Multi Cloud Management Platforms:
Practical Survey

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Cloud Management Platform

(Cloud) products that incorporate self-service interfaces, provision system images, enable metering and billing, and provide for some degree of workload optimization through established policies

Source: Gartner IT Glossary – Cloud Management Platforms – http://www.gartner.com/it-glossary/cloud-management-platforms
Practical Guide to Cloud Management Platforms – Cloud Standards Customer Council – https://www.omg.org/cloud/deliverables/CSCC-Practical-Guide-to-Cloud-Management-Platforms.pdf

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How do we compare CMP?

- Cloud Orchestration Support
- Cloud Application Support
- Platform Intelligence

Are Cloud Platforms Ready for Multi-Cloud?

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Abstract. Multi-cloud computing is getting a momentum as it offers various advantages, including vendor lock-in avoidance, better client proximity and application performance improvement. As such, various multi-cloud platforms have been developed, each with its own strengths and limitations. This paper aims at comparing all these platforms to unveil the best one as well as ease the selection of the right platform based on

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Cloud Orchestration Support

- Multi-Cloud support
- Resource Diversity
- BYON support
- Service support
- Automation

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Cloud Application Support

- Modelling (language, diversity, resource selection)
- Lifecycle Management
- Data Management (Data creation, migration,
- Workflow Support
- Containerization

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Platform Intelligence

- Optimisation
  - Utility functions
  - Objective versality
  - Continuous reasoning
  - Constraints

- Monitoring (system/custom metrics, aggregation)

- Runtime adaptation

- Event management

- Data management

- Dynamic Resource Offering Discovery

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Apache Brooklyn

- Is an open-source framework for modelling, deploying and managing distributed applications defined using blueprints

- License: Apache 2.0

- **Cloud Orchestration Support:**
  - Uses Apache jclouds
  - 20+ public clouds, private cloud, bare server, Dockers
  - Implements OASIS CAMP and TOSCA standards
  - Supports Block and Object storage

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	GOOD
BYON	YES
Services	LOW
Automation	GOOD

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Apache Brooklyn

- Is an open-source framework for modelling, deploying and managing distributed applications defined using blueprints

- License: Apache 2.0

- **Cloud Application Support**
  - blueprints to describe application
  - many supported components: Kafka, Cassandra, MongoDB, MySQL, Tomcat
  - TOSCA standard
  - YAML

Cloud Application Support	Evaluation
Modelling	GOOD
Lifecycle	GOOD
Data Management	NO
Workflow support	MEDIUM
Containerization	MEDIUM

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Apache Brooklyn

- Is an open-source framework for modelling, deploying and managing distributed applications defined using blueprints

- **Platform Intelligence**
  - Scaling (Metric-based auto-scaler): dynamically adjusts its size in response to keeping a metric within a given range. It adds/removes members automatically
  - It monitors those deployments, maintains a live model, and runs autonomic policies to maintain their health
  - Monitoring:
    - built-in sensors
    - Enrichers (composite)
  - Load Balancing

Platform Intelligence	Evaluation
Optimisation	MEDIUM
Monitoring	MEDIUM
Runtime adaptation	MEDIUM
Event management	MEDIUM
Data management	NO
Offering Discovery	NO

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Scalr

- Is a hybrid cloud management platform designed specifically for enterprises
- License: paid (5-20$ monthly)
- Cloud Orchestration Support
  - Cost effective, automated, standarized and fast application deployments
  - AWS, GCP, Azure, Openstack, VMware support
  - Roles and hierarchical structure of management

Cloud Orchestration Support	Evaluation
Multi-cloud	MEDIUM
Resource diversity	MEDIUM
BYON	YES
Services	GOOD
Automation	GOOD

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Scalr

- Is a hybrid cloud management platform designed specifically for enterprises
- License: paid (5-20$ monthly)
- Cloud Application Support
  - Modelling: Scalr Farm Builder: YAML
  - High-level declarative descriptions of user's goal
  - Application lifecycle automation
  - Security policies

Cloud Application Support	Evaluation
Modelling	GOOD
Lifecycle	GOOD
Data Management	NO
Workflow support	GOOD
Containerization	MEDIUM

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Scalr

- Is a hybrid cloud management platform designed specifically for enterprises

- License: paid (5-20$ monthly)

- Optimisation:
    - Capability to centralise and delegate policy administration through Software Defined Cloud Governance to ensure consistent implementation of Security and Compliance policies across all cloud deployments.
    - more than 10 built in events that can trigger orchestration rules
    - Set of policies such as reducing unused resources

- Cost visibility

- Utilized a hierarchical, top down approach for policy

- enforcement: balancing needs of finance, security, IT,

and development teams

Platform Intelligence	Evaluation
Optimisation	MEDIUM
Monitoring	MEDIUM
Runtime adaptation	LOW
Event management	MEDIUM
Data management	NO
Offering Discovery	NO

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Cisco Cloud Center Suite

- Set of integrated modules that simplifies the lifecycle management of multicloud applications, workflows, and their infrastructure

- License: paid

- Many cloud providers supported

- Ability to support multitude of services at platform level

- Action Orchestrator:
    - Simplifies business processes through workflow automation and seamless integration with extended ecosystem solutions through a broad set of adaptors and standardized interfaces.

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	GOOD
BYON	YES
Services	GOOD
Automation	MEDIUM

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Cisco Cloud Center Suite

- Set of integrated modules that simplifies the lifecycle management of multicloud applications, workflows, and their infrastructure

- Workload Manager:
  - Provides multicloud management of infrastructure and applications so you can design, deploy, and optimize your deployments on premises and in public clouds with governance policies that provide centralized visibility and control.

- It enables both to edit management workflows and execute application workflows by using specific workflow engines

- Very good workflow support

Cloud Application Support	Evaluation
Modelling	MEDIUM
Lifecycle	LOW
Data Management	MEDIUM
Workflow support	GOOD
Containerization	MEDIUM

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Cisco Cloud Center Suite

- Set of integrated modules that simplifies the lifecycle management of multicloud applications, workflows, and their infrastructure

- Cost Optimizer:
  - Analyzes the consumption patterns of deployed workloads and provides visibility into your total cloud spend. It also identifies cost-optimization strategies so you avoid paying for resources that don't deliver value.
  - It prepares recomendations for cost optimisation

Platform Intelligence	Evaluation
Optimisation	LOW
Monitoring	LOW
Runtime adaptation	LOW
Event management	MEDIUM
Data management	MEDIUM
Offering Discovery	GOOD

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Google Anthos

Hybrid application management platform for on-premise and public clouds with support for service mesh, containers, micro-services and functions as well as strong focus on security and workload migration.

- License: paid, from 10k USD/month

- Cloud Orchestration Support
  - Computing Environment: Google Kubernetes Engine (GKE) and GKE On-Premise
  - Only main Cloud Providers supported
  - Support a multitude of services at the platform level

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	MEDIUM
BYON	YES
Services	GOOD
Automation	MEDIUM

Anthos

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Google Anthos

Hybrid application management platform for on-premise and public clouds with support for service mesh, containers, micro-services and functions as well as strong focus on security and workload migration.

- License: paid, from 10k USD/month

- Cloud Application support
  - Good data management: Data creation and secure data migration while exhibiting a medium data source
  - Modelling: Rich inheritance model
  - Knative

Cloud Application Support	Evaluation
Modelling	MEDIUM
Lifecycle	LOW
Data Management	GOOD
Workflow support	NO
Containerization	MEDIUM

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Google Anthos

- Hybrid application management platform for on-premise and public clouds with support for service mesh, containers, micro-services and functions as well as strong focus on security and workload migration.
- Optimisation
  - Scaling support, both vertical and horizontal scaling of containerised components.
  - Autoscaling to handle all incoming requests
- Built in metrics presented in interactive dashboards, latency, traffic, erros
- Support for SLOs

Platform Intelligence	Evaluation
Optimisation	MEDIUM
Monitoring	MEDIUM
Runtime adaptation	LOW
Event management	GOOD
Data management	GOOD
Offering Discovery	NO

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Azure Arc

- Azure Arc enables deployment of Azure services anywhere and extends Azure management to any infrastructure

- License: no cost (in preview)

- Support for on-premise, VMs, Kubernetes, and Services offered by Azure

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	MEDIUM
BYON	YES
Services	MEDIUM
Automation	MEDIUM

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Azure Arc

- Azure Arc enables deployment of Azure services anywhere and extends Azure management to any infrastructure

- Platform Intelligence
  - Azure Monitor provides monitoring for containers and VMs

- Application Support
  - Security policies for Kubernetes and enabled servers

Cloud Application Support	Evaluation	Platform Intelligence	Evaluation
Modelling	MEDIUM	Optimisation	LOW
Lifecycle	LOW	Monitoring	MEDIUM
Data Management	NO	Runtime adaptation	NO
Workflow support	NO	Event management	NO
Containerization	GOOD	Data management	NO
		Offering Discovery	NO

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IBM Multicloud manager

- IBM MCMP is a digital consumption and delivery platform with integration and orchestration layers that supports multiple technology stacks across a multivendor platform.

- License: paid (each service separately)

- Collaboration with Red Hat

- Support for many Cloud Providers, also Kubernetes

- Consumption console

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	MEDIUM
BYON	YES
Services	MEDIUM
Automation	MEDIUM

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IBM Multicloud manager

- IBM MCMP is a digital consumption and delivery platform with integration and orchestration layers that supports multiple technology stacks across a multivendor platform.

- Data management:
  - Cloud Pak for Data: offers businesses an extensible, cloud-native data and AI platform that runs on any cloud and modernizes how they collect, organize and analyze data while implementing AI throughout the organization.

- Template designer: blueprints
  - Terraform templates

- Policies for alerts

Cloud Application Support	Evaluation
Modelling	GOOD
Lifecycle	LOW
Data Management	GOOD
Workflow support	LOW
Containerization	MEDIUM

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IBM Multicloud manager

- IBM MCMP is a digital consumption and delivery platform with integration and orchestration layers that supports multiple technology stacks across a multivendor platform.

- Application Resoures Management (additional service)
    - Optimizes application performance, compliance, and cost in real-time
    - Monitoring
    - Continuosly optimize the environment

- Policies for alerts

- Cost monitoring

- Event and data management

Platform Intelligence	Evaluation
Optimisation	GOOD
Monitoring	MEDIUM
Runtime adaptation	GOOD
Event management	MEDIUM
Data management	MEDIUM
Offering Discovery	GOOD

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Cloudify

- Provides cloud orchestration as well as a unified platform for both Cloud and Edge

- License: Apache 2.0, versions: Community/Premium

- Runtime and deployment
  - Orchestration engine, Workflow engine
  - Main Cloud providers, basic services

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	MEDIUM
BYON	YES
Services	LOW
Automation	MEDIUM

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Cloudify

- Provides cloud orchestration as well as a unified platform for both Cloud and Edge

- Design and Development:
  - Modelling lanuage based on TOSCA standard
  - Blueprints contain complete orchestration plan for application/service
  - Topology, life-cycle management, policies, resources
  - Can use Terraform, Jenkins, Ansible
  - Good lifecycle management

Cloud Application Support	Evaluation
Modelling	GOOD
Lifecycle	GOOD
Data Management	NO
Workflow support	MEDIUM
Containerization	MEDIUM

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Cloudify

- Provides cloud orchestration as well as a unified platform for both Cloud and Edge

- Operation and Management
  - Security Policies
  - Only horizontal auto-scaling based on simple rules

Platform Intelligence	Evaluation
Optimisation	MEDIUM
Monitoring	LOW
Runtime adaptation	MEDIUM
Event management	NO
Data management	NO
Offering Discovery	LOW

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Sixsq Nuvla

- Software solution for multi-cloud, hybrid cloud and edge device application management

- License: Apache 2.0, paid support

- Cloud Orchestration Support
  - Cloud Neutraility: All mainstream Cloud Providers supported
  - Only container support, Docker, Docker Swarm, Kubernetes
  - Edge support
  - REST API

- Developed from SlipStream

Cloud Orchestration Support	Evaluation
Multi-cloud	MEDIUM
Resource diversity	LOW
BYON	YES
Services	LOW
Automation	MEDIUM

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Sixsq Nuvla

- Software solution for multi-cloud, hybrid cloud and edge device application management

- Cloud Application Support
  - Docker container native
  - Data management

- Platform Intelligence
  - Monitoring and notifications
  - Data replication

Cloud Application Support	Evaluation
Modelling	MEDIUM
Lifecycle	MEDIUM
Data Management	MEDIUM
Workflow support	MEDIUM
Containerization	MEDIUM

Platform Intelligence	Evaluation
Optimisation	MEDIUM
Monitoring	LOW
Runtime adaptation	MEDIUM
Event management	NO
Data management	NO
Offering Discovery	LOW

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Morpheus Data

- A multi-cloud management platform for hybrid IT and DevOps automation with special focus on cost and performance optimisation.

- A Leader in the 2020 Magic Quadrant for CMP for the 2nd year

- License: paid

- Cloud Orchestration Support
  - extensible plug-in SDK for those that want to curate their own integrations.
  - nearly 100 codeless technology integrations
  - Executing user supplied plan

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	GOOD
BYON	YES
Services	GOOD
Automation	GOOD

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Morpheus Data

- A multi-cloud management platform for hybrid IT and DevOps automation with special focus on cost and performance optimisation.

- Cloud Application Support
  - application lifecycle with scaling, logging, monitoring, backup, and migration

- Platform Intelligence
  - Focus on cost optimisation
  - AI-based rightsizing reduces costs up to 30%.
  - Data management

Platform Intelligence	Evaluation
Optimisation	MEDIUM
Monitoring	MEDIUM
Runtime adaptation	MEDIUM
Event management	LOW
Data management	MEDIUM
Offering Discovery	NO

Cloud Application Support	Evaluation
Modelling	MEDIUM
Lifecycle	MEDIUM
Data Management	LOW
Workflow support	MEDIUM
Containerization	MEDIUM

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Cloud Bolt

- CloudBolt unifies private and public cloud into a single enterprise hybrid cloud where end-users can manage and orchestrate IT resources.

- Licence: paid, year subscription

- Cloud Orchestration Support:
    - 20+ private and public clouds (e.g., VMware, AWS, Azure, GCP, and more)
    - extensible, plug-in architecture that comes with 200+ plugins
    - Executing user supplied plan
    - It is focused on provisioning and orchestration

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	GOOD
BYON	YES
Services	MEDIUM
Automation	MEDIUM

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Cloud Bolt

- CloudBolt unifies private and public cloud into a single enterprise hybrid cloud where end-users can manage and orchestrate IT resources.

- Cloud Application Support
  - blueprints library for orchestration and automated provisioning of IT resources.

- Platform Intelligence:
  - Focused on cost monitoring and visualisation
  - Basic monitoring capabilities

Cloud Application Support	Evaluation
Modelling	MEDIUM
Lifecycle	LOW
Data Management	LOW
Workflow support	MEDIUM
Containerization	LOW

Platform Intelligence	Evaluation
Optimisation	NO
Monitoring	LOW
Runtime adaptation	LOW
Event management	MEDIUM
Data management	NO
Offering Discovery	MEDIUM

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DC/OS

- Is container-orchestrator (data centre operating system) that builds upon the resource manager Apache Mesos

- License: open source, Apache 2.0

- Cloud Orchestration Support
  - Extensible resource isolation, multiple resource isolation zones.
  - Service discovery and distributed load balancing
  - Docker containers, big data pipeline tools, and traditional apps
  - Scheduling and Resource allocation
  - Mixed workload colocation based on Apache Mesos

Cloud Orchestration Support	Evaluation
Multi-cloud	MEDIUM
Resource diversity	GOOD
BYON	YES
Services	GOOD
Automation	GOOD

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DC/OS

- Is container-orchestrator (data centre operating system) that builds upon the resource manager Apache Mesos

- License: open source, Apache 2.0

- Cloud Application Support
  - Stateful storage support, multiple persistent and ephemeral storage options
  - distributed load balancing

Cloud Application Support	Evaluation
Modelling	GOOD
Lifecycle	GOOD
Data Management	MEDIUM
Workflow support	NO
Containerization	MEDIUM

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DC/OS

- Is container-orchestrator (data centre operating system) that builds upon the resource manager Apache Mesos

- License: open source, Apache 2.0

- Platform Intelligence
  - Autoscaling built-in policies like based on queue length, using requests per second or CPU and memory usage
  - Service discovery
  - Automatic recovery from failure
  - Built-in utilisation metrics

Platform Intelligence	Evaluation
Optimisation	MEDIUM
Monitoring	MEDIUM
Runtime adaptation	MEDIUM
Event management	MEDIUM
Data management	MEDIUM
Offering Discovery	GOOD

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MELODIC

- A single universal platform for optimized deployment and management of applications in the cloud.

- License: open source, MPL 2.0, paid support from 7bulls.com

- Cloud Orchestration Support
  - It can derive and execute automatically an application deployment plan
  - Support for main Cloud Providers
  - Support for IaaS, FaaS, some services and Docker containers

Cloud Orchestration Support	Evaluation
Multi-cloud	GOOD
Resource diversity	MEDIUM
BYON	YES
Services	MEDIUM
Automation	GOOD

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MELODIC

- A single universal platform for optimized deployment and management of applications in the cloud.

- License: open source, MPL 2.0, paid support from 7bulls.com

- Cloud Application Support
  - CAMEL, rich multi-cloud application modelling language
  - Good support of application lifecycle
  - Policy modelling
  - Flexible definitions of utility functions, and SLOs
  - Possibility to manage data

Cloud Application Support	Evaluation
Modelling	GOOD
Lifecycle	MEDIUM
Data Management	MEDIUM
Workflow support	MEDIUM
Containerization	LOW

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MELODIC

- A single universal platform for optimized deployment and management of applications in the cloud.

- Platform Intelligence
  - Strong focus on utility and model-driven application adaptation
  - Ability to continuous optimisation of multi-cloud application
  - Decision about data placement and support for data-locality awareness
  - Three levels aggregation of metrics: instance, Cloud and application
  - Complex event processing
  - Continuous offers discovery

Platform Intelligence	Evaluation
Optimisation	GOOD
Monitoring	GOOD
Runtime adaptation	GOOD
Event management	GOOD
Data management	MEDIUM
Offering Discovery	GOOD

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Comparison

	Cloud Orchestration Support	Cloud Application Support	Platform Intelligence
Apache Brooklyn	23 GOOD	16 MEDIUM	12 MEDIUM
Scalr	21 GOOD	18 MEDIUM+	9 LOW
Cisco Cloud Center Suite	23 GOOD	18 MEDIUM+	14 MEDIUM
Google Anthos	21 GOOD	12 MEDIUM	17 MEDIUM+
Azure Arc	19 MEDIUM+	9 LOW	4 NO
IBM Multicloud Manager	19 MEDIUM+	15 MEDIUM	24 GOOD
Cloudify	17 MEDIUM+	16 MEDIUM	8 LOW
SixSq Nuvla	13 MEDIUM	15 MEDIUM	8 LOW
Morpheus	25 GOOD	13 MEDIUM	13 MEDIUM
Cloud Bolt	21 GOOD	9 LOW	8 LOW
DC/OS	23 GOOD	16 MEDIUM	17 MEDIUM+
Melodic	21 GOOD	15 MEDIUM	28 GOOD

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