 168, 169–175, 183
  - elements, relations, and properties of, 168–169
  - implementation style of, 167, 168, 175–179, 183

- Allocation viewpoint (continued)
  - overview of, 167
  - styles of, 168
  - summary of, 169
  - work assignment style of, 167, 168, 179–182, 183
- allowed-to-use relation, 42, 67, 91, 96, 97, 387, 435
  - notation for, 83
  - and relations among layers, 81
  - represented as rings, 85
  - and segmented layers, 84
  - and UML access dependency, 88
- Alternatives, and design decisions, 330
- Ambiguity
  - and architecture documentation, 335
  - avoiding, 25–26, 373
- Analysis. *See also* Architecture Tradeoff Analysis Method
  - accuracy, 297
  - and ADLs, 375
  - after-situation, in air traffic control system, 62
  - and allocation views, 38
  - architecture as artifact for, xxvi, 10, 12, 13, 30, 32, 37, 41, 111, 114, 117, 324, 379
  - availability, 12, 116, 298
  - and behavior, 260–262, 264, 265, 267, 273, 284, 398
  - and C4ISR Architecture Framework, 357
  - and combined views, 201, 202
  - and Darwin, 375
  - definition-use, 259
  - dependability, 138
  - and deployment style, 171
  - functional, 4+1 logical view as aid for, 16
  - impact, 47, 55, 83, 99, 294, 298, 386
  - informal notations and, 145, 147
  - and inheritance, 76
  - and layers, 83
  - memory-capacity, 388
  - and MetaH/ControlH, 283
  - methods for architecture, 297, 302–304
  - modifiability, 12, 261, 262, 298
  - module viewpoint used for, 47
  - and module views, 41, 48
  - performance, 10, 11, 12, 14, 38, 48, 63, 116, 127, 138, 143, 163, 167, 172, 202, 205, 238, 261, 262, 265, 273, 283, 296, 297, 319, 366, 388
  - with ports represented as annotations, 149–150
  - and Rapide, 284
  - rate-monotonic schedulability, 330
  - reliability, 14, 38, 48, 105, 116, 143, 172, 261, 283, 296, 388
  - results, in ECS system, 416–417
  - results, in view template, 319, fig321, 398
  - and RUP use case view, 345
  - and SDL, 279
  - security, 12, 38, 138, 172, 283, 298, 319, 388
  - showing results to stakeholder, 296, 297, fig301
  - structured, 365
  - and styles, 18, 20, 215, 216, 217
  - tools, UML-based, 149
  - usability, 12, 298
  - and viewpoints in ANSI/IEEE-1471-2000, 362, 363
  - and Wright, 375
- Analysts
  - documentation needs of, 296–297
  - interest of, 297
  - and interface documentation, 238
- Annotations, ports as, 150–151
- ANSI/IEEE-1471-2000, 344, 361–362, 380, 382
  - conceptual framework of, 362
  - information requirements and addressing of requirements, 363
  - views in, 361
- Aperiodic communication, 272
- API. *See* Application programming interface
- Application architecture, 17
- Application builders, documentation needs of, 294–295
- Application Data Type Module, in A-7E avionics system, 59–60
- Application programming interface, 82, 245
- Architects, 30, 379
  - and architecture documentation, 11
  - architecture overview presentations given by, 330–332
  - and assertions, 316
  - behavioral documentation by, 260
  - and interface documentation, 238
  - and interface specifications, 226, 257
  - of the future, interest and documentation needs of, 299–300



- views chosen by, 289
- and viewtypes, 18
- Architectural approaches, ATAM and identification/analysis of, 303, 304
- Architectural elements, 5
  - classes of, 3
- Architectural mismatch, 258
- Architectural patterns, defining, 215
- Architectural strategy, in architecture
  - overview presentation, 331
- Architectural structure, organizational
  - structure mirrored by, 179
- Architectural styles, xxxi, 18, 30, 32, 33, 221
- Architectural views, xxvii, xxxi, 15–17, 331
- Architecture, xxvi
  - application, 17
  - concept of styles fundamental to, 217
  - design *versus*, 5–8
  - dynamic change in, 210
  - dynamism and variability documented in, 211
  - and fitness for purpose, 32
  - functional, 17
  - goal of documenting, 30
  - importance of, xxv
  - layered view of, 77
  - and module decomposition style, 53
  - project management, 17
  - reasoning behind: background, design constraints, and rationale, 328–330
  - role of, 1–2
  - Siemens Four View model for, 17
  - and system overview, 326
  - technical, 17
  - variability in, 209
- Architecture background
  - in ECS documentation, 398–399, 416, 432–433, 445–449, 454, 466
  - in view packets, 319–320
- Architecture-based simulation, 261
- Architecture definition languages, 375. *See also* Architecture description languages
- Architecture description languages, 9, 145–147, 223, 286, 344, 374–376
- Architecture evaluation, and stakeholder communication, 300
- Architecture overview presentation,
  - building, 330–332
- Architecture Tradeoff Analysis Method, 12, 297, 302, 416
  - outputs, 304
  - steps in analysis phase of, 303–304
- Arcs, for indicating containment, 56
- Array-bounds violations, 235
- Arrows, 173
  - in architectural diagrams, 28–29, 31
  - bidirectional, 90
  - box-and-arrow diagrams, 144, 283
  - on connectors, 145
  - double-headed, 29
  - depends-on relation represented by, 48
  - in message sequence chart, 276
  - in sequence diagrams, 272, 273
  - single-headed, 29
  - in statecharts, 278
  - triangle dashed, and interfaces shown in UML, 241
  - two-way, 90
- A-7E avionics system (U.S. Navy), 101, 306–308
  - architecture of, 89
  - candidate view list, 306–307
  - combining views step, 307–308
  - prioritize step, 308
  - software architecture, decomposition of, 58
  - stakeholders and useful documentation, 307
- Aspect-oriented programming, 221
- Assertions, 316, 317
- Assigned-to relation, 465
- Association classes, connector types as, 152
- Associations, connector types as, 152
- Assumptions
  - in architecture background, 319–320
  - in ECS documentation, 398, 417, 455
- Asynchronous communication, 264, 265, 272, 274–275, 280, 284
- Asynchronous format, 405
- Asynchronous messages, 109
- ATAM. *See* Architecture Tradeoff Analysis Method
- Atomic styles, 202
- Attachment relation, 110, 445, 453
- Attachments
  - guidelines for defining graphs using, 110
  - and pipes and filters, 387
- Attitude data, 405
- Attribute goals, 329
- Author property, 35



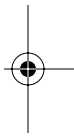


Availability  
 analysts interested in, 296  
 analyzing, 298  
 and architecture documentation, 12  
 and C&C viewtype, 116  
 and ECS project, 309  
 Avionics applications, 283. *See also* A-7E  
 avionics system

**B**

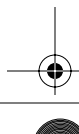
Bandwidth property, 171  
 Bank account, Z schemas for, 282  
 Banking application, IDL example for  
 element in, 252  
 Baseline  
 of ECS documentation, 383, 410  
 number, 316  
 Basic assumptions, in SCR-style interface,  
 250  
 Bass, L., xxvi, 32, 57, 58, 212  
 Become, construct in UML, 213  
 Becomes, stereotype of UML dependency,  
 174–175  
 Behavioral diagrams, 264, 352  
 Behavioral documentation  
 and C4ISR operational architecture view,  
 360  
 clock-triggered stimulation, 265–266  
 constraints on ordering, 264–265  
 and flowcharts, 366  
 representations in, 266  
 static models, 275–284  
 system analysis, 261–262  
 and traces, 268–275  
 types of communication in, 264  
 Behavior descriptions, references on, 285  
 Behavior-hiding module, in A-7E avionics  
 system, 59, 89  
 Binary code files, and component diagrams,  
 350  
 Binary protocols, and UML-RT, 159  
 Binding, purpose of, 147  
 Binding time, of option, 209  
 Birds-eye-view, of system during runtime,  
 104  
 Blackboards  
 description of, 165  
 shared-data, 134  
 Blackboard style, 130, 131  
 and Data Banker Module, 60  
 Black-box tester, interests of, 293

Blocks, communication between processes  
 and, 280  
 Boehm, Barry, 373  
 Bolding words, 322  
 Booch, G., 285  
 Boolean algebra, 242  
 Boolean type, in SDL, 280  
 Border types, and software elements, 174  
 Bosch, J., 32  
 Bottlenecks  
 and allocation decisions, 172  
 identifying, 2  
 Box-and-arrow diagrams, 144, 283  
 Box-and-line diagrams, 26, 103, 143, 152  
 Box-and-line notations, for documenting  
 C&C styles, 164  
 Boxes, 173  
 and interfaces shown in UML, 241  
 Bracket notation, in SCR-style interface,  
 249  
 Breadth-first order, understanding view in,  
 189  
 Bridging elements, 20, 189, 190  
 “Bringing in a program,” 70  
 Britton, Kathryn Heninger, 12  
 Brooks, Fred, 69, 366  
 Browsers, and XML, 256  
 Browser type, 139  
 Budgets  
 and choice of views, 290, 312  
 and work assignment style, 181  
 Buffered pipes, 127  
 Bugs, tracking sources of, 117  
 Buhr, R. J. A., 286  
 Build checking, and signatures, 245  
 Builder of element, and interface  
 documentation, 237  
 Builder pattern, 218  
 Building documentation package, 315–341  
 choosing number of documents in,  
 315–316  
 documentation beyond views, 323–330  
 documenting views, 317–320  
 validating software architecture  
 documentation, 335–338  
 Build-*versus*-buy decisions, 54  
 Buschmann, F., 165, 218  
 Business context, in ECS, 408  
 Business drivers, ATAM and presentation  
 of, 303  
 Bus speed, 171



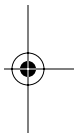
**C**

- C++, 93, 100, 234
- Callbacks, 88, 94, 118, 137
- Calls procedure connectors, 119, 120
- Calls relation, 68
- Call substate, 277, 278
- Candidate view list
  - for A-7E avionics system, 306–307
  - for ECS project, 309–310
  - and view choices, 305
- Capitalize System, C&C and module views
  - of, 119
- Capsules, in UML-RT, 157
- Captions, 322
- Carleton University, use case map notation
  - developed at, 269
- Cartoons, architectural, 320, 331
- Casselman, 286
- C4ISR Architecture Framework, 344, 356–361, 380
  - common architectural views, 357–358
  - common products, 358, 360–361
  - essential products, 358, 359
  - supporting products, 358, 359–360
- Change analysis, in ECS system module
  - decomposition view packet, 416–417
- Change history, 316
- Character type, in SDL, 280
- Charstring type, in SDL, 280
- Checkpoint and recovery, 373
- Child node, in tree, 247
- Child-parent relationships, and view
  - packets, 219, 317
- Children
  - interfaces of, 6
  - view packets, 188, 191, 320
- Chunking information, 187, 219
  - descriptive completeness, 192–195
  - refinement, 191–192
  - view packets, 188–191
- Circle-and-line drawings, in context
  - diagrams, 198
- Circles, 173
- Class attributes, ports as, 151
- Class diagrams, 103
  - UML, 97–99, 199, 349
- Classes, 108
  - component types and instances
    - represented by, 159–160
  - connector types as, 153
  - and module viewtype, 101
  - ports as, 151–152
    - for representing component types and instances, 159–160
    - types as in UML, 149
- Clements, P., xxvi, 32, 57, 58, 165
- Clients, 19, 103, 107, 120, 136
- Client-server connector, 105, 109
- Client-server style, 19, 20, 30, 37, 105, 125, 135–139, 163
  - elements, relations, and properties, 136–137
  - examples of, 138–139
  - overview of, 135–136
  - relation to other styles, 138
  - and shared-data style, 131
  - system analyses of, 138
  - uses for, 137–138
- Client-server view, view packet in, 190
- Clinton, William Jefferson, 316
- Clock-triggered stimulation, 265–266
- CM. *See* Configuration management
- Code reviews, 337
- Code view, Siemens Four Views, 17, 353, 355–356
- Coherence, 179
- Cohesion, and layers, 81
- Collaboration diagrams, 38, 99, 154, 268, 272–274, 284
  - for JavaPhone, 274
  - and peer-to-peer style, 139
  - Web sites on, 287
- Collaborations
  - systems as, 154, 155
  - systems mapping to, 157
- Color
  - and layer diagrams, 87
  - for software elements, 174
- COM. *See* Component object model
- COM+, 38, 139
- Combined views, 191, 200–208, 220
  - A-7E avionics system, 307–308
  - documenting, 187, 206
  - for ECS project, 310
  - examples of, 207–208
  - and view choices, 305
- Coming to terms
  - architectural views, 15–17
  - components *versus* UML components, 161–162
  - documentation, description, representation, specification, 8–9





- Coming to terms (continued)
    - exceptions and error handling, 233–236
    - generalization, 76
    - signatures, interfaces, API, 245–246
    - software architecture, 2–4
    - styles and patterns, 217–219
    - substitutability, 46–47
    - subsystem, 62–64
    - uses relation, 68–71
    - virtual machines, 93
  - Commercial components, 344, 376, 377, 380
  - Communicating-processes style, 142–143, 164, 169
    - in component-and-connector viewtype, 37
    - description of, 165
    - elements, relations, and properties, 142
    - examples of, 143
    - overview of, 142
    - relation to other styles, 143
    - summary of, 142
    - uses for, 143
  - Communicating-processes view, 308, 312, 388
    - in ECS, 450–456
    - in ECS, mapping between decomposition view and, 401
  - Communication
    - among states, 279
    - and architecture documentation, 10
    - effective, 379
    - module viewtype used for, 47
  - Communication channels, and deployment style, 170
  - Communications and System Management Segment, in ECS, 466
    - Module Decomposition View Packet for, 10, 422
  - Communications Subsystem, in ECS, 405
  - Communication types, 264, 265
  - Competence set of the program, 236
  - Compile time, 209, 214
  - Compile time information, runtime information *versus*, 213–215
  - Completeness, 148, 180
  - Complexity, of commercial software components, 377
  - Component, 21, 22
    - types, 148–152, 163
  - Component-and-connector (C&C) views, 48, 162, 327, 373
    - and ECS project, 309
    - mapping between module decomposition view and, 57
    - poorly documented, 111
    - and view choices, 312
  - Component-and-connector (C&C) viewtype, xxxii, 18, 20, 21, 23, 24, 30, 35, 36–38, 48, 103–123, 163, 168, 207, 289, 300.
    - See also* Styles of component-and-connector viewtype
  - control flow diagrams represented by, 366
  - data flow diagrams represented by, 364
  - elements, relations, and properties of, 106–112
    - and execution architecture view, 355
    - and logical view of Rational Unified Process, 345
  - notations for, 118
  - overview of, 103–106
  - projections of, 117
  - relation to other viewtypes, 118–120
    - and RUP process view, 346
  - summary checklist, 120–121
  - summary of, 106–107
  - uses for, 116
- Component-based software engineering, 22, 123
  - Component diagrams, UML, 350–351
  - Component ensemble, 377
  - Component instances, 108
    - as classes, 161
    - mapping to capsule-stereotyped objects, 157
    - as objects in UML, 148
  - Component object model, 120
  - Component ports
    - connector roles associated with, 110
    - mapping to UML-RT ports, 157
  - Components, 23, 24, 36, 104, 120, 123, 143, 163
    - and Acme ADL, 145
    - in C&C viewtype, 107–109
    - creation and deletion of, 213
    - in publish-subscribe style, 132
    - replication of, 212–213
    - as subsystems, 154, 155, 156
    - UML components *versus*, 161–162
    - useful properties of, 134, 137
  - Component technologies, 120





- Component types, 148
  - classes for representing, 159–160
  - in graphical depictions, 144
  - mapping to UML capsule-stereotyped classes, 157
- Compositional reasoning techniques, 262
- Composition relation, 56
- Computational viewpoint, 373
- Computer Software Configuration Item, 61, 62, 405
- Computer Software Components, 61, 62
- Computer Software Units, 62
- Conceptual view, Siemens Four Views, 17, 353, 353–354, 354
- Concurrency
  - and finite state machines, 279
  - and statecharts, 277
  - and use case maps, 269
- Concurrency-related analyses, 388
- Concurrent units, 388
- Config module, 118, 120
- Configuration item property, 178
- Configuration management, 184, 344, 378–379, 380
  - system, 178
  - techniques, 175–176
- Configuration parameters, 232, 249
- Connecting elements, 3
- Connection substate, 277
- Connector abstractions
  - choosing, 114–115
  - guidelines for, 115
  - necessity of, 113
- Connector instances
  - as links, 152
  - mapping to UML links, 157
  - as objects, 153
- Connector mechanisms, 123
- Connectors, 36, 104, 120, 123, 142, 143, 162
  - and Acme ADL, 145
  - arrows on, 145
  - in C&C views, 364
  - in C&C viewtypes, 109–110
  - creation and deletion of, 213
  - mapping to UML-RT connectors, 157
  - necessity of, 112–113
  - representing, 152–153, 162
- Connector types, 148–152, 163
  - as association classes, 152
  - as associations, 152
  - as classes, 153
  - description of, 109
  - in graphical depictions, 144
- Consistency
  - in architecture documentation, 335
  - with presentation, 322
- Consistency checking
  - in active design reviews, 337
  - among view packets, 195
- Constraints, in design decision, 329–330
- Construction, module viewtype used for, 47
- Contained objects, systems as, 153
- Containment
  - informal notations for, 56
  - relation, 54, 177
- Contents, notation for, 86
- Contents property, for layer, 81
- Context diagrams, 219
  - context of, 197
  - in ECS documentation, 398, 416, 420, 429, 432, 438, 441, 446, 466
  - informal notations for, 198
  - and other supporting documentation, 197–198
  - purpose of, 196
  - top-level, 196–197
  - UML notation for, 198–200
  - using, 187, 195–200
  - in view packets, 319, 340
- Continuous-query databases, 130
- Contradiction, and architecture documentation, 335
- Control flow, 363
- Control flow diagrams, 121
- Control flow projections, 117–118, 121
- Control flow views, 344, 365–366
- ControlH, 283, 286
- Controller component type, 107
- Conway, M., 179, 184
- Copy-migrates-to relation, 171
- CORBA, 38, 115, 120, 134, 139
- COTS
  - and Communication and Systems Management Segment in ECS, 466
  - ECS dependence on, 408
  - products, 331
  - selection, 92, 377–378
- COTS engineers, ECS reliance on, 309
- Coupling, 179
- CPUs
  - and deployment style, 170

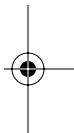


CPUs (continued)  
 and peer-to-peer computing, 140  
 properties, 171  
 Credentials, 377, 378  
 Cross-view child, 190  
 Cross-view siblings, 189  
 CSCI. *See* Computer Software Configuration Item  
 CSCs. *See* Computer Software Components  
 CSMS. *See* Communications and System Management Segment  
 CSP, 165, 221  
 CSS. *See* Communications Subsystem  
 CSUs. *See* Computer Software Units  
 Currency, of documentation, 27  
 Customer/acquirer; Software Architecture Documentation Package used by, 390  
 Customers  
 documentation needs of, 295–296  
 interests of, 295

**D**

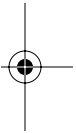
DAAC. *See* Distributed Active Archive Center  
 Dahl, Ole-Johan, 100  
 Data accessors, 129, 130, 131, 388, 403, 443  
 Data architectures, 373  
 Data Banker, in A-7E avionics system, 60, 307  
 Database access connector, 105  
 Databases, 107  
 Database systems, and shared-data style, 129  
 Data dictionaries, 365, 367  
 Data Dictionary Service, and Data Management Subsystem, 447  
 Data elements, 3  
 Data exchange, 38, 142  
 Data flow, 363  
 Data flow diagrams, 121, 364, 367  
 Data flow projections, 117–118, 121, 127  
 Data flow views, 344, 364–365  
 Data granule, 405  
 Data ingest features, in ECS, 409  
 Data integrity, in ECS, 309  
 Data management features, in ECS, 408–409  
 Data Management Subsystem, in ECS, 446  
 Data processing features, in ECS, 409  
 Data product, 405

Data repositories/stores, 103, 120, 165, 170, 191, 217, 443  
 Data sources/destinations, in context diagrams, 197  
 Data streams, 223  
 Data transformation, and pipe-and-filter style, 127  
 Data type dependencies, documenting, 364  
 Data Type Identifiers, 407  
 Data types, locally defined, 231  
 Date of issue and status, 316  
 DCCI. *See* Distributed Computing Configuration Item  
 Deadlock, analysis techniques for, 261  
 Debugging, uses relation and, 71  
 Decomposition, of work assignments, 181  
 Decomposition refinement, 191, 192, 219  
 Decomposition relation, 54  
 Decomposition style, 30, 42, 53–62, 99  
 elements, relations, and properties, 54–55  
 examples of, 57–62  
 in module viewtype, 35  
 notations for, 56  
 overview of, 53–54  
 relations to other styles, 57  
 summary of, 55  
 uses of, 55  
 Decomposition views  
 in ECS, 386  
 and ECS project, 310, 312  
 layers and modules shown from, 90  
 and modifiability, 298  
 and usability, 298  
 Degree, of node, 247  
 Dependence analysis, 261, 262  
 Dependencies, 162  
 connectors represented as, 156  
 documenting, 211  
 and one-to-many, 204  
 time-based, 266  
 Dependency arrows, in UML notation for deployment style, 174  
 Dependency relation, 150  
 Depends-on relation, 42, 43, 44, 50, 97, 387  
 arrows for representing, 48  
 and uses relation, 68, 69  
 and uses style, 64  
 Depictions of entities, in context diagrams, 197  
 Deployment diagrams, UML, 351





- Deployment style, xxxii, 30, 183
  - in allocation viewtype, 38, 167, 168, 169–175
  - elements, relations, and properties of, 169, 170–172
  - examples of, 175
  - example view in informal notation, 174
  - incorrect use of, 173
  - informal notations for, 173–174
  - notation for, 173–175
  - overview of, 169
  - relation to other styles, 175
  - summary of, 170
  - UML notation for, 174
  - uses for, 172–173
- Deployment unit, 347
- Deployment view
  - Kruchten 4+1, 16
  - in ECS documentation, 388, 457–460
  - and ECS project, 312
  - Rational Unified Process, 344, 347, 347–348
  - in UML, 175
  - and security, 298
- Deprecated methods, and Java interfaces, 231
- Depth, of tree, 247
- Depth-first order, understanding view in, 189
- DeRemer, F., 51
- Description, 9
- Description attribute, variation point
  - characterized by, 212
- Descriptive completeness, 187, 192–195, 219
- Design, architecture *versus*, 5–8
- Design background section, in behavioral documentation, 260
- Design constraints, and architecture, 328, 329
- Design decisions, documenting, 329–330, 340
- Design errors, and deployment style, 173
- Designers, and active design reviews, 337
- Designers of other systems, documentation
  - needs of, 293, 294
- Design issues, rationale and, 232. *See also* Rationale
- Design patterns, 32
  - abstract factory pattern, 217
  - adapter pattern, 217
  - builder pattern, 218
  - “Gang of Four”, 217, 218
  - observer pattern, 134
- Design time, 209
- Developers
  - interests of, 292
  - and interface documentation, 238
  - Software Architecture Documentation
    - Package used by, 390
- Development
  - and behavioral documentation, 262–263
  - and items to document, 263
- Development team member, documentation
  - needs of, 291–292
- Development tools, ECMA “toaster” model
  - for integration of, 210
- Development view, Kruchten 4+1, 16
- DFDs. *See* Data flow diagrams
- Diamond-shaped symbols, in use case maps, 270, 271
- Dictionaries, 231
  - and C4ISR, 361
  - in SCR-style interface, 249–250
- Dijkstra, Edsger, 24, 100
- DIM. *See* Distributed Information Manager
- Directionality, and arrows, 145
- Directory, 328
- Directory structures, 177
- Disk or other storage unit capacity property, 171
- Distributed Active Archive Center, 392, 393, 405, 455
- Distributed Computing Configuration Item, in ECS, 405
- Distributed Information Manager, in ECS, 447–449
  - and Data Management Subsystem, 447, 448
- Distributed query processing, and SDPS
  - Data Management architecture, 448
- Distributed Web-based information systems, as client-server style, 136
- Division by zero, 235
- Document adornments, 315
- Documentation, xxvii, 1, 8, 9, 106, 193. *See also* Documenting; Documenting
  - behavior; Software interfaces
  - documentation
    - avoiding ambiguity in, 25–26, 30
    - avoiding repetition in, 25, 30
    - beyond views, 323–330





Documentation (continued)  
 and combined views, 200–201  
 completeness strategy and statements in  
 notation key, 194–195  
 context diagrams and supporting,  
 197–198  
 currency of, 27  
 example for interface resource, 254  
 and fitness of purpose, 28, 31  
 notation explained in, 26  
 purpose of, 30  
 of rationale, 27, 30  
 reviewing for fitness of purpose, 340  
 rules of, 24–28, 30–31, 32  
 standard organization in, 26–27, 30  
 template for documentation beyond  
 views, 324  
 validation of, 335–338  
 for view, 15, 188  
 writing from reader's point of view,  
 24–25, 30

Documentation roadmap, 323, 324–326,  
 340  
 and C4ISR, 361, 362  
 for layered view of system S, 325

Documenting. *See also* Documentation;  
 Documenting behavior  
 architecture, 315  
 combined views, 187, 206  
 connector abstractions, 114  
 data type dependencies, 364  
 dynamic architectures, 187, 188  
 dynamism, 187, 188, 210–211, 220  
 extension points, 210  
 mapping between views, 327  
 new styles, 188, 215–217, 220  
 rationale behind design decision, 340  
 variability, 209–210, 211, 220  
 variable architectures, 187  
 view packets, 321  
 view packets from different views, 189,  
 190, 191  
 views, 317–320

Documenting behavior, 259–288  
 beyond structure, 259–260  
 location of, 260  
 notations and languages for, 266–283  
 reasons for, 260–263  
 what to document, 263–266

Document type declarations, 256

DoD. *See* U.S. Department of Defense

Draft number, 316

DTDs. *See* Document type declarations

Duration type, in SDL, 280

Dynamic binding, 100

Dynamic models, 4

Dynamic relations, 170

Dynamism  
 documenting, 187, 188, 210–211, 220  
 notations for, 212–213

**E**

Earth Observing System, 391

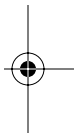
ECMA toaster model, 210

ECS. *See* EOSDIS Core System

ECS views, 308–312  
 candidate view list produced for, 309–310  
 combined views, 310  
 prioritizing, 310–312  
 stakeholders and architectural views, 311

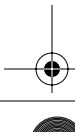
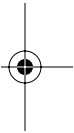
ECS Software Architecture Documentation:  
 Volume I  
 caveats about, 381  
 Chapter 1: ECS architecture  
 documentation roadmap, 385–390  
 Chapter 2: ECS system overview, 385,  
 391–396  
 Chapter 3: ECS software architecture view  
 template, 385, 397–399  
 Chapter 4: Mapping between views, 385,  
 400–402  
 Chapter 5: Directory, 385, 403–404  
 Chapter 6: architecture glossary and  
 acronym list, 386, 405–407  
 Chapter 7: Rationale, background, and  
 design constraints, 386, 408–409

ECS Software Architecture Documentation:  
 Volume II  
 Chapter 1: Module decomposition view,  
 386, 414–425  
 Chapter 2: Module uses view, 387,  
 426–430  
 Chapter 3: Module generalization view,  
 387, 431–434  
 Chapter 4: Module layered view, 387,  
 435–438  
 Chapter 5: Component-and-connector  
 pipe-and-filter view, 387, 439–442  
 Chapter 6: Component-and-connector  
 shared-data view, 387–388, 443–449  
 Chapter 7: Component-and-connector  
 communicating-processes view, 388





- Chapter 8: Allocation Deployment View, 388, 457–460
- Chapter 9: Allocation Implementation View, 388–389, 461–463
- Chapter 10: Allocation Work Assignment View, 389, 464–467
- ECS system (NASA)
  - background of, 391–392
  - broad requirements for, 394–395
  - deployment of, 395–396
  - EOS mission science data flow, 392–394
  - as example of decomposition style, 57
  - layered view from, 91, 92, 93
  - primary repository of, 132
- EDG. *See* EOS Data Gateway
- Education, and module views, 41
- Educational use, of architecture
  - documentation, 10
- Effects, and design decisions, 330
- Efficiency guide, in SCR-style interface, 252
- EJB. *See* Enterprise JavaBeans
- Element behavior, in element catalog, 319
- Element catalogs, 197–198, 260, 284, 318, 340, 365
- Element interface documentation, 229, 318–319
- Element mismatch, 123
- Elements
  - of allocation viewtype, 168, 169
  - alternative relationships among, 194
  - binding times for, 209
  - bridging, 189
  - in C&C viewtype, 106, 107–110
  - categories for, 210
  - in client-server style, 136
  - combining of, in creating new styles, 216
  - in communicating-processes style, 142
  - decomposition of in one style and substructure in another style, 190
  - of decomposition style, 54, 55
  - in directory, 328
  - and documenting mapping between views, 327
  - in generalization style, 72
  - informal sketch of activities through, 270
  - information about in notation key, 194–195
  - interfaces realized by, 240
  - interfaces with, 224, 257
  - of layered style, 80–81
  - list of, 323
  - of module viewtype, 42, 43
  - multiple actors interacting with, 244
  - with multiple interfaces, 225, 242
  - in overlay, 206
  - in peer-to-peer style, 140
  - in pipe-and-filter style, 126
  - and properties, in element catalog, 318
  - in publish-subscribe style, 133
  - relations in C&C viewtype, 106, 110
  - requirements of, 232
  - and resource semantics, 230
  - of shared-data style, 129
  - splitting, 205
  - in style guide, 39
  - three related, 192
  - of uses style, 65
- Elements affected by option, documenting, 209
- Element types, of hybrid style, 205
- “Elevator speech” test, 202
- Ellsberger, J., 285
- e-mail, 264
- Emphasis, visually distinct forms for, 322
- Encapsulation, 22, 23, 100, 181
- Encodings, choosing, 148
- End users
  - documentation needs of, 296
  - interest of, 296
- Engineering viewpoint, 373
- Enterprise architectures, 343, 344, 373
- Enterprise deployments, allocations and, 173
- Enterprise integration systems, 372
- Enterprise JavaBeans, 131, 134, 137
- Enterprise viewpoint, 372
- Environment, of element, 223, 224
- Environmental elements
  - of allocation viewtype, 168
  - in deployment style, 169–170
  - in implementation style, 177
  - representation of, 174
- Environmental structure, and software architecture, 183
- EOC. *See* EOS Operation Center
- EOS. *See* Earth Observing System
- EOS Data and Information System, 391, 395, 433
- EOS Data Gateway, 409
- EOSDIS. *See* EOS Data and Information System





EOSDIS Core System, 392  
 EOS Operation Center, 393  
 EOS Standard Products, 392  
 Error  
   conditions, 234  
   correction, and redundancy, 337  
   detection, 194  
   handling, 94, 121, 231, 233–236  
 Error-logging element, 194  
 ESA. *See* European Space Agency  
 Essential products, C4ISR Architecture  
   Framework, 358, 359  
 European Space Agency, 391  
 Event broadcast, 103  
 Event-oriented point of interaction, 244  
 Evidence, and design decisions, 330  
 Examples, in style guide, 40  
 Exception conditions, types of, 234–236  
 Exceptions, 118, 231, 234–236, 258  
   classification of, associated with resource  
   on element's interface, 235  
 Exception set, 236  
 Executable files, and component diagrams,  
   350  
 Execution path, in use case map, 270  
 Execution view, Siemens Four Views, 17,  
   353, 355, 356  
 Execution migrates to, 171  
 Existence of interfaces, showing, 239–241  
 Extended Computer Module, in A-7E  
   avionics system, 59  
 Extensible Markup Language, 255–257  
 Extension and evolution, and generalization  
   style, 73  
 Extension points, documenting, 210

**F**

Factor tables, 333, 334  
 Fagin-style code inspections, 337  
 Failover, 105  
 Failure recovery, and *n*-tier systems, 208  
 Failures, 172  
 Failure set, 236, 237  
 Fault tolerance  
   property, 172  
   and shared-data style, 129  
 Federal Aviation Administration, 246  
 Federates, 253  
 File structure, mapping of software  
   environment onto, 167  
 Fill patterns, and software elements, 174

Filter Behavior Module, in A-7E avionics  
   system, 60–61  
 Filter class, capsule stereotyped, 159  
 Filters, 107, 126, 127  
 Filter component type, 107, 108, 147, 155,  
   159  
   instances of, 159  
 Finite state machine, 276  
   and concurrency, 279  
   and SDL, 279  
   and statecharts, 277  
 First-class entities, connectors as, 123  
 Fitness of purpose  
   analyzing for, 32  
   documentation reviewed for, 28, 31, 335,  
   340  
 Flight Operations Segment, in ECS, 414,  
   424  
 Flowcharts, 365, 366  
 Flow control, depiction in sequence  
   diagrams, 272  
 Fonts, 321, 322  
 Footnotes, for assertions, 317  
 Form, and architecture documentation, 335  
 Formal notations for C&C styles, 145–159  
   Acme ADL, 145–147  
   ADLs, 145  
   UML, 148–157, 159  
 FOS. *See* Flight Operations Segment  
 “4+1 views,” xxxiii, xxxv, 32. *See also*  
   Kruchten 4+1, Rational Unified  
   Process 4+1 views  
 Framework models, 4  
 Frameworks, 76  
 Functional architecture, 17  
 Functionality  
   and *n*-tier systems, 208  
   property, 112

**G**

Gamma, E., 14, 217  
 “Gang of four” design patterns, 217, 218  
 Garlan, D., 22, 23, 32, 123, 165  
 Gateways, 262  
 GCDIS. *See* Global Change Data and  
   Information System  
 Generalization, 76  
 Generalization relation, 72, 73  
 Generalization/specialization relation, 387  
 Generalization style, 36, 42, 53, 71–77, 99  
   elements, relations, and properties, 72–73



examples of, 77  
 notations for, 74  
 overview of, 71–72  
 relations to other styles, 74  
 summary of, 72  
 uses for, 73–74  
 Generalization view, in ECS, 387  
 Generator access program, in A-7E avionics system, 247–248  
 Geometric adjacency, allowed-to-use relation denoted by, 83  
 get programs, in A-7E avionics system, 248  
 Global Analysis, 332–334, 341, 352  
 Global Change Data and Information System, and ECS, 395  
 Global climate change, 391  
   and ECS project, 309  
 Glossaries, 316, 323, 328, 339, 340  
   in architecture overview presentation, 332  
   and C4ISR, 361  
 GNU License, software registered under, 141  
 Gnutella open source project, 141  
 Granularity, 191, 196, 366  
 Graphical notations, for interfaces, 239  
 Growth, architecture's capacity for, 331  
 Guard conditions, in statecharts, 278

## H

Hardware, mapping of software architecture onto, 167  
 Hardware-hiding module, in A-7E avionics system, 59  
 Harel, David, 277, 285  
 Harvey, Miles, 323  
 Hearsay II, 130  
 Height, of tree, 247  
 Herzum, P., 17, 22  
 Hierarchical elements, 7  
 High Level Architecture, 135, 253  
 High Level Architecture publish-subscribe mechanism, 135  
 Hissam, S., 377  
 HLA. *See* High Level Architecture  
 Hoare, C. A. R., 26  
 Hofmeister, C., 17, 32  
 Hogrefe, D., 285  
 Honeywell Web site, 286, 287  
 Horizontal dimension, in sequence diagram, 271

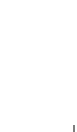
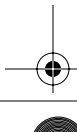
HPSM. *See* High Level Architecture publish-subscribe mechanism  
 HTML. *See* Hypertext Markup Language  
 HTTP. *See* Hypertext Transfer Protocol  
 Hybrid style, 201, 205, 207, 220  
 Hybrid views, representing, 206  
 Hyman, Isabelle, 343  
 Hyperlinking, 378  
 Hypertext documentation, 344, 378, 380  
 Hypertext Markup Language, 138  
 Hypertext Transfer Protocol, 138

## I

Icons  
   for implementation style, 178  
   use case, 198  
 Identity of interface, 228  
 Idiosyncracies, with commercial software components, 377  
 IDL. *See* Interface Definition Language  
 IEEE  
   Recommended Practice for Architectural Description of Software-Intensive Systems, 361  
   standard for architecture documentation, 343, 344  
 #ifdef facilities, 214  
 Impact analysis, 47  
 Implementation constraints, 46  
 Implementation information property, of module, 42, 45–46  
 Implementation inheritance, 73, 75  
 Implementation refinement, 192, 219  
 Implementation strategies, and style, 215  
 Implementation style, xxxii, 38, 175–179, 183  
   and code architecture view, 356  
   elements, relations, and properties of, 177–178  
   example of, 179  
   notation for, 178–179  
   overview of, 175–177  
   relation to other styles, 179  
   and software configuration management, 184  
   summary of, 177  
   uses for, 178  
 Implementation view  
   in ECS documentation, 388–389, 461–463  
   Rational Unified Process, 344, 346, 346, 348



- Implicit invocation, 133, 134
- Includes relation, 69
- Inconsistencies, in architecture overview presentation, 332
- Incremental development, 36, 70
- Indentation, 48
- Index, in ECS documentation, 403–404
- Informal notations, 397
  - for C&C styles, 144–145
  - for context diagrams, 198
  - for decomposition style, 56
  - for deployment style, 173–174
  - implementation view in, 178
  - for layered style, 83–87
  - for module viewtype, 48
  - for uses style, 65–66
  - for variability and dynamism, 212–213
- Information, segmenting of, 321
- Information design, 321–322
- Information-hiding, 5, 22, 54, 181
  - and decomposition style, 58
  - and layers, 82
- Information needs, of stakeholders, 290–300
- Information requirements, in ANSI/IEEE-1471-2000 standard, 363
- Information viewpoint, 372
- Infrastructure support people
  - documentation needs of, 298–299
  - interest of, 299
- IngestData, in ECS, 433
- Ingest subsystem, in ECS, 450–456
- Inheritance, 74, 76, 100
- Inherits-from relation, 35, 69
- Initialization program, 226
- init() method, 225
- Input ports, and pipes, 127
- Instability of commercial software components, 377
- Installation architectures, 373
- Instance-level collaboration diagram, 154
- Instances, 108
  - in Acme, 147
  - as classes, 160
  - classes for representing, 159–160
  - in collaboration diagram, 273
  - of Filters and Pipes, 155
  - and message sequence charts, 275
  - as objects in UML, 149
- Instruction execution speed, 171
- Integer type, in SDL, 280
- Integraters, 173
  - documentation needs of, 292–293
  - and interface documentation, 238
  - interests of, 293
- Integration testing, uses relation and, 71
- Intent, in HPSM, 135
- Interaction diagrams, 260
- Interactions, constraints on, 265
- Inter-element communication, 262
- Interface Definition Language, 241, 252
- Interface documentation examples, 246–257
  - custom notation, 253–255
  - IDL, 252
  - SCR-style interface, 246–252
  - XML, 255–257
- Interface inheritance, 73, 75
- Interface instances, 225
- Interface resource, example of
  - documentation for, 254
- Interfaces, xxxi, 3, 4, 6, 12–13, 120, 224–225, 245
  - in Acme, 147
  - balancing amount of information in documenting of, 226
  - of components, 108
  - definition of, 223
  - documentation of, 223–258, 229
  - in ECS documentation, 453
  - and Extensible Markup Language, 255–257
  - graphical notations for, 239
  - identity of, 228
  - Java, 231
  - notation for, 86
  - ports as, 151
  - principles about, 224–226
  - quality attribute characteristics of, 232
  - realized by elements, 240
  - resources in, 237
  - showing existence of, 239–241
  - symbols for, 240, 243
  - two-way, 257
  - in UML, 241
  - variability provided by, 232
  - and viewtypes of elements for, 223
  - writing specifications for, 226–228
- Interface stereotype, 241
- Interface types, 225
- International Partner Data Systems, 395





International Partner Ground Systems, 392  
International Partner Instrument Control Centers (ICC), 393  
International Telecommunications Union  
Telecommunications Standardization Sector, 279  
Web site, 285, 287  
Internet, 138  
Internetworking subsystem, 93  
Interoperability Subsystem, in ECS, 406  
Intraelement behavior, 262  
Invokes-procedure connector, 139  
Invokes-services role, 110  
IOS. *See* Interoperability Subsystem  
IPGS. *See* International Partner Ground Systems  
is-a relation, 42, 43, 50  
    and generalization style, 71  
    in module viewpoint, 44  
is-part-of relation, 35, 42, 43, 45, 50, 54, 56, 57, 386  
    in module viewpoint, 43–44  
    and textual schemes, 48  
Issue Card, in Global Analysis, sample, 334  
Issuing organization, name of, 316  
Italicizing words, 322  
ITU. *See* International Telecommunications Union

## J

Jackson, Michael, 221, 367  
Jacobson, I., 33, 285  
Jargon, avoiding, 25  
JavaBeans, 120  
Java interfaces, 231  
JavaPhone, 268  
    example use case for, 269  
    hierarchical structure and inter-element behavior in SDL for, 280  
    intraprocess behavior in SDL flowchart for, 281  
    message sequence chart for, 276  
    UML collaboration diagram for, 274  
    UML sequence diagram for, 272, 273  
    UML statechart for, 278  
    use case map, 270, 271  
    Z schemas for, 283  
Java RMI, 38, 139  
JavaSpaces, 130  
Jazayeri, M., 14  
JTAPI, 277, 278

## K

Kazman, R., xxxvi, 32, 57, 58  
Keys, xxxiv, 26, 56, 66, 87, 90, 111, 144, 194, 195, 197, 201, 202, 264, 317–318, 321, 331, 340  
    in ECS documentation, 397  
Keywords, relations indicated by, 48  
Knowledge-based systems, and shared-data style, 129  
Knowledge sources, 130  
Kron, H. H., 51  
Kruchten, Philippe, 15, 380  
Kruchten 4+1, 15–16, 32, 344–348

## L

Landsat 7, 392  
Language description, in documentation roadmap, 325  
Large systems, more views needed by, 202  
Late-binding parameters, 214  
Latencies, 2  
Layer diagrams, 81  
Layered process element type, 205  
Layered style, 19, 30, 36, 42, 53, 77–93, 99  
    elements, relations, and properties, 80–82  
    examples of, 91–93  
    notations for, 83–88  
    overview of, 77–80  
    relation to other styles, 88–91  
    uses for, 82–83  
Layered views, 14, 387  
    in ECS documentation, 435–438  
Layering  
    in *n*-tiered client-server architecture, 138  
    schemes, 78  
Layers, 80, 86, 95  
    bridging, 79  
    defined, 36  
    representational problems with UML  
        packages and, 88  
        size and color, 87  
    uses for, 82  
Level, of node in tree, 247  
Level of data, ECS, 406  
Libraries, 113  
LIM. *See* Local Information Manager  
Linda, 130  
Lines, 173  
Links  
    in collaboration diagram, 273–274  
    connector instances as, 152

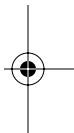


Link time, 209  
 Liskov, Barbara, 100  
 List of acronyms, 316  
 List of elements, 323  
 Local change or variation, and  
   generalization style, 74  
 Local Information Manager, and Data  
   Management Subsystem, in ECS, 447,  
   448  
 Locally defined data types, 231  
 Logical interfaces, 244  
 Logical view  
   Kruchten 4+1, 16  
   Rational Unified Process, 344, 345, 345,  
   348  
 Lollipop notation, 48, 151  
   and interfaces shown in UML, 241  
 Loops, 70, 366

**M**

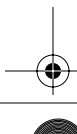
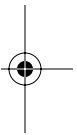
Main module, 120  
 Maintainers, 237  
   documentation needs of, 293–294  
   interest of, 294  
   Software Architecture Documentation  
   Package used by, 389–390  
 Malveau, R., 32  
 Management information, in  
   implementation information, 46  
 Manager, and interface documentation, 239  
 Mandatory attribute, variation point  
   characterized by, 212  
 Many-to-many mapping, 204  
 Many-to-one mapping, 203, 204  
 Mapping, 46, 89, 96  
   and combined views, 201, 202, 203  
   between component-and-connector view  
   and decomposition view, 57  
   between module decomposition view and  
   C&C communicating-processes view, in  
   ECS, 401  
   between module decomposition view and  
   C&C shared-data view, in ECS, 401  
   between module decomposition view and  
   module generalization view, in ECS,  
   401  
   between module decomposition view,  
   module uses view, allocation  
   implementation view, and allocation  
   work assignment view, in ECS,  
   402

  and module views, 49, 50  
   types of, 203–205  
   between views, 327, 335, 340, 400–402  
 Mapping table, 202  
 MBPS. *See* Megabits-per-second  
 Mediation, and multiple interfaces, 243  
 Megabits per second, 457  
 Memory allocation failures, 234  
 Memory  
   capacity, 171  
   properties, 171  
   stores and deployment style, 170  
 MergeAndFilter, 159  
 MergeAndSort, 147  
   refinement of, 128, 129  
 Message passing, 38, 142, 223, 406  
 Message sequence charts, 268, 274–275,  
   279, 284, 285  
   for JavaPhone, 276  
   Web sites on, 287  
 Messaging, 264  
 MetaH, 283, 375  
   user manual, 286  
   Web sites on, 287  
 Metamodels, 76  
 Meunier, H., 218  
 Middleware, 36  
 migrates-to relation, 170, 171, 173  
 Migration of objects, 213  
 Migration trigger property, 172  
 Million-instructions-per-second, 457  
 MIL-STD-498 military standard, 61  
 MIL-STD-2167A military standard, 61  
 MIPS. *See* Million-instructions-per-second  
 Miscommunication, 367–372  
 Mission to Planet Earth, 406  
   components of, 391  
   ECS and goals of, 395  
 Model-checkers, 296  
 Model checking, 261  
   verifiers, 12  
   and Z, 281  
 Model-View-Controller, 76, 134, 217  
 Modifiability, 1, 2, 8  
   analysts interested in, 296  
   analyzing, 298  
   and architecture documentation, 12  
   and design decisions, 330  
   and layers, 82  
   and shared-data style, 131  
 Modula modules, 22





- Module view, Siemens Four View, 17, 353, 354, 356
  - Module decomposition, 89
  - Module decomposition style
    - and RUP implementation view, 346
    - and work assignment style, 181
  - Module decomposition view
    - in ECS, 386, 414–418, 422, 423, 424, 430, 456
  - Module generalization style, and RUP implementation view, 346
  - Module generalization view
    - in ECS documentation, 431–434
    - mapping between module decomposition view and, in ECS, 401
  - Module generator, SCR-style interface for, 246–252
  - Module guide, 101
  - Module interconnection language, 22, 51
  - Module interconnection view, Siemens Four Views, 17
  - Module interfaces, 118
  - Module notations, in UML (examples), 49
  - Modules, xxxi, 5, 6, 7, 21, 22, 23, 24, 41, 50
    - defined, 35
    - implementing, 175
  - Module structure, 15
  - Module uses style, and RUP implementation view, 346
  - Module view, 41, 118, 227, 327
    - and ECS project, 309
    - UML class diagrams used in, 349
    - and views choices, 312
  - Module viewtype, xxxii, 18, 20, 21, 30, 35–36, 41–51, 289, 300. *See also* Styles of module viewtype
    - for A-7E avionics system, 307
    - control flow diagrams represented by using, 366
    - data flow diagrams represented in, 364
    - elements, relations, and properties of, 42–46
    - and module architecture view, 354
    - notations for, 48
    - overloading of, 49
    - overview of, 41–42
    - relation to other viewtypes, 48–50
    - summary checklist, 50
    - summary of, 42–43
    - uses for, 47–48
  - Mowbray, T., 32
  - MSC. *See* Message sequence charts
  - MTPE. *See* Mission to Planet Earth
  - Multidimensional separation of concerns, 221
  - Multiple elements from one view, mapping to single element of another view, 206
  - Multiple interfaces, 225, 242–244, 257
  - Multiple views, 203, 220
  - MVC. *See* Model-view-controller
- N**
- Name attribute, variation point
    - characterized by, 212
  - Name directory services, 37, 135
  - Name property
    - for layer, 81
    - of module, 42
    - of module viewtype, 44
  - Names, of issuing organizations, 316
  - n*-ary connectors, 120
  - NASA. *See* U.S. National Aeronautics and Space Administration
  - NASA/SPSO Product List Tables, 392
  - National Space Development Agency, Japan (NASDA), 391
  - National Transportation Safety Board, 246
  - Natural language, for conveying semantic information, 242
  - Natural type, in SDL, 280
  - Negotiated Attributed Ownership
    - Divestiture, 253, 254
  - Neighbors, 51
  - Nested states, 277
  - Nesting, and module viewtypes, 48
  - Nesting notation, for decomposition style, 56
  - Nesting of states, and statecharts, 277
  - Network Ingest Request, 407
  - New stakeholders
    - documentation needs of, 299
    - interest of, 299
  - New styles
    - creating and documenting, 215–217
    - documenting, 220
  - n*-level hierarchy, 137
  - NOAA, 393
  - Nodes, in UML notation for deployment style, 174, 175
  - Noncompleteness strategy, and statements in key, 195
  - Nord, R. L., 17, 32





Norwegian Computing Center (Oslo),  
 object-oriented concepts developed at,  
 100

Notation key, 194, 331. *See also* Keys

Notations, 26

- for C&C styles, 143–159
- for context diagrams, 198–200
- for decomposition style, 56
- in ECS documentation, 397
- for interface documentation, 239–242, 257
- for interfaces, 87
- for layered style, 83–88
- for message sequence charts, 275
- in sequence diagrams, 272, 273
- in statecharts, 279
- in style guide, 40
- in use case maps, 270, 271

*n*-tier client server architecture, 89, 91, 137,  
 181, 207–208

*n*-tier hierarchy, 138

*n*-tier systems, essence of, 208

Numbering schemes, 322

*n*-way data synchronization, 103

Nygaard, Kristen, 100

**O**

Object attributes, ports as, 151

Object code, 120

Object Constraint Language, 272

Object diagrams

- C&C views similar to, 103
- UML, 349

Object Management Group, 241, 285

- Web site, 287

Object-modeling notations, 48

Object orientation, 32

- architectural styles for, 32
- design, 36, 73, 217
- inheritance, and is-a relation, 44
- programming, 22, 41
- and Z, 283

Object request broker, 92

Objects, 36, 100, 103, 107, 120

- component instances in UML used as,  
 148
- components as, 154
- connector instances as, 153
- instances as in UML, 149

Object Z, 283, 286

Observer pattern, 134

Ockerbloom, J., 23

OCL. *See* Object Constraint Language

OMG. *See* Object Management Group

On-board attitude data, 407

One-to-many mapping, 204

Operational view, C4ISR Architecture  
 Framework, 357–358

Operation schema, 282

Optional attribute, variation point  
 characterized by, 212

Options

- binding time of, 209
- documenting dependencies among, 211
- elements affected by, 209

ORB. *See* Object request broker

Ordering constraints, 263

Organizational structure, mirroring of  
 architectural structure by, 179

Outline numbering, 48

Output ports, and pipes, 127

Overhead, and layers, 82

Overlays, 201

- combined views as, 220
- elements and relations in, 206

Overloading, of module viewtype, 49

Overview, in style guide, 39

Overview architecture diagram, 122

Oxford University, Z developed at, 286

**P**

Packages

- and module viewtype, 101
- in UML, 87–88, 153

Page formats, 315

Pan operation, and view packets, 189

Parameters

- compile-time, 214
- late-binding, 214

Parenthetical nesting, 48

Parents, 247, 317

- interfaces, 6, 45
- view packets and, 320

Parnas, David, 7, 15, 22, 32, 93, 94, 96, 236

- and SCR-style interface specifications,  
 258
- on uses relation, 71, 100

Parsers, and XML, 256

Parts description, in documentation  
 roadmap, 324–325

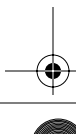
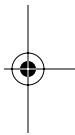
Pascal, Blaise, 25

Patient monitoring system, UML use case  
 diagram for, 198, 199



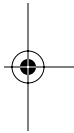


- Patterns, 76, 379. *See also* Design patterns  
  architectural, defining, 215  
  styles *versus*, 217–219
- Paulish, D. J., 179
- PCs, 207
- Peer-to-peer computing, xxxii, 140, 164
- Peer-to-peer style, 37, 119, 138, 139–141  
  elements, relations, and properties,  
    139–140  
  examples of, 141  
  implicit invocation combined with, 134  
  overview of, 139  
  relation to other types, 141  
  system in, 141  
  uses for, 140
- People elements, and work assignment style,  
  179, 180
- Performance, 1–2, 54, 105  
  analysts interested in, 296  
  analyzing, 202, 297, 388  
  and architecture documentation, 12  
  and C&C viewtype, 116  
  deployment style for analysis of, 172  
  and ECS project, 309  
  and *n*-tier systems, 208  
  and shared-data style, 131
- Performance analyst, and interface  
  documentation, 238
- Performance engineers, 172, 297  
  and architecture, 12  
  Software Architecture Documentation  
    Package used by, 389
- Performance property, 111
- Periodic communication, 272
- Perry, D. E., 15
- Persistence  
  components, 206  
  and resource usage restrictions, 231  
  and shared-data style, 131
- Perspectives  
  Architecture Tradeoff Analysis Method,  
    302–304  
  choosing connector abstractions, 114–115  
  classes used to represent component types  
    and instances, 159–160  
  data flow and control flow projections,  
    117–118  
  differences between architecture and  
    design, 5–8  
  global analysis, 332–334  
  levels of distraction, 95–97  
  meaning of “is,” 316–317  
  miscommunication, 367–372  
  multiple interfaces, 242–244  
  necessity of connectors, 112–113  
  presentation, 321–322  
  UML class diagrams, 97–99  
  upwardly mobile software, 94–95  
  what time is it?, 213–215
- Physical elements, and software element  
  requirements, 171
- Physical Models Module, in A-7E avionics  
  system, 61
- Physical units, environmental element  
  properties relevant to, 171–172
- Physical view, Kruchten 4+1, 16
- PId type, in SDL, 280
- Pipe, 126
- Pipe-and-filter style, xxxii, 19, 20, 37, 108,  
  118, 126–129, 163, 189  
  and ECS, 309  
  elements, relations, and properties,  
    126–127  
  examples of, 128–129  
  overview of, 126  
  relation to other styles, 127–128  
  summary of, 126  
  system in, 128, 190  
  uses for, 127
- Pipe-and-filter system  
  in Acme, 145  
  with shared database, 191
- Pipe-and-filter view, 208, 387  
  in ECS, 439–442
- Pipe-and-filter view packet, 190
- Pipe connector type, 108  
  in Acme, 146, 147
- PipeFilter family, 145–146, 165
- Pipeline, 127
- Pipes, 36, 109, 110, 127, 128
- Placeholders, 316
- Plus sign (+), package names prefixed with,  
  88
- Politi, M., 285
- Portability, 2, 79, 82
- Portability guide, 82
- Port instances, mapping to UML port-  
  stereotyped objects, 157
- Ports, 108, 109, 112, 120, 121, 153  
  and Acme ADL, 145  
  as annotations, 150–151  
  in capsule stereotyped Filter class, 159



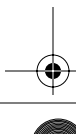
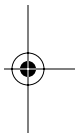


- Ports (continued)
  - as classes, 151–152
  - as class/object attributes, 151
  - difficulty in representing, 162
  - as UML interfaces, 151
  - ways of representing, 150–152
- Port types, mapping to port-stereotyped implementation classes, 157
- POSET, 284
- Postconditions, 242
  - for documenting resource usage restrictions, 231
  - and SCR-style interface, 248
- Postulates, 377, 378
- Precision
  - with interface specifications, 227
  - and resource semantics, 230
- Preconditions, 237, 242
  - for documenting resource usage restrictions, 231
  - and SCR-style interface, 248
- Predicate logic, Z language based on, 281
- Preexisting components, from commercial vendors, 377
- Presentation, importance of, 321–322
- Prieto-Diaz, R., 51
- Primary presentation 15, 48, 67, 77, 91, 128, 176, 182, 202, 241
  - graphical, 318
  - in RUP documentation, 348
  - in view packets, 317, 320
- Primitives, and statecharts, 277
- Priority
  - of events, 134
  - property of communicating-processes style, 142
  - of scenarios, in Architecture Tradeoff Analysis Method, 304
  - of views, during view selection, 306
  - of views, for A-7E avionics system, 308
  - of views, for ECS, 310–312
- Privacy, and shared-data style, 131
- Problem frames, 221
- Problem space, 221
- Problem statement, in architecture overview presentation, 330–331
- Procedure calls, 109, 128, 223
- Process models, 4
- Process stereotype, 150
- Process stop, and message sequence charts, 275
- Process structure, 15
- Process view
  - Kruchten 4+1, 16
  - Rational Unified Process, 344, 346–347, 348
- Processes, 7, 36, 103, 120
  - communication between blocks and, 280
  - failure, 234
  - and message sequence charts, 275
- Processing elements, 3
- Process migration, 373
- Processor clock speed, 171
- Process stereotype, 150
- Process stop, and message sequence charts, 275
- Process structure, 15
- Process style, 169
- Process view, 16
- Product line application builder, interest of, 295
- Product line implementation, 54
- Profiles
  - UML, 156–157, 159
  - UML-RT, 163
- Programming in the large, 22
- Programming-in-the-small, 51
- Program start-up time, 214
- Program write time, 214
- Projections, 121
- Project management architecture, 17
- Project manager
  - documentation needs of, 290–291
  - software architecture documentation package used by, 389
- Proofs, and Z, 281
- Properties, 106, 111, 143
  - and Acme ADL, 145
  - in allocation viewtype, 168, 169
  - in client-server style, 136
  - in communicating-processes style, 142
  - in decomposition style, 54, 55
  - in directory, 328
  - in element catalog, 318
  - in hybrid style, 205
  - of filters, 127
  - in layered style, 81–82
  - for modules, 35
  - in module viewtype, 42, 44–46
  - in peer-to-peer style, 140
  - in pipe-and-filter style, 126
  - in publish-subscribe style, 133





- in shared-data style, 130
    - in style guide, 39
    - in uses style, 65
  - Protocols, 3, 19, 109, 123, 233, 242, 262
  - ProtPipe, 157
  - provides information, and interfaces, 224, 257
  - Provides-services role, 110
  - P-specs, 365
  - Publish, definitions of in newspaper industry, 135
  - Publisher role, 110
  - Publish-subscribe connector, 105, 110
  - Publish-subscribe style, xxxii, 21, 37, 109, 120, 131, 132–135, 163
    - examples of, 135
    - overview of, 132–134
    - relation to other styles, 134
    - summary of, 133
    - uses for, 134
  - Publish-subscribe system
    - two versions of, 114, 115
    - views of, 192
  - Publish-subscribe view, 21
  - Putman, Janis, 380
- Q**
- Quality attribute utility tree, generating, 303
  - Query processing, for SDPS Data Management architecture, in ECS, 448–449
  - Queuing-thematic analysis, 216
- R**
- RAID. *See* Redundant array of inexpensive disks
  - RAID disk, Data Management Subsystem, in ECS, 446
  - Ran, A., 14
  - Rapide, 283–284, 286–287, 375
  - Rate-monotonic real-time schedulability analysis, 296
    - tools, 12
  - Rational Software Corporation, 15
    - Web site, 380
  - Rational Unified Process, 17, 32, 343, 344
    - approaches for achieving views in, 348
    - information about, 380
  - Rational Unified Process 4+1 views, 17, 344–348
    - deployment view, 344, 347, 348
    - implementation view, 344, 346, 348
    - logical view, 344, 345–346, 348
    - process view, 344, 346, 347, 348
    - use case view, 344, 345, 348
  - Rationale, 340, 379
    - and architecture, 319, 328–330
    - and C4ISR, 361
    - cost/benefit equation for, 330
    - and design issues, 232, 340
    - documenting, 27, 376
    - in ECS documentation, 398, 416, 432–433, 446–449, 454
    - for large-scale decisions, 323
    - for view packets, 198
  - Reader role, 110
  - Reader's viewpoint, documentation written from, 24–25
  - Real-Time Profile, UML, 152, 156–157, 159, 164
  - Real type, in SDL, 280
  - Redundancy, in active design reviews, 337
  - Redundant array of inexpensive disks, 171
  - Reference, organizing documentation for ease of, 27
  - Reference architectures, 210, 373, 374
  - Reference Model for Open Distributed Processing, 344, 372–373, 380
  - Reference models, 76
  - Refinement, 109, 187, 191–192, 219
    - descriptive completeness related to, 195
    - of MergeAndSort, 128, 129
  - Registry entries, 113
  - Relation notations, in UML (examples), 49
  - Relations
    - in allocation viewtypes, 168, 169
    - allowed-to-use, 42
    - in client-server style, 136
    - in communicating-processes style, 142
    - in decomposition style, 54, 55
    - in directory, 328
    - in ECS documentation, 415, 420, 429, 432, 435, 440, 445, 453, 459, 462, 465,
    - in hybrid view, 205
    - in implementation style, 177
    - in layered style, 81
    - and modules, 35
    - in module viewpoint, 42, 43–44
    - in overlay, 206
    - in peer-to-peer style, 140
    - in pipe-and-filter style, 126





Relations (continued)  
 and properties, in element catalog,  
 318  
 in publish-subscribe style, 133  
 in shared-data style, 130  
 in style guide, 39  
 UML class diagrams showing, 98  
 in uses style, 65  
 Relationship information, and style guide,  
 216  
 Relations section, in ECS documentation,  
 398  
 Relation to other views section, in style  
 guide, 40  
 Relevant views, 13  
 Reliability, 1  
 analysis, 105  
 and C&C viewtype, 116  
 deployment style for analysis of, 172  
 and shared-data style, 131  
 Reliability property, 111  
 Remote method invocation, 38  
 Remote procedure call, 50, 264  
 Repetition  
 avoiding, 25, 378  
 controlling, 373  
 Replication, 212–213, 373  
 Repositories, 36  
 Representation, 8  
 Request-reply connector, 136, 138, 141  
 Request-reply invocation, 138  
 Requirement specification, message  
 sequence charts for, 275  
 Requirements traceability, 47  
 requires information, and interfaces, 224,  
 257  
 Resource consumption property, 172  
 Resource requirements, and constraints  
 satisfied property, 172  
 Resource requirements property, 111–112  
 Resources, 224, 230  
 in interface document, 228  
 in interfaces, 237  
 reallocating, 211, 213  
 undesired circumstances and actions  
 taken by, 233–234  
 Resource semantics, 229, 230  
 Resource syntax, 229  
 Resource usage restrictions, 231  
 Responsibilities  
 and modules, 35

reallocation of, 211  
 and use case maps, 269  
 Responsibilities property  
 of module, 42  
 of module viewtype, 44  
 Reuse, 36  
 and combining styles, 216  
 and generalization style, 74  
 Reviewers, 336  
 and active design review, 337, 338  
 Rich reasoning, connector abstractions and  
 support for, 113  
 Rings, using to represent layers, 84–85  
 RMI. *See* Remote method invocation  
 RM-ODP. *See* Reference Model for Open  
 Distributed Processing  
 Rohnert, H., 218  
 Roles, 112, 120, 153  
 and Acme ADL, 145  
 connector, 109  
 Roots, 247  
 Rowling, J. K., 209  
 RPC. *See* Remote procedure call  
 RTI. *See* Runtime infrastructure  
 Rumbaugh, J., 285  
 “Running the architecture,” 261  
 Runtime, 209, 214  
 dependencies, 173  
 XML used for exchanging information at,  
 256  
 Runtime information, compile time  
 information *versus*, 213–215  
 Runtime infrastructure, 135, 253  
 Runtime presence, and C&C views, 120

**S**

SADL, 375  
 Safety, analysis techniques for, 261  
 Safety critical property, 172  
 Same-view view packets, 188–189  
 Sandwiching, 70  
 Sarma, A., 285  
 Satellites, NASA, 392  
 Scalability, and n-tier systems, 208  
 Scaling, 3  
 Scenarios, 16, 336  
 ATAM and prioritizing of, 304  
 dependencies among options shown by, 211  
 and simulation, 263  
 and system analysis, 261  
 trace-oriented, 233



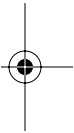


- tracing, 332
- usage, 242
  - and use case maps, 269
- SCF. *See* Science Computing Facility
- Schedulability, analysis techniques for, 261
- Schedule estimates, and work assignment style, 181
- Schedules, and views choice, 290, 312
- Schema Account, 282
- Schemas, in Z, 281
- Schmidt, D., 165
- Science Computing Facility, in ECS, 407
- Science data processing, 92
- Science Data Processing Segment, in ECS, 407, 449
  - Module Generalization View Packet for, 431–434
  - Module Uses View Packet for, 426
- Science Investigator-led Processing System, in ECS, 407
- Science software, 407
- Scientific Computing Facilities, 393
- Scientist, as ECS stakeholder, 407
- SCR. *See* Software Cost Reduction
- Scribes, 302
- Scripts, and component diagrams, 350
- SCR-style interface, 246–252, 258
- SDL. *See* Specification and description language
- SDL diagrams, 285
- SDL Forum Society, Web site, 285
- SDPS. *See* Science data processing
- Seacord, R., 377
- Security, 1, 2, 105, 373
  - analysts interested in, 296
  - analyzing, 298
  - and architecture documentation, 12
  - deployment style for analysis of, 172
  - and ECS, 309
  - and shared-data style, 131
- Security analyst, software architecture
  - documentation package used by, 389
- Security architectures, 373, 374
- Security property, 112
- Segmented layers
  - documenting in UML, 89
  - notation for, 83–84, 85–86
- Selection decisions, 376–377
- Semantic information, 242
  - and behavioral documentation, 259
  - for interface documentation, 257
- Semantic match, 148
- Semantics, 232
  - resource, 229
  - and style, 215
- sends-data-to relation, 192, 364
- Sensor component type, 107
- Sequence diagrams, 99, 263, 268, 270–272, 284
  - and collaboration diagrams, 274
  - for JavaPhone, 273
  - Web sites on, 287
- Servers, 19, 103, 107, 120, 136
- Server type, 108
- Service-oriented point of interaction, 244
- Set theory, Z language based on, 281
- Shading, of software elements, 174
- Shadow boxes, and component replication, 212
- Shared-data style, 19, 20, 125, 129–132, 163, 189
  - in component-and-connector viewtype, 37
  - elements, relations, and properties, 129–131
  - example of, 132
  - overview of, 129
  - relation to other styles, 131
  - summary of, 129–130
  - system of, 190
  - uses for, 131
- Shared-data view, 208, 310, 312
  - in ECS documentation, 443–449
  - in ECS, mapping between module decomposition view and, 401
- Shared memory, 223
- Shaw, Mary, 4, 22, 32, 123, 165, 258
- Siblings, 247
  - relationships, 219, 317
  - and view packets, 188, 320
- Sidebars, xxxiv, 322
- Side effects, 229, 231
- Siemens Corporate Research, 17
- Siemens Four View model, 17, 343–344, 352, 353, 380
  - code architecture view, 355–356
  - conceptual architecture view, 353, 354
  - execution architecture view, 355
  - global analysis, 352
  - module architecture view, 354
- Signal-processing applications, and pipes
  - and filters, 127





- Signal-processing systems, 37, 126
- Signals, 280
- Signature information, and interfaces shown in UML, 241
- Signature matching, 245, 246
- Signatures, 21, 229, 245, 246
- Sign-off approvals, 315
- Simple Object Access Protocol, 257
- Simple PipeFilter system, 159
- Simple system, UML-RT description for, 158
- Simplicity, with presentation, 322
- Sims, O., 17, 22
- Simula-67, 100
- Simulation, 12, 296
  - message sequence charts for, 275
  - and system development, 263
- Simulation generators, 12, 296
- Sink protocol role, 157
- SIPS. *See* Science Investigator-led Processing System
- Size, of trees, 247
- Slashes, role in collaboration denoted by, 157
- Slice, 63
- Smalltalk, 22, 100
- Smith, C., 33
- Snyder, Alan, 100
- SOAP. *See* Simple Object Access Protocol
- Sockets, 36
- Software architects, xxv, xxxi. *See also* Architects
- Software architecture, xxv, 360, 379
  - and accurate time and budget estimates, 179
  - and allocations, 173
  - categories of, 21
  - definitions of, 2–4, 5
  - emergence of, 1
  - and environmental structure, 183
  - mapping of, 167
  - Siemens Four Views approach to, 353
- Software configuration management, and implementation style, 184
- Software Cost Reduction, 246
- Software Decision Module, in A-7E avionics system, 59
- Software elements
  - of allocation viewtype, 168
  - in deployment style, 170
  - properties relevant to, 172
- Software engineering, software architecture as subdiscipline within, 1
- Software Engineering Institute (Carnegie Mellon University), xxv, 2
  - software architecture Web page, 32
- Software interface documentation, 223–258
  - examples of, 246–257
  - interface specifications, 226–228
  - notation for, 239–242
  - overview of, 223–226
  - stakeholders of, 237–239
  - standard organization for, 228–233
- Software modules
  - Java compiler version as example of property of, 178
  - and work assignment style, 179
- Software product line, 294
- Software projects, architecture-based management of, 184
- Software Utility Module, in A-7E avionics system, 61
- Software work breakdown structures, 179
- Solution space, 221
- Sommerlad, P., 218
- Soni, D., 17, 32
- Source code, 41, 43, 47, 175, 350, 353, 355
- Source code files, and component diagrams, 350
- Source protocol role, 157, 159F
- Specification, 8
- Specification and description language, 276, 279–281, 284
  - and message sequence charts, 275
  - Web site on, 287
- Specification-level collaboration diagram, 154
- Spivey, J. M., 286, 288
- Splitter, 159
- Splitter filter, 147
- SQL. *See* Structured query language
- Stack-based error propagation scheme, 94
- Stack layers, notation for, 83
- Stafford, J. A., 287
- Stakeholder communication needs, and architecture documentation, 10–11
- Stakeholders, 10, 14, 30, 227, 257, 258, 373
  - and abstract interface documents, 255
  - communicating with, 300, 302
  - documentation accessibility and, 379
  - documentation needs of, 299–300





- and documentation of system analysis
  - behavior, 260
  - documentation organization for, 324–326
  - and documentation roadmap, 325
  - ECS, 311
  - identifying, 335, 336
  - and interface documentation, 237–239
  - interfaces written for, 246
  - packaging system for, 315
  - software architecture documentation
    - package used by, 389–390
  - study of documentation needs of, 301
  - and styles, 20
  - view choices and needs of, 203
  - and viewpoints in ANSI/IEEE-1471-2000, 362
- Stal, M., 218
- Standard organization, for documentation, 26–27
- Start, example of communicating-processes connector mechanism, 142
- Statecharts, 99, 255, 260, 276, 277–279, 284
  - for JavaPhone, 278
  - references on, 285
  - and state diagrams, 277
  - web sites on, 287
- Stateless protocol, 138
- States, communication among, 279
- State schema, 282
- Static models, 267, 275–284
  - other notations, 283–284
  - SDL, 279–281
  - statecharts, 277–279
  - Z, 281–283
- Static structure diagrams, 349
- Stdio module, 119, 120
- Stereotypes, 174–175
- Stop, example of communicating-processes connector mechanism, 142
- Stream-of-consciousness writing, 25
- Stream-of-execution writing, 25
- String-processing application, in pipe-and-filter style, 128–129
- Structural relationships, and system views, 259
- Structured query language, 225
- Structure of systems, and structure of organizations, 184
- Structures, software, 15
- Style catalogs, 165, 215
- Style guides, 19, 108, 109, 121, 215, 220
  - and attachments, 110
  - for documentation, 322
  - interdependent questions imposed by, 216
  - standard organization of, 39–40
- Styles, xxxii, 18–20, 143, 217–219, 379
  - combinations among, 201
  - combining, 216–217
  - in component-and-connector viewtype, 36–38
  - definition of new type in, 207
  - in module viewtype, 35–36
  - techniques for developing, 216–217
  - for viewtypes, 21
  - of writing, 321
- Styles of allocation viewtype, 169–182
  - deployment style, 169–175
  - implementation style, 175–179
  - work assignment style, 179–182
- Styles of component-and-connector viewtype, 125–165
  - client-server style, 125, 135–139
  - communicating-processes style, 125, 142–143
  - notations for, 143–159
  - peer-to-peer style, 125, 139–141
  - pipe-and-filter style, 125, 126–129
  - publish-subscribe style, 125, 132–135
  - shared-data style, 125, 129–132
- Styles of module viewtype, 53–101
  - decomposition style, 53–62
  - generalization style, 71–77
  - layered style, 77–93
  - uses style, 64–68
- Style specialization, 217
- Subclasses, 240
- Submodules, 45, 54
- Subscriber role, 110
- Substates, 277, 279
- Substitutability, 46–47
- Substructure, 162
- Subsystem construct, for representing modules, 66
- Subsystems, 54, 164
  - choice of, 153
  - components as, 154, 155, 156
  - discussion of, 62–64
  - and global analysis, 332
  - internetworking, 93
  - and layers, 91





Subsystems (continued)  
 and module viewpoint, 101  
 using, 154–156  
 Subsystem stereotype, 153  
 Subtasks, 95  
 Subtrees, 247  
 Subtypes, and inheritance, 76  
 Summary, 316  
 Superstate, 277  
 Supporting documentation, 320  
 Supporting products, C4ISR Architecture Framework, 358, 359–360  
 Symbols. *See also* Icons; Notations  
 options attached to, 212  
 use case maps, 270, 271  
 variation points represented by, 212  
 Synchronization, 3, 38, 142  
 Synchronous communication, 264, 265, 272, 284  
 Synchronous service invocation, 137  
 Syntactic information, conveying, 241  
 Syntax, 229, 232  
 System analysis  
 architecture as basis of, 12  
 and behavior documentation, 260  
 driving development activities, 262–263  
 System architecture, software architecture *versus*, 360  
 System builder, and interface  
 documentation, 238  
 System building, and implementation style, 178  
 System context, in architecture overview  
 presentation, 331  
 System decomposition, 262  
 System deployment, cost of, 173  
 System documentation, message sequence charts for, 275  
 System Generation Module, in A-7E  
 avionics system, 61  
 System overview, 326, 340  
 Systems, 143  
 as collaborations, 154, 155  
 as contained objects, 153  
 mapping to collaborations, 157  
 as UML subsystems, 153  
 Systems analysis, and behavioral  
 documentation, 261–262  
 Systems architecture view, C4ISR  
 Architecture Framework, 358, 360

Systems configuration parameters, SCR-style interface, 250  
 Szyperski, C., 22

**T**  
 Table of contents, 315  
 in ECS documentation, 384, 411–413  
 Tables, and documenting mapping between views, 327  
 Tachtenberg, Marvin, 343  
 Tagging, layer interfaces, 88  
 Tasking failure, 234  
 TBD. *See* To be determined  
 TCOZ, 283, 286  
 TDRS. *See* Tracking and Data Relay Satellites  
 Team resource allocation management, and work assignment style, 181  
 Teams, and work assignment view, 179  
 Team structure, mapping of software architecture onto, 167  
 Technical architecture, 17  
 Technical architecture view, C4ISR  
 Architecture Framework, 358, 360  
 Technical communication, 321  
 Technical writers, xxxi  
 Technology viewpoint, 373  
 Telephony, and SDL, 279  
 Terminal Connection substate, 277, 278  
 Terms. *See* Coming to terms  
 Test-case specification, message sequence charts for, 275  
 Tester of element, and interface  
 documentation, 237–238  
 Testers  
 documentation needs of, 292–293  
 interests of, 293  
 Test information, in implementation  
 information, 46  
 Text-based approach, advantages with, 147  
 Textual primary presentation, 318  
 Theorem provers, 12, 296  
 Three-dimensional models, notation for, 85–86  
 Three-tier architecture, 207  
 Three-tier system, 208  
 Throughput, 2  
 Tiers, 207  
 layers confused with, 89–90, 91  
 in *n*-tiered client-server architecture, 138  
 Tilt operations, and view packets, 189





- Time-based dependencies, 266
  - Timeouts, 118, 121, 275
  - Time-related constraints, 263
  - Timers, and message sequence charts, 275
  - Time to market, 329
  - Time type, in SDL, 280
  - Title pages, 315
  - TLCD. *See* Top-level context diagram
  - Toaster models, 85
  - To be determined, 27
  - Tool support
    - and choice/number of views, 203
    - and XML, 256
  - Top-level context diagrams, 196–197, 219
  - Top-level view packets, 191
  - Trace-oriented models, 284
  - Trace-oriented scenarios, 233
  - Traces, 242, 266–267, 268–275
    - collaboration diagrams, 272–274
    - message sequence charts, 274–275
    - to requirements, 336
    - sequence diagrams, 270–272
    - use case maps, 269–270
    - use cases, 268–269
    - use of various types in behavioral documentation, 268
  - Tracking and Data Relay Satellites, 392
  - Transactions, 373
  - Transfers-control relation, 366
  - Transitions, and substates, 277, 279
  - Tree, definition of, 247
  - Triggered knowledge source, 130
  - Tuples, 130
  - Tuple spaces, 130
  - Two-tier systems, 37, 136, 207
  - Type checking, and Z, 281
  - Types, 321
    - in Acme, 146
    - as classes, 160
    - as classes in UML, 149
    - in components of C&C view, 107
    - and inheritance, 76
- U**
- UML. *See* Unified Modeling Language
  - UML components, components *versus*, 161–162
  - Underlining words, 322
  - UniCon, 375
  - Unified Modeling Language, xxv, xxxvi, 143, 162, 184, 260, 344
    - access dependency, 88
    - behavioral diagrams, 352
    - C&C views documented with, 148–157, 159
    - class and object diagrams in, 349–350
    - component diagrams in, 350–351
    - decomposition style notations in, 56
    - deployment diagrams in, 351
    - deployment views, 175
    - interface and implementation inheritance shown by, 75
    - interfaces, ports as, 151
    - interfaces shown in, 241
    - layers in, 87
    - module notation examples, 49
    - and modules, 41
    - new developments with, 380
    - notations for context diagrams, 198–200
    - notations for deployment style, 174–175
    - notations for generalization style, 74
    - Real-Time profile (UML-RT), 152, 156–157, 159, 163, 164, 165
    - Real-Time profile, summary of mapping from C&C to, 158
    - Real-Time profile ports, component ports mapped to, 157
    - relation notations in, 49
    - segmented layers documented in, 89
    - sequence diagram in, 272
    - subsystems, 63–64, 153, 154–156
    - use case diagrams, 199
    - uses style in, 66–67
  - Uniform resource indicator, 256
  - Uniform resource location, 139
  - UNIX pipes, 37, 126
  - Unused services, and layers, 82
  - Updates, in HPSM, 135
  - Upwardly mobile software, 94–95
  - Upward uses, 94, 95
  - URL. *See* Uniform resource location
  - U.S. Department of Defense, 253, 380
    - and C4ISR Architecture Framework, 356, 357
  - U.S. Global Change Research Program, 395
  - U.S. National Aeronautics and Space Administration, ECS system at, 381
  - U.S. Navy, A-7E avionics system, 101, 306–308
  - Usability
    - analysts interested in, 296
    - analyzing, 298
    - and architecture documentation, 12



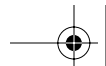
Usage  
 and interface specifications, 230  
 restrictions, 232  
 scenarios, 242  
 Usage guide, 232–233  
 Usage guide section, in behavioral  
 documentation, 260  
 Use, definition, 78  
 Use case diagrams, 99, 198  
 Use case icon, 198  
 Use case maps, 268, 269–270, 284  
 references on, 286  
 Web sites on, 288  
 Use cases, 268–269, 284, 331  
 references on, 286  
 in use case diagrams, 198  
 Use case diagrams, UML, 199  
 Use case view, Rational Unified Process,  
 344, 345, 345, 348  
 use-mechanism relation, and execution  
 architecture view, 355  
 User interface features, in ECS, 409  
 User name type, 139  
 Users, Software Architecture Documentation  
 Package used by, 390. *See also*  
 Stakeholders  
 Uses  
 meaning of, 78  
 upward, 94, 95  
 Uses relation, 65, 66, 68–71, 387  
 introduction of, 100  
 and uses style, 36  
 Uses structure, 15  
 Uses style, 30, 42, 53, 64–71, 91, 99  
 elements, relations, and properties, 65  
 example of, 67  
 in module viewtype, 36  
 notations for, 65  
 overview of, 64–65  
 relation to other styles, 67  
 summary of, 65  
 in UML, 66–67  
 uses for, 65  
 Uses views, 308  
 in ECS, 310, 387, 426–430  
 and modifiability, 298

**V**

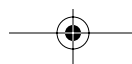
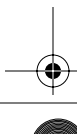
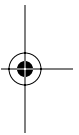
Vagueness, and interface specifications, 230  
 Validation  
 message sequence charts for, 275

of software architecture documentation,  
 335–338  
 Value, of nodes in tree, 247  
 Value assignment, and resource semantics, 229  
 Van der Linden, F., 14  
 Variability  
 documenting, 187, 209–210, 211, 220  
 notations for, 212–213  
 Variability guide, 211  
 in ECS documentation, 398, 416, 421, 438  
 for view packets, 198, 319, 340  
 Variation points, 209, 211, 212, 214  
 Verbs, and interface specifications, 230  
 Version  
 branches, 177  
 for ECS documentation, 383, 410  
 numbers, 316  
 Vertical dimension, in sequence diagram, 271  
 Vertical slice, 63  
 View choices, 289–313  
 examples of, 306–312  
 making, 305–306  
 prioritizing, 306  
 stakeholders and documentation needs,  
 290–300  
 Viewgraphs, 330  
 View packets, 187, 188–191, 219  
 components of, 340  
 context diagrams in supporting  
 documentation for, 197–198  
 description of, 188  
 descriptive completeness, refinement  
 and, 195  
 from different views, 189–191  
 in ECS documentation, 389  
 ECS views presented as, 397  
 element catalog for, 197–198  
 elements in one style composed of  
 elements arranged in another style, 190  
 parts in documenting of, 321  
 rationale for, 198  
 related, 320  
 same system seen in different lights, 191  
 same-view, 188–189  
 variability guides for, 198  
 Viewpoints  
 in ANSI/IEEE-1471-2000 standard,  
 361–362  
 and RM-ODP standard, 372–373  
 Views, 13–15, 32, 315, 379  
 architectural, 15–17





- code, 17
  - combinations among, 201
  - conceptual, 17
  - coordinated use of, 313
  - decomposition refinements used in, 192
  - deployment, 14
  - development, 16
  - documentation beyond, 323–330
  - documenting, 15, 317–320
  - execution of, 17
  - in implementation style, 176
  - interface specifications documented as
    - part of, 227
  - layered, 14
  - logical, 16
  - many separate ones or a few combined ones?, 202–203
  - mapping between, 327, 335, 340
  - module interconnection, 17
  - physical, 16
  - process, 16
  - template for documentation beyond, 324
  - times for combining, 201–203
  - top-level context diagrams for, 197
  - View-specific information, in element's interface, 224
  - View templates, 323, 340
    - and C4ISR, 361
    - organization of, 326
  - Viewtypes, xxxi, 18
    - allocation, 35, 38–39
    - categories of, 18, 20
    - component-and-connector, 35, 36–38
    - module, 35–36
    - styles for, 21
  - Virtual machines, 77, 78, 79, 93
  - Visibility information, and modules, 35
  - Visibility of interface(s) property, of module
    - viewtype, 44–45
  - Visibility property, 54
  - Visual Basic, 133
  - Visual clarity, in UML, 148
  - Visual documentation, 104
  - Visual emphasis, consistency of, 321
  - Visual styles, consistency with, 322
  - Vocabulary, of style, 215. *See also* Coming to terms
- W**
- Walkthroughs, 367
  - Wallnau, K., 377
  - Watchdog information, and
    - communicating-processing style, 143
  - Waugh, Evelyn, 329
  - Web-based documentation, 378
  - Web site(s)
    - ACM special-interest group on hypertext, hypermedia, and the Web, 378
    - collaboration diagrams, 287
    - Honeywell, 286, 287
    - International Telecommunications Union, 285, 287
    - message sequence charts, 287
    - MetaH, 287
    - Object Management Group, 287
    - Rational Software Corporation, 380
    - SDL Forum Society, 285
    - sequence diagrams, 287
    - software architecture, at SEI, 32
    - Specification and description language, 287
    - statecharts, 287
    - use case maps, 288
    - Z, 288
  - Weiss, David, on active design reviews, 336–338
  - White-filled boxes, conjugate roles shown as, 159
  - Williams, L., 33
  - Window systems, as client-server style, 135
  - Wolf, A. L., 15, 287
  - Words, visual emphasis for, 322
  - Work assignment, 5
  - Work assignment style, xxxii, 30, 57, 179–182, 183
    - in allocation viewtype, 38–39
    - elements, relations, and properties, 179–180
    - example of, 182
    - notations for, 181
    - relation to other styles, 181–182
    - uses for, 180–181
  - Work assignment views, 54
    - and combined views, 310
    - in ECS, 312, 389, 464–467
  - Work breakdown structures, and work assignment style, 181
  - World Wide Web, 138
  - Worms, 214
  - Wright, 375
  - Writer role, 110





Writing style, 321

Wuerges, H., 94

**X**

XML. *See* Extensible Markup Language

**Y**

Yang, Chen Ning, 289

Youngest child, in tree, 247

**Z**

Z, 221, 276, 281–283, 284

  references on, 286

  Web sites on, 288

Zero, division by, 235

Zoom in/zoom out operations, and view  
  packets, 189, 191

Z schemas, for JavaPhone, 283

