

WHAT IS CLAIMED IS:

1. An information technology (IT) computer system comprising:

a controller;

a resource for connection to the controller, wherein the resource comprises a first service and a second service, wherein the first and second services have dependency with respect to each other, wherein the first service comprises a dependency service with respect to the second service, and wherein the second service comprises a dependent service with respect to the first service; and

an application programming interface (API) that interfaces the first and second services with each other and with the controller; and

wherein the controller is configured to manage an interoperability of the first service with respect to the second service.
2. The system of claim 1 wherein the second service is configured to issue a call on the first service through the API for the first service to perform an operation.
3. The system of any of claims 1-2 wherein the first service is configured to ask the controller to validate the second service in order to perform an operation for the second service.
4. The system of claim 3 wherein the controller is further configured to validate the second service based on at least one of mutual tls authentication, public key authorization, and/or network-based validation.
5. The system of any of claims 1-4 wherein the first service is configured to perform an operation for the second service contingent on a permission from the controller.
6. The system of any of claims 1-5 wherein the controller is further configured to provision encryption keys to the first and second services for use in validation of the first and second services.

7. The system of claim 6 wherein the encryption keys comprise different key pairs for each of the first and second services, each key pair comprising a public key and a private key.
8. The system of claim 7 wherein the controller is further configured to delete its copies of the private keys after provision of the private keys to the first and second services, and wherein the controller is configured to manage validation of the first and second services based on the public keys.
9. The system of any of claims 1-8 wherein the controller is further configured to disconnect the resource from any external networks when the first and/or second service is being configured by the controller.
10. The system of claim 9 wherein the controller is further configured to re-connect the resource to any disconnected external networks after the first and/or second service has been configured by the controller.
11. The system of any of claims 9-10 further comprising at least one of an in band connection, an out of band connection, and/or a storage area network connection between the resource and the controller, and wherein the controller is further configured to disconnect the resource from the in band connection, out of band connection, and/or storage area network connection when the first and/or second service is being configured by the controller.
12. The system of claim 11 wherein the controller is further configured to re-connect the resource to the disconnected in band connection, out of band connection, and/or storage area network connection after the first and/or second service has been configured by the controller.
13. The system of any of claims 1-12 wherein the controller is further configured to resolve dependencies between the first and second services.
14. An information technology (IT) method for use with a computer system comprising a controller, a resource connected to the controller, wherein the resource comprises a first service and a second service, wherein the first and second services have dependency with respect to each other,

wherein the first service comprises a dependency service with respect to the second service, and wherein the second service comprises a dependent service with respect to the first service, the method comprising:

interfacing the first and second services with each other and with the controller via an application programming interface; and

the controller managing an interoperability of the first service with respect to the second service.

15. The method of claim 14 further comprising:

the second service calling on the first service through the API for the first service to perform an operation.

16. The method of any of claims 14-15 further comprising:

the first service asking the controller to validate the second service in order to perform an operation for the second service.

17. The method of claim 16 further comprising:

the controller validating the second service based on at least one of mutual tls authentication, public key authorization, and/or network-based validation.

18. The method of any of claims 14-17 further comprising:

the first service performing an operation for the second service contingent on a permission from the controller.

19. The method of any of claims 14-18 further comprising:

the controller provisioning encryption keys to the first and second services for use in validation of the first and second services.

20. The method of claim 19 wherein the encryption keys comprise different key pairs for each of the first and second services, each key pair comprising a public key and a private key.
21. The method of claim 20 further comprising:
the controller deleting its copies of the private keys after provision of the private keys to the first and second services; and
controller managing validation of the first and second services based on the public keys.
22. The method of any of claims 14-21 further comprising:
the controller disconnecting the resource from any external networks when the first and/or second service is being configured by the controller.
23. The method of claim 22 further comprising:
the controller re-connecting the resource to any disconnected external networks after the first and/or second service has been configured by the controller.
24. The method of any of claims 22-23 wherein the resource is connected to the controller via at least one of an in band connection, an out of band connection, and/or a storage area network connection between the resource and the controller, the method further comprising:
the controller is further disconnecting the resource from the in band connection, out of band connection, and/or storage area network connection when the first and/or second service is being configured by the controller.
25. The method of claim 24 further comprising:
the controller re-connecting the resource to the disconnected in band connection, out of band connection, and/or storage area network connection after the first and/or second service has been configured by the controller.
26. The method of any of claims 14-25 further comprising:

the controller resolving dependencies between the first and second services.

27. An information technology (IT) computer system comprising:

a controller;

a resource for connection to the controller, wherein the resource comprises a first service and a second service, wherein the first and second services have dependency with respect to each other, wherein the first service comprises a dependency service with respect to the second service, and wherein the second service comprises a dependent service with respect to the first service; and

wherein the controller is configured to maintain a cleanup rule that identifies a modification made to the first service as a dependency of the second service, wherein the cleanup rule supports deletion, removal, and/or undoing of the modification to the first service if the second service is deleted and/or disabled.

28. The system of claim 27 wherein the second service is configured to call on the first service for the first service to perform an operation, and wherein the modification to the first service relates to performance of the operation; and

wherein the controller is configured to identify the modification to the first service as part of the cleanup rule.

29. The system of claim 28 wherein the cleanup rule associates the modification to the first service with the second service.

30. The system of any of claims 28-29 wherein the controller is further configured to (1) determine that the second service is or is to be deleted and/or disabled, and (2) in response to the determination that the second service is or is to be deleted and/or disabled, apply the cleanup rule to delete, remove, and/or undo the identified modification to the first service.

31. The system of any of claims 27-30 wherein the resource comprises a plurality of additional services that have dependencies with respect to each other, and wherein the cleanup rule comprises a plurality of cleanup rules that identify modifications made to the services by services.

32. The system of claim 31 wherein each service that is a dependent service is associated with cleanup rules that identify modifications to its dependency services.
33. The system of any of claims 31-32 further comprising:
an application programming interface (API) that interfaces the services with each other and with the controller.
34. The system of claim 33 wherein the dependent services are configured to call on their dependency services through the API; and
wherein the controller is configured to identify the modifications to the dependency services as part of the cleanup rules.
35. The system of claim 34 wherein the API is configured to log commands from the services, and wherein the controller is further configured to generate the cleanup rules from the logged API commands.
36. The system of any of claims 27-35 further comprising a plurality of resources for connection to the controller, wherein the resources comprise a plurality of services that have dependencies with respect to each other, and wherein the cleanup rule comprises a plurality of cleanup rules that identify modifications made to the services by services.
37. An information technology (IT) method comprising:
running a first service and a second service on a resource in a computer system that includes a controller connected to the resource, wherein the first and second services have dependency with respect to each other, wherein the first service comprises a dependency service with respect to the second service, and wherein the second service comprises a dependent service with respect to the first service; and

the controller maintaining a cleanup rule that identifies a modification made to the first service as a dependency of the second service, wherein the cleanup rule supports deletion, removal, and/or undoing of the modification to the first service if the second service is deleted and/or disabled.

38. The method of claim 37 further comprising:

the second service calling on the first service for the first service to perform an operation, and wherein the modification to the first service relates to performance of the operation; and

the controller identifying the modification to the first service as part of the cleanup rule.

39. The method of claim 38 wherein the cleanup rule associates the modification to the first service with the second service.

40. The method of any of claims 38-39 further comprising:

the controller determining that the second service is or is to be deleted and/or disabled; and

in response to the determination that the second service is or is to be deleted and/or disabled, the controller applying the cleanup rule to delete, remove, and/or undo the identified modification to the first service.

41. The method of any of claims 37-40 wherein the resource comprises a plurality of additional services that have dependencies with respect to each other, and wherein the cleanup rule comprises a plurality of cleanup rules that identify modifications made to the services by other services.

42. The method of claim 41 wherein each service that is a dependent service is associated with cleanup rules that identify modifications to its dependency services.

43. The method of any of claims 41-42 further comprising:

an application programming interface (API) interfacing the services with each other and with the controller.

44. The method of claim 43 further comprising:
the dependent services calling on their dependency services through the API; and
the controller identifying the modifications to the dependency services as part of the cleanup rules.
45. The method of claim 44 further comprising:
the API logging commands from the services; and
the controller generating the cleanup rules from the logged API commands.
46. The method of any of claims 37-45 wherein a plurality of resources are connected to the controller, wherein the resources comprise a plurality of services that have dependencies with respect to each other, and wherein the cleanup rule comprises a plurality of cleanup rules that identify modifications made to the services by services.
47. An information technology (IT) computer system comprising:
a controller;
a compute resource for connection to the controller; and
a storage resource for use by the compute resource;
wherein the controller is configured to provision a storage credential for the storage resource to the compute resource; and
wherein the compute resource is configured to connect to, log on to, and/or communicate with the storage resource based on the storage credential.
48. The system of claim 47 wherein the controller is further configured to (1) pair the compute resource with the storage resource and (2) put the paired compute resource and the storage resource on the same network or fabric.
49. The system of claim 48 wherein the controller is further configured to (1) disable a storage area network (SAN) connection between the compute resource and the storage resource, and (2) make

the storage resource available to the compute resource on an isolated connection network to thereby put the paired compute resource and the storage resource on the same network or fabric.

50. The system of claim 49 wherein the isolated connection network comprises a vlans, a vxlans, and/or an Infiniband partition.

51. The system of any of claims 47-50 wherein the storage credential comprises a password or pass phrase.

52. The system of any of claims 47-51 wherein the storage credential comprises a chap key.

53. The system of any of claims 47-52 wherein the storage credential comprises an encryption key.

54. The system of claim 50 wherein the compute resource is configured to compute log in credentials for the storage resource from the encryption key based on encryption techniques.

55. The system of any of claims 47-54 wherein the storage credential comprises a certificate.

56. The system of any of claims 47-55 further comprising a plurality of compute resources and a plurality of storage resources, and wherein the controller is configured to provision storage credentials for the storage resources to the compute resources so that a plurality of the compute resources are paired with different ones of the storage resources.

57. An information technology (IT) method for use with a computer system comprising a controller, a compute resource connected to the controller, and a storage resource for use by the compute resource, the method comprising:

the controller provisioning a storage credential for the storage resource to the compute resource; and

the compute resource connecting to, logging on to, and/or communicating with the storage resource based on the storage credential.

58. The method of claim 57 further comprising:

the controller is further pairing the compute resource with the storage resource; and

the controller putting the paired compute resource and the storage resource on the same network or fabric.

59. The method of claim 58 further comprising:

the controller disabling a storage area network (SAN) connection between the compute resource and the storage resource; and

wherein the putting step comprises making the storage resource available to the compute resource on an isolated connection network.

60. The method of claim 59 wherein the isolated connection network comprises a vlans, a vxlans, and/or an Infiniband partition.

61. The method of any of claims 57-60 wherein the storage credential comprises a password or pass phrase.

62. The method of any of claims 57-61 wherein the storage credential comprises a chap key.

63. The method of any of claims 57-62 wherein the storage credential comprises an encryption key.

64. The method of claim 60 further comprising:

the compute resource computing log in credentials for the storage resource from the encryption key based on encryption techniques.

65. The method of any of claims 57-64 wherein the storage credential comprises a certificate.
66. The method of any of claims 57-65 wherein the computer system further comprises a plurality of compute resources and a plurality of storage resources; and
- wherein provisioning step comprises the controller provisioning storage credentials for the storage resources to the compute resources so that a plurality of the compute resources are paired with different ones of the storage resources.
67. An information technology (IT) computer system comprising:
- a controller;
- a resource;
- an in band management connection for connecting the resource to the controller;
- a first connection for connecting the controller to an instance in a cloud; and
- a second connection for connecting the cloud instance to the in band management connection;
- wherein the controller is configured to provision the cloud instance via the first connection;
- and
- wherein the controller and/or the resource is configured to operationally interact with the provisioned cloud instance via the second connection.
68. The system of claim 67 wherein the cloud instance comprises a cloud storage resource.
69. The system of claim 68 wherein the controller is further configured to (1) maintain system state information, (2) create a storage bucket for the cloud storage resource, and (3) save connection information for the cloud storage resource as part of the system state information.
70. The system of claim 69 wherein the resource comprises a compute resource, and wherein the controller is further configured to provide the connection information for the cloud storage resource to

the compute resource to thereby enable the compute resource to connect with and use the cloud storage resource.

71. The system of any of claims 67-70 wherein the cloud instance is part of a pool of cloud instances that are managed by the controller as a cloud resource pool.

72. The system of claim 71 wherein the controller is further configured to set up the resource as a cloud resource pool capable host.

73. The system of claim 72 wherein the controller is further configured to (1) maintain system state information, and (2) add information about cloud instances in the cloud resource pool to the system state information.

74. The system of claim 73 wherein the controller is further configured to create a VPN connection to the cloud resource pool through the in band management connection.

75. The system of any of claims 67-74 wherein the controller is further configured to identify a type for the cloud instance via the first connection.

76. The system of claim 75 wherein the controller is further configured to identify a configuration of the cloud instance via the first connection.

77. The system of any of claims 75-76 wherein the controller is further configured to (1) maintain system rules, and (2) determine based on the system rules whether the cloud instance is to be bought for and/or added to the system.

78. The system of claim 77 wherein the controller is further configured to, in response to a determination that the cloud instance is to be bought for and/or added to the system, use a template to add the cloud instance to the system as another resource for the system.

79. The system of claim 78 wherein the controller is further configured to power on and/or enable the cloud instance via the first connection.

80. The system of claim 79 wherein the controller is further configured to find and load a boot image for the cloud instance from the template based on the identified cloud instance type.

81. The system of claim 80 wherein the cloud instance is further configured to boot based on the boot image.

82. The system of any of claims 67-81 wherein the first connection connects the controller to the cloud instance via a cloud application programming interface (API).

83. The system of claim 82 wherein the cloud API allows a purchase of and/or connection to the cloud instance by the controller.

84. The system of any of claims 67-83 wherein the second connection connects the cloud instance to the in band management connection via a VPN.

85. An information technology (IT) method for use with a computer system comprising a controller, a resource, an in band management connection that connects the resource to the controller, a first connection that connects the cloud instance to the in band management connection, and a second connection that connects the cloud instance to the in band management connection, the method comprising:

the controller provisioning the cloud instance via the first connection; and

the controller and/or the resource operationally interacting with the provisioned cloud instance via the second connection.

86. The method of claim 85 wherein the cloud instance comprises a cloud storage resource.

87. The method of claim 86 further comprising:

the controller (1) maintaining system state information, (2) creating a storage bucket for the cloud storage resource, and (3) saving connection information for the cloud storage resource as part of the system state information.

88. The method of claim 87 wherein the resource comprises a compute resource, the method further comprising:

the controller providing the connection information for the cloud storage resource to the compute resource to thereby enable the compute resource to connect with and use the cloud storage resource.

89. The method of any of claims 85-88 wherein the cloud instance is part of a pool of cloud instances that are managed by the controller as a cloud resource pool.

90. The method of claim 89 further comprising:

the controller setting up the resource as a cloud resource pool capable host.

91. The method of claim 90 further comprising:

the controller is further (1) maintaining system state information, and (2) adding information about cloud instances in the cloud resource pool to the system state information.

92. The method of claim 91 further comprising:

the controller creating a VPN connection to the cloud resource pool through the in band management connection.

93. The method of any of claims 85-92 further comprising:

the controller identifying a type for the cloud instance via the first connection.

94. The method of claim 93 further comprising:
the controller identifying a configuration of the cloud instance via the first connection.
95. The method of any of claims 93-94 further comprising:
the controller (1) maintaining system rules, and (2) determining based on the system rules whether the cloud instance is to be bought for and/or added to the system.
96. The method of claim 95 further comprising:
the controller, in response to a determination that the cloud instance is to be bought for and/or added to the system, using a template to add the cloud instance to the system as another resource for the system.
97. The method of claim 96 further comprising:
the controller powering on and/or enabling the cloud instance via the first connection.
98. The method of claim 97 further comprising:
the controller finding and loading a boot image for the cloud instance from the template based on the identified cloud instance type.
99. The method of claim 98 further comprising:
the cloud instance booting based on the boot image.
100. The method of any of claims 85-99 wherein the first connection connects the controller to the cloud instance via a cloud application programming interface (API).
101. The method of claim 100 further comprising:

the cloud API allowing a purchase of and/or connection to the cloud instance by the controller.

102. The method of any of claims 85-101 wherein the second connection connects the cloud instance to the in band management connection via a VPN.

103. An information technology (IT) computer system comprising:

a controller;

a memory;

a plurality of resources for connection to the controller; and

a plurality of services for execution by at least one of the resources, wherein the services include a first service and a second service, wherein the first and second services have dependency with respect to each other; and

wherein the memory is configured to store a plurality of backup rules, the backup rules including specifications of backup rules that are associated with the first service; and

wherein the controller or at least one of the resources is configured to (1) access the first service-associated backup rules in the memory, and (2) perform a backup operation for the first service according to the accessed first service-associated backup rules, wherein the first service-associated backup rules define linkages with the second service that cause data relating to the second service to also be backed up in coordination with backing up data relating to the first service.

104. The system of claim 103 wherein the memory is further configured to store a plurality of templates, the templates including a template associated with the first service, the first service-associated template including the first service-associated backup rules and/or a pointer thereto.

105. The system of any of claims 103-104 wherein the resources include a plurality of compute resources, wherein at least one of the compute resources is configured to perform the backup operation;

wherein the resources further include a plurality of storage resources; and

wherein the controller is further configured to provision storage space within at least one of the storage resources to the backup operation for archiving of backed up data therein.

106. The system of claim 105 wherein the controller is further configured to provide the first service with access to the provisioned storage space for archiving of the backed up data therein in accordance with the backup operation.

107. The system of any of claims 105-106 wherein the first service-associated backup rules include a plurality of rules that govern how the storage resources are to be provisioned to the backup operation.

108. The system of any of claims 103-107 wherein the controller is further configured to initiate a restore operation with respect to the first service based on the backed up data related to the first and second services.

109. The system of any of claims 103-108 wherein the backup rules further include specifications of backup rules that are associated with the second service, and wherein the backup operation includes accessing and executing at least a portion of the second service-associated backup rules.

110. The system of claim 109 wherein the first service-associated backup rules include a pointer to the second service-associated backup rules.

111. The system of any of claims 109-110 wherein the services further include a third service, wherein the third service is dependent with respect to the second service; and

wherein the second service-associated backup rules define linkages with the third service that cause data relating to the third service to also be backed up in coordination with backing up data relating to the first and second services.

112. The system of any of claims 103-111 wherein the services further include a third service, wherein the third service is dependent with respect to the first service; and

wherein the first service-associated backup rules define linkages with the third service that cause data relating to the third service to also be backed up in coordination with backing up data relating to the first and second services.

113. The system of any of claims 103-112 wherein the first service-associated backup rules include restoration information associated with the first service.

114. An information technology (IT) method for use with a computer system comprising a controller, a memory, a plurality of resources connected to the controller, and a plurality services for execution by at least one of the resources wherein the resource comprises a first service and a second service, wherein the first and second services have dependency with respect to each other, wherein the first and second services have dependency with respect to each other, the method comprising:

storing a plurality of backup rules in the memory, the backup rules including specifications of backup rules that are associated with the first service;

accessing the first service-associated backup rules in the memory; and

performing a backup operation for the first service according to the accessed first service-associated backup rules, wherein the first service-associated backup rules define linkages with the second service that cause data relating to the second service to also be backed up in coordination with backing up data relating to the first service, wherein the backup operation is performed by the controller or at least one of the resources.

115. The method of claim 114 wherein the memory stores a plurality of templates, the templates including a template associated with the first service, the first service-associated template including the first service-associated backup rules and/or a pointer thereto, and wherein the accessing step comprises accessing the first-associated backup rules via the first service-associated template.

116. The method of any of claims 114-115 wherein the resources include a plurality of compute resources, wherein at least one of the compute resources performs the backup operation;

wherein the resources further include a plurality of storage resources; and

wherein the method further comprises the controller provisioning storage space within at least one of the storage resources to the backup operation for archiving of backed up data therein.

117. The method of claim 116 further comprising:

the controller providing the first service with access to the provisioned storage space for archiving of the backed up data therein in accordance with the backup operation.

118. The method of any of claims 116-117 wherein the first service-associated backup rules include a plurality of rules that govern how the storage resources are to be provisioned to the backup operation.

119. The method of any of claims 114-118 further comprising:

the controller initiating a restore operation with respect to the first service based on the backed up data related to the first and second services.

120. The method of any of claims 114-119 wherein the backup rules further include specifications of backup rules that are associated with the second service, and wherein the backup operation includes accessing and executing at least a portion of the second service-associated backup rules.

121. The method of claim 120 wherein the first service-associated backup rules include a pointer to the second service-associated backup rules.

122. The method of any of claims 120-121 wherein the services further include a third service, wherein the third service is dependent with respect to the second service; and

wherein the second service-associated backup rules define linkages with the third service that cause data relating to the third service to also be backed up in coordination with backing up data relating to the first and second services.

123. The method of any of claims 114-122 wherein the services further include a third service, wherein the third service is dependent with respect to the first service; and

wherein the first service-associated backup rules define linkages with the third service that cause data relating to the third service to also be backed up in coordination with backing up data relating to the first and second services.

124. The method of any of claims 114-123 wherein the first service-associated backup rules include restoration information associated with the first service.

125. The system or method of any of claims 1-102 wherein the controller is further configured to manage backup operations for one or more components of the system, including services having dependencies with respect to each other.

126. The system or method of claim 125 wherein the controller is further configured to manage backup operations as set forth in any of claims 103-124.

127. A system, apparatus, method, and/or computer program product comprising any combination of features disclosed herein.