

# Introduction to the Cluster Metadata Store (CMS)

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## Cluster Metadata Store (CMS)

### Overview

The Cluster Metadata Store (CMS) provides a single logical point of metadata storage for a SAWA v2 cluster. Located on the Cluster Control Manager node of the control ring, the store provides the source of 'truth' regarding the state of the cluster and its resources. Each resource being managed in the cluster is represented by a row in a table in CMS that reflects the state of that resource. CMS provides the persistence for state-machine driven workflows driven from within the Management Service that control all updates to resources and which ensures that the metadata either reflects a known stable state of a resource or that a workflow is in-progress currently modifying the resource.

Each type of resource that requires management is represented by a table in the store with each instance of the resource represented by a row in that table. Metadata describing the resource is held in columns on the table. Lower level resources that are managed by Windows Fabric exclusively, such as the location and state of replicas is not represented in the store. Some resources are purely logical. For example, Logical Server is an important user abstraction that hides the location of a database on an instance, allowing databases to be distributed across multiple instances but presented to the user as co-located for management purposes.

As a governing principle of the SAWA v2 architecture, all creation, update and deletion of resources and their associated metadata is mediated by managed workflows that are tightly integrated with the metadata store. Fine-grained state machines are defined for each resource type and are instantiated at runtime to manage workflows impacting those resources. State machines describe stable states and unstable or work-in-progress states. State-related information for each resource is also persisted to the resource table.

At runtime a running state machine is instantiated for each resource being operated on based on the data held in the metadata store. This state machine instance mediates creation, all updates and deletion of the resource. All updates to resources and metadata in the store are handled by actions. Actions can be triggered by an event or automatically on entering into an unstable state. An action may transition the resource into a new state based on its outcome. An action on one resource may raise events on other resources allowing workflows to cascade across multiple related resources. The use of unstable states, automatic actions and branching transitions allows complex workflows to be expressed and managed at runtime. Workflows are triggered by an event on a resource in a stable state and continue until all resources affected by the workflow are in a stable state.

Through the use of unstable states and by persisting every state change to the store, a workflow can be designed to retry if resources are temporarily unavailable, and can be restarted and continued in the event of a failure of one or more executing state machines. Workflows can be designed to detect and automatically recover from errors, if necessary, reversing partial changes to resources.

CMS is the source of truth for the state of all SQL-related resources being managed on a cluster, however CMS is not a cache.

## CMS Features

- Source of truth for the state of all SQL-Related resources being managed in the cluster.
- Not a cache. The control ring architecture and connectivity model do not require the metadata store to be involved in the user login pipeline or subsequent SQL execution at runtime.
- It is neither updated optimistically before resource updates nor after the fact.
- For any individual resource CMS reflects either the current state of the resource or that a workflow is in progress intending to create, update or delete the resource.
- CMS supports the metadata requirements of all internal cluster management services and user-focused login and provisioning services.
- CMS enables state-machine based workflows through persisting state information. By persisting transient state changes in durable storage, CMS allows workflows to be resilient to unavailable resources, and enables workflow restart in the event of a failure of a workflow controller, the CCM node or the CMS database or the control ring as a whole.
- CMS is not required for or referenced during user login to a database; user login must succeed even if the CMS store is unavailable.
- CMS is query-able from off-cluster for management, monitoring and troubleshooting.
- CMS is secured so that only authorized users or components can update or query data. The store enables and where required enforces adherence to rules governing PII or other sensitive data.
- CMS is monitoring to provide insight into the immediate health and performance of the store (distinct from monitoring the resources represented in the store).
- Full telemetry data is available from all update actions and state changes allowing off-cluster troubleshooting, audit and performance analysis.

- CMS interactions are designed in a way that it would not affect scenarios requiring performance goals.

## Availability

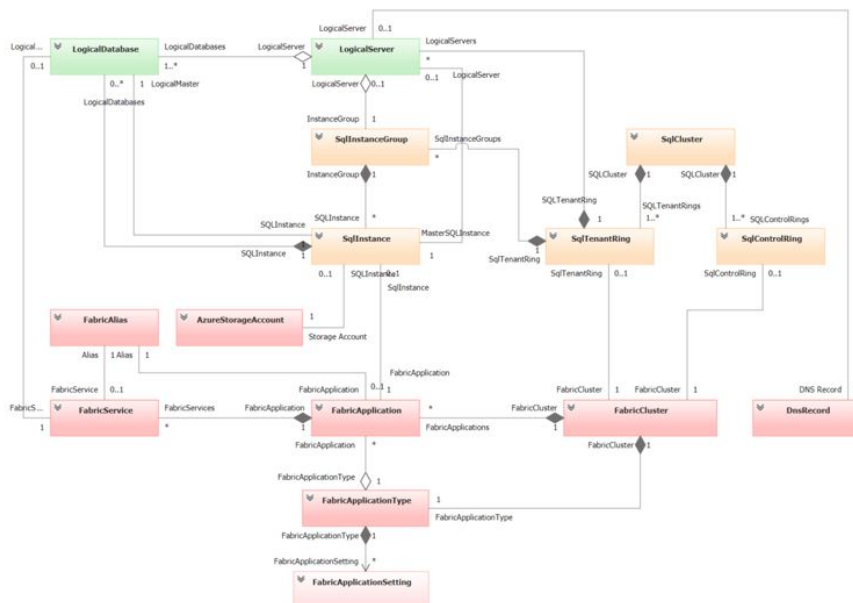
- CMS is a single point of failure in the SAWA v2 architecture. If CMS is unavailable, server and database provisioning and management will be unavailable. It is critical that it achieve maximum reliability.
- As the control ring runs on public compute on SKUs without local database storage, CMS will be implemented on a Remote Storage SQL Database and will be subject to the availability inherent in that storage model.
- As CMS uses Remote Storage, the database files are mastered in Azure Storage and must leverage Azure storage-provided geo-replication.
- CMS is protected from CCM node or Control Ring failure through WinFab.
- CMS is protected from data center disaster and can be recovered from remote backups in the event of failure
- All CMS content must be backed up off-cluster and available for recovery in the event of a cluster failure.

## Domain Model

The key concepts that are represented in CMS can usefully be represented in a domain model. The model can be thought of as organized in layers reflecting the architectural structure of a cluster.



Picture 1



Picture 2

The domain model reflects the structural constraints that apply to a steady-state running cluster after initialization.

## CMS v1 Schema

### State Machine Data

The following columns are included in all tables managed by a state machine.

| Column Name                | Data Type        | Nullable | Default | Description   |
|----------------------------|------------------|----------|---------|---|
| state                      | nvarchar(128)    | False    |         | The current state in the FSM state machine.   |
| stable                     | bit              | False    |         | Indicates that the current state is unstable (triggers an automatic action).  |
| error                      | bit              | False    |         | Indicates that the current state is declared as an error state.   |
| request_id                 | uniqueidentifier | True     |         | <p>The active request id. Populated while the instance is participating in a workflow. This allows correlation of instances of different state machines that are participating in the same request. The value is provided by the client – typically will be provided by RDFE over the RP API.</p> <p>The value is set when an instance joins a workflow, either as the initial state machine or one that joins as a successor through instantiation or an event raised in an action executed on another instance already in the workflow.</p> <p>The value is reset to null when the state machine returns to a stable state.</p> |
| workflow_position<br>[new] | hierarchyid      | True     |         | <p>Hierarchically structured identifier of the position, relative to other state machine instances in the current workflow, at which this instance last received an event or was created.</p> <p>The value is reset to null when the state machine returns to a stable state.</p>   |

| Column Name                  | Data Type                | Nullable | Default | Description  |
|------------------------------|--------------------------|----------|---------|--|
| next_successor               | int                      | False    | 0       | <p>The id used for the next successor in a workflow. When an event is raised in an action on another state machine or a state machine is initialized, this value is appended to the current workflow_position to create the workflow position of the successor. The value is then incremented by the FSM framework.</p> <p>The value is reset to 1 when the state machine returns to a stable state.</p> |
| create_time [new]            | datetime2                | False    |         | The time the record was created.   |
| last_update_time             | datetime2 [was datetime] | False    |         | The time the record was last updated. Has the same value as CreateTime when first created.   |
| last_state_change_time [new] | datetime2                | False    |         | The time the state was last changed. May be different from last_update_time. The time is not changed if a transition flows recursively to the same state.  |
| concurrency_token            | bigint                   | True     |         | A value that is changed whenever the row is changed.   |
| process_id [new]             |                          | True     |         | The fabric id of the process containing an FSM instance that is currently actively managing the state machine on this row. Is populated when a long running action is in progress that is not-interruptible. Allows a running state machine to be picked up by the same process if the   |

| Column Name                    | Data Type | Nullable | Default | Description   |
|--------------------------------|-----------|----------|---------|---|
|                                |           |          |         | process fails and is restarted by WinFab.   |
| last_exception [was exception] | xml       | True     |         | Details of the last exception raised during execution of the state machine on this instance. Cleared on next successful action or state transition on the instance. |

## Customer Visible Data

### Logical Databases

Table: tbl\_logical\_databases

View: logical\_databases

FSM: LogicalDatabaseStateMachine

Contains one row per database. Includes Logical Master and User databases.

|    | Column Name                             | Data Type        | Nullable | Default           | Description  |
|----|---|------------------|----------|-------------------|--|
| PK | logical_server_name<br>[new]            | nvarchar(128)    | True     |                   | The logical server that contains the database.<br>[persisted computed column based on following SQL InstanceGroup -> LogicalServer]  |
| PK | logical_database_id<br>[new]            | uniqueidentifier | False    | newsequentialid() | Globally-scoped database Id. Allows tracking cross-cluster database moves or relationships, for example.   |
|    | sql_instance_name<br>[was InstanceName] | nvarchar(128)    | False    |                   | Identifies the SQL instance in which the database is hosted.<br>This value may change if the database edition changed between Premium and Standard which would cause the database to be moved between instances. Will also change if the database is moved between instances to load balance instance. |
|    | logical_database_name                   | nvarchar(128)    | False    |                   | The name of the database.  |
|    | dropped_time                            | datetime2        | True     |                   | The time this database was dropped or  |



|  | Column Name             | Data Type    | Nullable | Default        | Description   |
|--|-------------------------|--------------|----------|----------------|---|
|  |                         |              |          |                | deferred dropped. This is included in an unique index with logical_server_name, database_name to enforce name uniqueness but allow database names to be reused once dropped.  |
|  | edition                 | nvarchar(25) | False    | Standard       | Standard   Premium  |
|  | max_size_bytes          | bigint       | False    | 1048576 (1 MB) | Database size quota. If the database exceeds this size it is capped and allows only read and delete queries. Permitted values defined by a set of client side business rules that currently allow 20MB, 100MB, 1GB, 5GB, 10GB, 20GB, 30GB, 40GB, 50GB, 100GB, 150GB. These rules are not enforced on the database.  |
|  | service_level_objective | nvarchar(25) | False    | Shared         | Shared P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21 P22 P23 P24 P25 P26 P27 P28 P29 P30 P31 P32 P33 P34 P35 P36 P37 P38 P39 P40 P41 P42 P43 P44 P45 P46 P47 P48 P49 P50 P51 P52 P53 P54 P55 P56 P57 P58 P59 P60 P61 P62 P63 P64 P65 P66 P67 P68 P69 P70 P71 P72 P73 P74 P75 P76 P77 P78 P79 P80 P81 P82 P83 P84 P85 P86 P87 P88 P89 P90 P91 P92 P93 P94 P95 P96 P97 P98 P99 P100 P101 P102 P103 P104 P105 P106 P107 P108 P109 P110 P111 P112 P113 P114 P115 P116 P117 P118 P119 P120 P121 P122 P123 P124 P125 P126 P127 P128 P129 P130 P131 P132 P133 P134 P135 P136 P137 P138 P139 P140 P141 P142 P143 P144 P145 P146 P147 P148 P149 P150 P151 P152 P153 P154 P155 P156 P157 P158 P159 P160 P161 P162 P163 P164 P165 P166 P167 P168 P169 P170 P171 P172 P173 P174 P175 P176 P177 P178 P179 P180 P181 P182 P183 P184 P185 P186 P187 P188 P189 P190 P191 P192 P193 P194 P195 P196 P197 P198 P199 P200 P201 P202 P203 P204 P205 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P1005 P1006 P1007 P1008 P1009 P1010 P1011 P1012 P1013 P1014 P1015 P1016 P1017 P1018 P1019 P1020 P1021 P1022 P1023 P1024 P1025 P1026 P1027 P1028 P1029 P1030 P1031 P1032 P1033 P1034 P1035 P1036 P1037 P1038 P1039 P1040 P1041 P1042 P1043 P1044 P1045 P1046 P1047 P1048 P1049 P1050 P1051 P1052 P1053 P1054 P1055 P1056 P1057 P1058 P1059 P1060 P1061 P1062 P1063 P1064 P1065 P1066 P1067 P1068 P1069 P1070 P1071 P1072 P1073 P1074 P1075 P1076 P1077 P1078 P1079 P1080 P1081 P1082 P1083 P1084 P1085 P1086 P1087 P1088 P1089 P1090 P1091 P1092 P1093 P1094 P1095 P1096 P1097 P1098 P1099 P1100 P1101 P1102 P1103 P1104 P1105 P1106 P1107 P1108 P1109 P1110 P1111 P1112 P1113 P1114 P1115 P1116 P1117 P1118 P1119 P1120 P1121 P1122 P1123 P1124 P1125 P1126 P1127 P1128 P1129 P1130 P1131 P1132 P1133 P1134 P1135 P1136 P1137 P1138 P1139 P1140 P1141 P1142 P1143 P1144 P1145 P1146 P1147 P1148 P1149 P1150 P1151 P1152 P1153 P1154 P1155 P1156 P1157 P1158 P1159 P1160 P1161 P1162 P1163 P1164 P1165 P1166 P1167 P1168 P1169 P1170 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P1669 P1670 P1671 P1672 P1673 P1674 P1675 P1676 P1677 P1678 P1679 P1680 P1681 P1682 P1683 P1684 P1685 P1686 P1687 P1688 P1689 P1690 P1691 P1692 P1693 P1694 P1695 P1696 P1697 P1698 P1699 P1700 P1701 P1702 P1703 P1704 P1705 P1706 P1707 P1708 P1709 P1710 P1711 P1712 P1713 P1714 P1715 P1716 P1717 P1718 P1719 P1720 P1721 P1722 P1723 P1724 P1725 P1726 P1727 P1728 P1729 P1730 P1731 P1732 P1733 P1734 P1735 P1736 P1737 P1738 P1739 P1740 P1741 P1742 P1743 P1744 P1745 P1746 P1747 P1748 P1749 P1750 P1751 P1752 P1753 P1754 P1755 P1756 P1757 P1758 P1759 P1760 P1761 P1762 P1763 P1764 P1765 P1766 P1767 P1768 P1769 P1770 P1771 P1772 P1773 P1774 P1775 P1776 P1777 P1778 P1779 P1780 P1781 P1782 P1783 P1784 P1785 P1786 P1787 P1788 P1789 P1790 P1791 P1792 P1793 P1794 P1795 P1796 P1797 P1798 P1799 P1800 P1801 P1802 P1803 P1804 P1805 P1806 P1807 P1808 P1809 P1810 P1811 P1812 P1813 P1814 P1815 P1816 P1817 P1818 P1819 P1820 P1821 P1822 P1823 P1824 P1825 P1826 P1827 P1828 P1829 P1830 P1831 P1832 P1833 P1834 P1835 P1836 P1837 P1838 P1839 P1840 P1841 P1842 P1843 P1844 P1845 P1846 P1847 P1848 P1849 P1850 P1851 P1852 P1853 P1854 P1855 P1856 P1857 P1858 P1859 P1860 P1861 P1862 P1863 P1864 P1865 P1866 P1867 P1868 P1869 P1870 P1871 P1872 P1873 P1874 P1875 P1876 P1877 P1878 P1879 P1880 P1881 P1882 P1883 P1884 P1885 P1886 P1887 P1888 P1889 P1890 P1891 P1892 P1893 P1894 P1895 P1896 P1897 P1898 P1899 P1900 P1901 P1902 P1903 P1904 P1905 P1906 P1907 P1908 P1909 P1910 P1911 P1912 P1913 P1914 P1915 P1916 P1917 P1918 P1919 P1920 P1921 P1922 P1923 P1924 P1925 P1926 P1927 P1928 P1929 P1930 P1931 P1932 P1933 P1934 P1935 P1936 P1937 P1938 P1939 P1940 P1941 P1942 P1943 P1944 P1945 P1946 P1947 P1948 P1949 P1950 P1951 P1952 P1953 P1954 P1955 P1956 P1957 P1958 P1959 P1960 P1961 P1962 P1963 P1964 P1965 P1966 P1967 P1968 P1969 P1970 P1971 P1972 P1973 P1974 P1975 P1976 P1977 P1978 P1979 P1980 P1981 P1982 P1983 P1984 P1985 P1986 P1987 P1988 P1989 P1990 P1991 P1992 P1993 P1994 P1995 P1996 P1997 P1998 P1999 P2000 P2001 P2002 P2003 P2004 P2005 P2006 P2007 P2008 P2009 P2010 P2011 P2012 P2013 P2014 P2015 P2016 P2017 P2018 P2019 P2020 P2021 P2022 P2023 P2024 P2025 P2026 P2027 P2028 P2029 P2030 P2031 P2032 P2033 P2034 P2035 P2036 P2037 P2038 P2039 P2040 P2041 P2042 P2043 P2044 P2045 P2046 P2047 P2048 P2049 P2050 P2051 P2052 P2053 P2054 P2055 P2056 P2057 P2058 P2059 P2060 P2061 P2062 P2063 P2064 P2065 P2066 P2067 P2068 P2069 P2070 P2071 P2072 P2073 P2074 P2075 P2076 P2077 P2078 P2079 P2080 P2081 P2082 P2083 P2084 P2085 P2086 P2087 P2088 P2089 P2090 P2091 P2092 P2093 P2094 P2095 P2096 P2097 P2098 P2099 P2100 P2101 P2102 P2103 P2104 P2105 P2106 P2107 P2108 P2109 P2110 P2111 P2112 P2113 P2114 P2115 P2116 P2117 P2118 P2119 P2120 P2121 P2122 P2123 P2124 P2125 P2126 P2127 P2128 P2129 P2130 P2131 P2132 P2133 P2134 P2135 P2136 P2137 P2138 P2139 P2140 P2141 P2142 P2143 P2144 P2145 P2146 P2147 P2148 P2149 P2150 P2151 P2152 P2153 P2154 P2155 P2156 P2157 P2158 P2159 P2160 P2161 P2162 P2163 P2164 P2165 P2166 P2167 P2168 P2169 P2170 P2171 P2172 P2173 P21 |

|  | Column Name        | Data Type     | Nullable | Default | Description  |
|--|--------------------|---------------|----------|---------|--|
|  |                    |               |          |         | Part of the datab<br>service key.  |
|  | fabric_service_uri | nvarchar(256) | True     |         | The URI of the<br>database service<br>Combined with<br>fabric cluster<br>provides the fore<br>key to the datab<br>service. |

Constraints:

Unique (SQLInstanceName & Name)

---

### Logical Database Features

Table: tbl\_sql\_database\_features

View: sql\_database\_features

FSM: DatabaseFeatureStateMachine

Contains one row per feature enabled on a database. Used for allow\_listing features on a specific database.

| Name          | Data Type    | Nullable | Default | Description                                |
|---------------|--------------|----------|---------|--|
| database_id   | bigint       | False    |         | The id of the database having the feature. |
| feature_name  | nvarchar(50) | False    |         | The name of the feature being described.   |
| feature_value | sql_variant  | False    |         | The feature value for this database.       |

---

### GeoDR Relationships [was GeoDR Relations]

Table: tbl\_geodr\_relationships

View: geodr\_relationships

FSM: GeodrRelationshipStateMachine

Contains one row per GeoDR relationship. Each row describes a replication relationship between a source database defined in the SQL Cluster and another database that may be in the current SQL cluster or some other SQL Cluster.

Note: Placeholder table schema is based on a modified version of the SAWA v1 Gateway Metadata schema and is subject to review.

|    | Column Name                        | Data Type        | Nullable | Default | Description  |
|----|------------------------------------|------------------|----------|---------|--|
| PK | source_database_id                 | bigint           | False    |         |  |
| PK | replica_sql_cluster_name           | nvarchar(128)    | False    |         | The SQL cluster in which the replica is located. May be a reference to the current or different SQL cluster. |
| PK | replica_database_guid              | bigint           | False    |         |  |
|    | link_id                            | uniqueidentifier | False    |         |  |
|    | geo_replica_state                  | nvarchar(64)     | True     |         |  |
|    | geo_replica_substate               | nvarchar(64)     | True     |         |  |
|    | copy_complete_subscription_id      | uniqueidentifier | False    |         |  |
|    | terminate_complete_subscription_id | uniqueidentifier | False    |         |  |
|    | is_created_with_database           | bit              | False    | 0       |  |

## Logical Servers

Table: tbl\_logical\_servers

View: logical\_servers

FSM: LogicalServerStateMachine

Contains one row per customer (logical) server.

|    | Column Name                                   | Data Type        | Nullable | Default           | Description  |
|----|---|------------------|----------|-------------------|--|
| PK | name  | nvarchar(128)    | False    |                   | Logical server name.   |
|    | logical_server_id                             | uniqueidentifier | False    | newsequentialid() | A guid assigned to the   |
|    | sql_instance_group<br>[was InstanceGroupName] | nvarchar(128)    | True     |                   | The SQL instance group that contains the SQL instances that host the databases in this logical server. |
|    | control_ring_dns_name                         | nvarchar(256)    | True     |                   | <verify usage, nullable?>  |
|    | customer_subscription_id<br>[new]             | uniqueidentifier | False    |                   | The SQL customer subscription Id under which this logical server was created.                          |
|    | admin_login_name<br>[was AdminName]           | nvarchar(128)    | True     |                   | The admin user login name assigned by the customer. A temporarily stored value, only                   |

|  | Column Name                                 | Data Type       | Nullable | Default | Description   |
|--|---|-----------------|----------|---------|---|
|  |   |                 |          |         | stored while being applied to the database.   |
|  | admin_login_password<br>[was AdminPassword] | varbinary(1024) | True     |         | The admin password. Encrypted. A temporarily stored value, only stored while being applied to the database. |

## SQL Cluster Infrastructure

### SQL Clusters [was Global Metadata]

Table: tbl\_sql\_clusters

View: sql\_clusters

FSM: SqlClusterStateMachine

Contains one row representing the SQL cluster itself. Contains metadata that is either specific to the SQL cluster or is global to the SQL Azure environment.

|    | Column Name  | Data Type     | Nullable | Description           |
|----|--|---------------|----------|-----------------------|
| PK | name   | nvarchar(128) | False    | The SQL cluster name. |
|    | primary_control_ring_name<br>[was PrimaryControlClusterName] | nvarchar(128) | False    |                       |
|    | add_remove_control_ring_sequence                             | bigint        | False    |                       |
|    | security_principal_sequence                                  | Bigint        | False    |                       |

### SQL Control Rings [was Control Hosted Services]

Table: tbl\_sql\_control\_rings extends tbl\_fabric\_clusters

View: sql\_control\_rings

FSM: SqlControlRingStateMachine

Contains one row per control ring in the SQL cluster.

Initially only one control ring will exist per SQL Cluster thus only one per row per CMS database. The North Star architecture allows for multiple control rings to exist in a single SQL cluster. A primary ring contains the active CMS which is the only stateful service on the control ring. Other control ring services can be accessed at either ring. This provides protection in the case that a stateless service in the ring is unavailable or overloaded.

|    | Column Name               | Data Type        | Nullable | Description  |
|----|---------------------------|------------------|----------|--|
| PK | name<br>[was ClusterName] | nvarchar(128)    | False    | Control ring name. This is the DNS name of the fabric cluster that forms the control ring. <example> |
|    | add_remove_sequence       | bigint           | True     |  |
|    | processed_alias_uri       | nvarchar(256)    | True     |  |
|    | dns_record_id             | uniqueidentifier | True     |  |
|    | is_bootstrap              | bit              | False    |  |
|    | ipv4_address              | nvarchar(15)     | True     |  |

## SQL Instances [was Instances]

Table: tbl\_sql\_instances

View: sql\_instances

FSM: SqlInstanceStateMachine

Contains one row per SQL Server instance running in a tenant ring and composed within a SQL Instance Group. Includes both Remote Storage and Local Storage instances.

|    | Column Name                       | Data Type        | Nullable | Description   |
|----|-----------------------------------|------------------|----------|---|
| PK | name                              | nvarchar(128)    | False    | <p>The name of the SQL Instance, constructed from the logical server name + a suffix indicating either the hosted premium database or a count of SQL instances in the SQL Instance group associated with the logical server, where 0 indicates this is the master instance containing the logical master database for a logical server.</p> <p>Examples<br/> H1679ab12\0 – the master SQL instance for a logical server<br/> H1679ab12&lt;database guid&gt; - an instance containing a premium database</p> |
|    | sql_instance_id<br>[was UniqueId] | uniqueidentifier | False    |   |
|    | Type                              | nvarchar(128)    | False    | <p>The type of SQL instance</p> <p>CMS<br/> SQL.LocalStorage<br/> SQL.RemoteStorage<br/> FQS.Compute<br/> FQS.Control</p>   |
|    | service_level_objective           | nvarchar(128)    | False    | <p>The service level objective assigned to the instance which acts as a size for the instance and determines the way the Windows Fabric</p>   |

|  | Column Name  | Data Type       | Nullable | Description   |
|--|--|-----------------|----------|---|
|  |  |                 |          | allocates instances to a node.<br>Values are:<br>Shared P1 P2 P2 P4   |
|  | target_service_level_objective                             | nvarchar(128)   | True     | The target service level objective, used when changing the size of the instance.<br>Values are:Shared P1 P2 P2 P4 |
|  | worker_service_affinity_tag                                | nvarchar(128)   | True     | <Is this a general purpose affinity tag that should be in fabric_applications?>                                   |
|  | storage_account_affinity_tag                               | nvarchar(128)   | True     |   |
|  | sql_instance_group_name<br>[was InstanceGroupName]         | nvarchar(128)   | True     | The SQL Instance Group in which this SQL instance participates.   |
|  | security_principal_id                                      | bigint          | True     |   |
|  | collation  | nvarchar(128)   | True     |   |
|  | trace_flags  | xml             | True     |   |
|  | reset_admin_login_name<br>[was ResetAdminName]             | nvarchar(128)   | True     |   |
|  | reset_admin_login_password<br>[was ResetAdminPasswordHash] | varbinary(1024) | True     |   |
|  | reset_admin_login_time<br>[was ResetAdminDate]             | datetime2       | True     |   |
|  | tenant_ring_name<br>[was ClusterName]                      | nvarchar(128)   | True     | Local fabric cluster DNS name (bound to a Worker service)<br><clarify> <verify>                                   |



|  | Column Name                                     | Data Type           | Nullable       | Description  |
|--|---|---------------------|----------------|--|
|  |   |                     |                | column length vs. DNS name>  |
|  | fabric_application_uri                          | nvarchar(256)       | True           | With tenant_ring_name identifies the application that implements this SQL Instance.                |
|  | dns_name  | nvarchar(256)       | True           | Global DNS (bound to Control services)<br><clarify>  |
|  | fabric_cluster_dns_name<br>[was ClusterDnsName] | nvarchar(256)       | True           | <clarify wrt FabricClusterName, DNS name>  |
|  | fabric_service_uri                              | nvarchar(256)       | True           | Current Winfab service Uri   |
|  | fabric_service_sequence                         | bigint              | True           |  |
|  | storage_account_dns_name                        | nvarchar(128)       | True           | Current placement  |
|  | storage_container_name                          | nvarchar(64)        | True           |  |
|  | storage_policy_name                             | nvarchar(128)       | True           |  |
|  | master_key_alg                                  | nvarchar(32)        | True           |  |
|  | master_key_length                               | int                 | True           |  |
|  | master_key                                      | [was MasterKeyBlob] | varbinary(MAX) | True   |
|  | processed_database_name                         | nvarchar(128)       | True           | Transient reference used during drop or other ordered workflow processing over multiple databases. |

|  | Column Name    | Data Type | Nullable | Description            |
|--|----------------|-----------|----------|------------------------|
|  | extension_data | xml       | True     | DW sourced <not here?> |

### SQL Instance Groups [was Instance Groups]

Table: tbl\_sql\_instance\_groups

View: sql\_instance\_groups

FSM: SqlInstanceStateMachine

Contains one row per SQL Instance Group. Includes a row for CMS in the control ring to support holding storage group and keys.

| Column Name                                | Data Type       | Nullable | Description   |
|--|-----------------|----------|---|
| name                                       | nvarchar(128)   | False    | The name of the SQL Instance Group. For SQL database is either 'CMS' or the corresponding logical server name.                        |
| members [delete]                           | xml             | True     | Used to manage locking the set of databases in the absence of an efficient query and lock behavior for a set of state machines in FSM |
| security_principal_id                      | bigint          | True     |   |
| security_principal_password [was Password] | varbinary(1024) | True     |   |
| extension_data                             | xml             | True     | Reserved for FQS use only. May be revised later.  |

### SQL Tenant Ring [was Worker Hosted Services]

Table: tbl\_sql\_tenant\_rings

View: sql\_tenant\_rings

FSM: SqlTenantRingStateMachine

Contains one row per tenant ring in the SQL cluster. Extends tbl\_fabric\_hosted\_services.

There may be multiple tenant rings per SQL cluster.

| Column Name               | Data Type      | Nullable | Description  |
|---------------------------|----------------|----------|--|
| name<br>[was ClusterName] | nvarchar(128)  | False    | The tenant ring name. This is the name of the fabric cluster that forms the control ring.<example>   |
| certificate               | varbinary(MAX) | True     | Certificate used for ring-wide encryption of data.<br>Not used in OneBox implementations.  |
| initial_counts            | xml            | True     | Initial allocation of nodes per node role in the tenant ring. Will be used to assist in allocation of nodes to VMs during placement.<br>Initially, SQL DDC will use the initial values as the max. |
| current_counts            | xml            | True     | Current count of nodes of each role.   |
| used_counts               | xml            | True     |  |
| target_counts             | xml            | True     | Target count. Used to allow buffering for expansion. The tenant ring state machine will grow the ring or shrink the ring as required if the target counts differ from the current counts.          |
| placement_base_weight     | int            | False    |  |
| placement_affinity_tag    | nvarchar(128)  | True     | A tag used in placement expressions to ensure only control ring applications are placed on the control ring.   |

Constraints:

## Secrets

Table: tbl\_secrets

View: secrets

FSM: SecretsStateMachine

Contains one row per individual secret.

| Column Name       | Data Type     | Nullable | Description  |
|-------------------|---------------|----------|--|
| consumer_name     | nvarchar(128) | False    | Name of the consumer, could be instance or instance group  |
| consumer_type     | nvarchar(128) | False    | Consumer type  |
| secret_type       | nvarchar(128) | False    | Type of Secret. Example: Cert, SAS key, Symmetric key, etc.  |
| generation_id     | int           | False    | Generation or version of the secret  |
| state             | nvarchar(128) | False    | Indicates state of the FSM   |
| thumbprint        | nvarchar(128) | True     | Primary generation number. Used during rollover of secret  |
| public_blob       | nvarchar(MAX) | True     | Public key of the blob (could be null for symmetric keys)  |
| private_blob      | Nvarchar(MAX) | False    | Private key blob   |
| issuer_name       | nvarchar(128) | False    | Who issued this key – to track changes to issuer   |
| issuer_type       | int           | False    | Type of issuer   |
| properties        | XML           | True     | Customer properties for this secret (e.g. key size, expiration, policy or container name for SAS keys, etc.) |
| marked_as_deleted | Bit           | False    | A bit is set if the secret should be deleted from clients  |

## Instance Group Secrets

Table: tbl\_instance\_group\_secrets

View: instance\_group\_secrets

FSM: InstanceGroupSecretsStateMachine

Contains one row per instance group secret.

| Column Name         | Data Type     | Nullable | Description  |
|---------------------|---------------|----------|--|
| name                | nvarchar(128) | False    | Name of the instance group                                 |
| state               | nvarchar(128) | False    | Indicates state of the FSM                                 |
| previous_generation | int           | True     | Previous generation number. Used during rollover of secret |
| current_generation  | int           | False    | Current generation number.                                 |
| next_generation     | int           | True     | Next generation number. Used during rollover of secret     |
| primary_generation  | int           | False    | Primary generation number. Used during rollover of secret  |

## Instance Secrets

Table: tbl\_instance secrets

View: instance secrets

FSM: InstanceSecretsStateMachine

Contains one row per instance secret.

| Column Name          | Data Type         | Nullable | Description  |
|----------------------|-------------------|----------|--|
| name                 | nvarchar(16)      | False    | Name of the instance                                       |
| state                | nvarchar<br>(128) | False    | Indicates state of the FSM                                 |
| previous_generation  | int               | True     | Previous generation number. Used during rollover of secret |
| current_generation   | int               | False    | Current generation number.                                 |
| next_generation      | int               | True     | Next generation number. Used during rollover of secret     |
| primary_generation   | int               | False    | Primary generation number. Used during rollover of secret  |
| current_app_property | nvarchar(128)     | True     | Current App property name                                  |

## Infrastructure

### Azure Storage Accounts

Table: tbl\_azure\_storage\_accounts

View: azure\_storage\_accounts

FSM: StorageAccountStateMachine

Contains one row per storage account.

|    | Column Name            | Data Type       | Nullable | Description   |
|----|------------------------|-----------------|----------|---|
| PK | dns_name               | nvarchar(128)   | False    | account name, (e.g. <a href="https://tomtalbay.blob.core.windows.net">tomtalbay.blob.core.windows.net</a> ) |
|    | subscription_id        | nvarchar(128)   | False    |   |
|    | storage_account_name   | nvarchar(128)   | False    | Account name of subscription  |
|    | containers_used        | int             | False    | Number of containers used.  |
|    | primary_key            | varbinary(4000) | True     | Primary account key   |
|    | secondary_key          | varbinary(4000) | True     | Secondary account key   |
|    | use_primary_key        | bit             | False    | Indicates if the primary key should be used for SAS signatures.   |
|    | placement_base_weight  | int             | False    | Weight used for allocation.   |
|    | placement_affinity_tag | nvarchar(128)   | True     | Affinity tag.   |

Constraints:

Unique: (subscription\_id & storage\_account\_name)

## Azure DNS Records

Table: tbl\_fabric\_aliases

View: fabric\_aliases

FSM: FabricAliasStateMachine

Contains one row per DNS Record.

TBD

## Fabric Aliases

Table: tbl\_fabric\_aliases

View: fabric\_aliases

FSM: FabricAliasStateMachine

Contains one row per Windows Fabric alias.

|    | Column Name                         | Data Type     | Nullable | Description  |
|----|-------------------------------------|---------------|----------|--|
| PK | fabric_service_uri                  | nvarchar(256) | False    | The exposed alias URI.   |
|    | add_remove_control_service_sequence | bigint        | False    | Sequence number for add remove events                                  |
|    | target_fabric_cluster_name          | nvarchar(128) | False    | The cluster name of the target fabric service.                         |
|    | target_fabric_service_uri           | nvarchar(256) | False    | The service URI component of the underlying fabric service identifier. |

---

## Fabric Application

Table: tbl\_fabric\_applications

View: fabric\_applications

FSM: FabricApplicationMachine

Contains a row for each Fabric Application.



|    | Column Name                              | Data Type     | Nullable | Description   |
|----|--|---------------|----------|---|
| PK | fabric_cluster_name<br>[was ClusterName] | nvarchar(128) | False    | The name of the fabric cluster which this application is located on.  |
| PK | fabric_application_uri                   | nvarchar(256) | False    |   |
|    | deployment_id_sequence                   | bigint        | True     | Sequence number used to track progress of a redeployment or interruption.   |
|    | application_type_name                    | nvarchar(256) | False    | Name of the fabric application.   |
|    | current_application_type_version         | nvarchar(256) | True     | The current fabric application version of this application. It is null if the application has not been created.   |
|    | target_application_type_version          | nvarchar(256) | False    | The target fabric application version. This is different from current version if there is an upgrade in progress, or if there is an upgrade in progress that is not yet complete. |
|    | deployment_parameters                    | xml           | True     | Parameter values that are substituted into the application manifest during windows fabric application provisioning. Parameters used vary by application type.                     |
|    | upgrade_policy                           | xml           | True     | Transient state during upgrade. Upgrade policy to use when WinFab to kick off the upgrade. Essentially XML-serialized UpgradePolicyDescription.                                   |
|    | rollout_key                              | nvarchar(256) | True     | Transient state during upgrade of the currently in-progress rollout for this app instance.  |
|    | last_upgrade_start_time                  | datetime2     | True     | Start time of the last upgrade of the application instance.   |

|  | Column Name                       | Data Type | Nullable | Description   |
|--|-----------------------------------|-----------|----------|---|
|  | last_upgrade_progress_change_time | Datetime2 | True     | Last time the upgrade prog changed for this applicator instance.            |
|  | upgrade_progress                  | xml       | True     | Xml serialization of WinFabApplicationUpgrade for this application instance |



## Fabric Application Settings

Table: tbl\_fabric\_application\_settings [TBD]

View: fabric\_application\_settings [TBD]

FSM: FabricApplicationTypeMachine

Contains deployment configuration settings for a specific application type.

Schema TBD, likely to be structured as multiple tables that are collectively related to tbl\_application\_type and **not** managed by a state machine.

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## Fabric Application Type

Table: tbl\_fabric\_application\_types

View: fabric\_application\_types

FSM: FabricApplicationTypeMachine

Contains a row for each Fabric Application Type for each fabric cluster and additional state to drive/track the progress of an application type upgrade.

|    | Column Name                      | Data Type     | Nullable | Description  |
|----|----------------------------------|---------------|----------|--|
| PK | fabric_cluster_name              | nvarchar(128) | False    | The name of the fabric cluster on which this application type is located.  |
| PK | application_type_name            | nvarchar(256) | False    | Name of fabric application type.   |
|    | application_build_path           | nvarchar(256) | True     | Relative path in the image store of the package we're currently upgrading to.  |
|    | current_application_type_version | nvarchar(256) | False    | The current version of this application type on this fabric cluster. This is the version new applications will get instantiated with.                |
|    | target_application_type_version  | nvarchar(256) | False    | Target version for this application type on this cluster. This is different from the current version only when there is an upgrade going on.         |
|    | applications_upgrading           | nvarchar(max) | True     | Pipe ( ) separated list of applications currently undergoing upgrade that are being tracked.<br>[will be upgrade to an xml column in a later change] |
|    | last_processed_application       | nvarchar(256) | True     | Uri of the last application upgrade was kicked off for. Used to save iteration state when kicking off upgrade for a large number of applications.    |
|    | deployment_tag                   | nvarchar(256) | True     | Textual tag for the current deployment going on.   |
|    | rollout_key                      | nvarchar(256) | True     | Transient state during upgrade. Key of the   |

|  | Column Name             | Data Type | Nullable | Description   |
|--|-------------------------|-----------|----------|---|
|  |                         |           |          | currently in-progress rollout for this app type.  |
|  | upgrade_policy          | xml       | True     | Transient state during upgrade. Upgrade policy to use when calling WinFab to kick off the upgrade. Essentially XML-serialized UpgradePolicyDescription. |
|  | last_rollout_outcome    | bit       | True     | Indicates the overall success or failure for the whole rollout. Starts out as true, flips to false as soon as an app instance fails upgrade.            |
|  | last_rollout_start_time | datetime2 | True     | Start time of the last rollout for this application type.   |

### Fabric Cluster [was Fabric Hosted Service]

Table: tbl\_fabric\_clusters

View: fabric\_clusters

FSM: FabricClusterStateMachine

Contains a row for each Fabric Cluster within the SQL Cluster. Fabric Cluster contains base data common to SQL Control Rings and SQL Tenant Rings.

|    | Column Name                     | Data Type     | Nullable | Description  |
|----|---------------------------------|---------------|----------|--|
| PK | name [was ClusterName]          | nvarchar(128) | False    |  |
|    | hosted_service_subscription_id  | nvarchar(128) | False    | The internal Microsoft-owned subscription id under which the fabric cluster is created.            |
|    | hosted_service_name             | nvarchar(128) | False    | The exposed Azure name of the fabric cluster.  |
|    | hosted_service_dns_name         | nvarchar(128) | True     | <verify usage, name; is this different to the above>   |
|    | deployment_id                   | nvarchar(128) | True     |  |
|    | deployment_id_sequence          | bigint        | True     | Sequence number used to track the progress of a deployment in case of interruption. <verify usage> |
|    | deployment_id_replaced_sequence | bigint        | True     | Sequence number used to track the progress of a redeployment in case of interruption.              |
|    | processed_fabric_uri            | nvarchar(256) | True     | <verify usage>   |
|    | ipv4_address                    | nvarchar(128) | True     |  |

## Fabric Services

Table: tbl\_fabric\_services

View: fabric\_services

FSM: FabricServiceStateMachine

Contains a row for each Fabric Service deployed in the SQL Cluster. Includes database services and SQL instance application services deployed on the tenant rings, as well as infrastructural services deployed to both the control ring and tenant rings.

| Column Name                              | Data Type      | Nullable | Description  |
|--|----------------|----------|--|
| fabric_cluster_name<br>[was ClusterName] | nvarchar(128)  | False    | The fabric cluster name.   |
| fabric_service_uri                       | nvarchar(256)  | False    |  |
| deployment_id_sequence                   | bigint         | True     |  |
| application_uri                          | nvarchar(256)  | False    |  |
| service_type_name                        | nvarchar(256)  | False    |  |
| placement_constraints                    | nvarchar(2000) | True     |  |
| initialization_data                      | varbinary(MAX) | True     |  |
| kind                                     | nvarchar(128)  | False    | Stateless or Stateful  |
| target_replica_set_size                  | int            | False    |  |
| has_persisted_state                      | bit            | True     | An additional qualifier required by Windows Fabric when kind == Stateful |
| min_replica_set_size                     | int            | True     |  |
| metrics                                  | xml            | True     |  |
| correlations                             | xml            | True     |  |

## Fabric Nodes

Table: tbl\_fabric\_nodes

View: fabric\_nodes

FSM: NodeStateMachine

Contains a row for each Fabric Node in the Fabric Clusters. Key to uniquely identify a node is the combination of node name and the fabric cluster name it belongs to.

| Column Name         | Data Type     | Nullable | Description   |
|---------------------|---------------|----------|---|
| name                | nvarchar(128) | False    | The node name.  |
| fabric_cluster_name | nvarchar(128) | False    | Name of the fabric cluster the node belongs to.   |
| fabric_state        | nvarchar(128) | False    | Textual representation of the state reported by WinFabric. This gets refreshed periodically (currently every 1 minute). |
| deactivation_intent | nvarchar(64)  | True     | The intent expressed for deactivation, if the state machine is in the process of deactivating the node. NULL otherwise. |

How good have you found this content?

