LEAD
COLLABORATE
INNOVATE

STATE
CLOUD
COMPUTING
STRATEGY

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THE SOUTH CAROLINA
DEPARTMENT *of* ADMINISTRATION

STATE
CLOUD
COMPUTING
STRATEGY

EXECUTIVE SUMMARY

The State of South Carolina has developed a cloud computing infrastructure strategy to more effectively and efficiently provision and manage cloud-based compute and storage resources. Cloud computing is expected to offer many benefits to the State of South Carolina including: leveraging economies of scale, commoditizing IT infrastructure, and a pay per-use model. Employing cloud services will allow the State of South Carolina to:

- Become more agile and responsive to constituent requests
- Shift IT resources to tasks that more directly support an agency's mission
- Adapt to scalability requirements more seamlessly
- Enable greater cost transparency

The adoption of cloud computing will be at the discretion of each state agency. The State of South Carolina is not mandating the adoption of cloud-based computing, instead the state is seeking to provide a unified, secure, cost-effective and state sanctioned solution for agencies who choose to leverage cloud-based infrastructure services.

To accelerate the availability of cloud computing for state agencies choosing to adopt cloud-based infrastructure services, the Department of Administration will partner with external service providers to enable Cloud Service Brokering (CSB) capabilities. CSB managed services offer technology, people, and processes/methodologies to implement cloud-based solutions. CSB services are generally organized around four core capabilities described below:

- Aggregation — Aggregation brings together multiple services in scale, such as cloud-scale provisioning, consistent management view, single sign-on and unified billing, as well as unified management, ease of access, customer support and service-level agreement (SLA) management
- Customization — Customization alters or adds to the capabilities of a service to perform its function, such as layering new data and process functions, visibility and analytics, or incorporating a new look and feel to the service. Customization brokerage is the implementation and management of change in people, processes and technologies
- Integration — Integration brings together multiple cloud services and makes them work cohesively to deliver an integrated result. CSB integrator capabilities include integration of: cloud endpoints in scale, governance, and community management and migration
- Governance (Compliance) — Ability to work with end users to define, register and enforce fine-grained, role-based cloud service policies, such as: ability to enforce policies in near real time, potentially across hundreds of thousands of users

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The purpose of the South Carolina 2018 Cloud Computing Strategy is to define an actionable set of goals. When implemented, the set of goals will begin to capture cloud computing benefits while continuing to maintain a safe, secure and reliable environment. Benefits will be captured and measured based on the actual experiences from state agencies who have chosen to adopt the State of South Carolina's cloud service offering.

State of South Carolina Cloud Computing Vision

To provide secure, reliable, agile and cost-effective cloud enabling capabilities to the State of South Carolina.

To achieve this vision, the State of South Carolina has identified the following goals:

- *Goal 1: Standardize an approach for managing cloud computing*
- *Goal 2: Increase service resiliency and reliability*
- *Goal 3: Enable standards for cloud readiness assessment and transition planning*
- *Goal 4: Optimize usage and financial transparency for agencies*

OVERVIEW

Purpose

The purpose of this document is to outline a unified approach for the State of South Carolina's cloud computing strategy in support of and in alignment with the 2018 South Carolina Statewide Strategic Information Technology Plan. This document is also intended to serve as a communication vehicle to be leveraged as guidance for all state agencies regarding the state's cloud strategy and for reference by external organizations as required. The desired outcome of the cloud strategy is to enable the State of South Carolina to realize positive strategic, financial and operational outcomes. It promotes a common understanding regarding the importance of cloud computing to state agency stakeholders and how leveraging cloud technologies can improve the state's ability to serve its constituents.

Cloud Strategy Scope

The strategy outlined in this document primarily focuses on public cloud infrastructure and platform-based solutions. Application-based cloud solutions (e.g., Software as a Service) are not intended to be addressed in this strategy. It is important to note that the state's cloud journey is in the beginning stages and this strategy will evolve as the state re-evaluates its current cloud maturity, available resources, tolerance to risk and the need for agility. Private cloud infrastructure services and hybrid cloud infrastructure services will remain components in the state's long-term cloud strategy.

Audience

The intended audience of this document is the state agency IT senior leaders, IT vendor partners, agency executives, agency application owners, agency and IT program and project managers, and the Department of Administration staff, who are stakeholders responsible for centralized information systems.

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Cloud Services Overview

Cloud computing is a style of computing where scalable and elastic IT capabilities are delivered "as a service" using internet technologies. When these services are provided internally by an organization, such as the Department of Administration, to its user community, it is referred to as "private cloud," and when services are acquired from external providers (via a shared tenant model), it is referred to as "public cloud." Some external providers specialize in providing public cloud services to government agencies that adhere to government regulations and security requirements. This form of public cloud is referred to as "government cloud."

There are many other forms of cloud delivery models. For example, an external provider can provision its services on dedicated physical assets for a specific client where the physical assets are not shared with other unrelated organizations. This form of cloud is referred to as virtual private cloud.

Cloud services must adhere to the five basic characteristics described below.

Service-Based	Scalable & Elastic	Shared	Metered by Use	Use of Internet Technologies
Cloud computing services can be considered "ready-to-use" or "off the shelf." Each service is designed to serve the specific needs of a set of consumers. User interfaces hide the implementation details and enable an automated response by the provider of the service to the consumer of the service (known as self-provisioning).	Elasticity, meaning the ability to grow or shrink infrastructure resources based on changes to workload, is a trait of shared pools of resources. Services can be scaled on-demand to add or remove technology resources as needed.	The underlying infrastructure, software or platforms are shared among the consumers of each service. This enables unused resources to serve multiple needs for multiple consumers, all working at the same time. This sharing enables the realization of economies of scale.	Services are tracked with usage metrics. These may include pay-as-you-go plans, subscriptions and fixed-price models. Usage metrics allow the consumer to shift from a capital expense model to an operating expense model, thus enabling chargeback (billing) based on usage.	Services are delivered using internet identifiers, formats and protocols.

The "as a service" nature of cloud computing lends itself to the grouping of services based on software, platform or infrastructure layer. These are commonly referred to as 'software as a service (SaaS),' 'platform as a service (PaaS),' or 'infrastructure as a service (IaaS).' These service layers will determine the delineation of responsibilties between the consumer of cloud services and the provider.

An illustration of several key operating model and their impacts is below:

	Dedicated IT	Colocation	Hosting Provider	Public IaaS	Public PaaS	Public SaaS
Data	◐	◐	◐	◐	◐	◐
Application	▣	▣	▣	▣	▣	▣
Virtual Machine	▦	▦	▦	▦	▦	▦
Server	▦	▦	▦	▦	▦	▦
Storage	▦	▦	▦	▦	▦	▦
Network	◉	◉	◉	◉	◉	◉
Data Center	▥	▥	▥	▥	▥	▥

Organization has control | **Organization shares control with service provider** | **Service provider has control**

Realities of Cloud Computing: Quelling Misconceptions

The evolution of cloud computing and the external provider community's desire to leverage or challenge this now mainstream computing model while positioning their products has resulted in several misconceptions that need to be understood and addressed. Some of the notable misconceptions include:

- Security — A common misconception about cloud computing is that it is not as secure as the traditional on-premises computing environments. Leveraging and properly configuring available government cloud capabilities such as data encryption, threat analytics and multifactor authentication technologies will allow the state to realize the benefits of the cloud environment while maintaining appropriate security protections
- Cost — It is assumed by many that cloud computing is always cheaper than other alternatives, however, that is not always the case. The applications and workload identified for the cloud must be reviewed and managed carefully to ensure cloud resources are being leveraged in the most effective and efficient manner
- Everything can live in the cloud — At some point in the distant future, this may become a true statement, however, limitations of legacy workloads or dependencies on legacy operating systems will have to be addressed first. Many applications may need to be modernized at significant cost before they can be cloud-hosted. Furthermore, as stated above, characteristics of some applications may result in higher total cost of ownership in the cloud

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Strategic Treatment of Cloud Computing

The State of South Carolina recognizes that security, flexibility and agility in deployment of new services is paramount to the success of future service delivery capabilities for state agencies and cloud computing will be an integral component of a hybrid service delivery capability.

Cloud and traditional data center models will be part of a continuum of complementary solutions for the foreseeable future. This cloud strategy will develop a set of goals and priorities for design, procurement, implementation, and operation of a uniform set of IaaS and PaaS cloud capabilities from which all agencies could benefit. These goals and priorities will collectively outline a roadmap to address:

- Required cloud capabilities such a private, public or government cloud
- Integration models and reference architectures
- Cloud security and use policies
- Cloud governance
- Resource and talent development
- Life cycle management
- Financial management
- Procurement

Multiple cloud service providers will be required to effectively support the state's requirements and the state will structure agreements that mitigate external cloud service provider lock-in.

Introduction to Cloud Service Broker Capabilities

The Department of Administration will offer cloud services to state agencies by leveraging services from an external Cloud Service Broker (CSB). A CSB as defined by Gartner is:

An IT role and business model in which an entity adds value to one or more cloud services on behalf of one or more consumers of that service model.
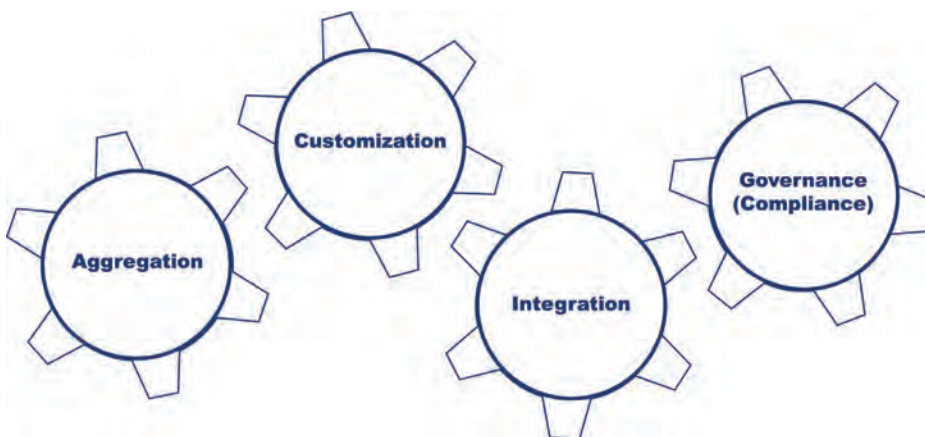
A CSB provides technology and services to take on activities of the brokerage function, and offers combined technology, people, managed services and methodologies to implement and manage CSB-related projects and requirements. CSB services are generally organized around four core capabilities as shown on the left.

CSB Core Capabilities

- **Aggregation —** Aggregation brings together multiple services in scale, such as cloud-scale provisioning, consistent management view, single sign-on and unified billing, as well as unified management, ease of access, customer support and SLA management
- **Customization —** Customization alters or adds to the capabilities of a service to perform its function, such as layering new data and process functions, visibility and analytics, or incorporating a new look and feel to the service. Customization brokerage is the implementation and management of change in people, processes and technologies
- **Integration —** Integration brings together multiple cloud services and makes them work cohesively to deliver an integrated result. CSB integrator capabilities include integration of: cloud endpoints in scale, governance, and community management and migration
- **Governance (Compliance) —** Ability to work with end users to define, register and enforce fine-grained, role-based cloud service policies, such as: ability to enforce policies in near real time in scale, potentially across hundreds of thousands of users

CSB Key Market Observations

According to Gartner, **public cloud services will have** a significantly higher compound annual growth rate (**CAGR) of 16.5% through 2020** compared to IT services

Through 2020, **50% of organizations will engage a cloud service brokerage provider** for their cloud needs given the increased adoption of multicloud and hybrid cloud consumption models.

Buyers looking for cloud services, will **demand CSB offers** that include an **SLA** and **business-outcome-based** approach, with clear metrics and value for the IT leader.

Buyers will **continue to adopt environments** that will be **hybrid in nature**. As a result, enterprises will source multiple cloud providers, **necessitating a** need for the **role of a CSB**

IaaS adoption **continues** its **rise**, but the **enterprises struggling** with the required **skills** and **experience** needed for deployments — **offering** an **opportunity** for **CSB**

The state anticipates leveraging a hybrid cloud environment consisting of public and private cloud technologies to support the diverse requirements of the different agencies. A CSB will allow the state agencies a central point of contact to provision and manage IaaS and PaaS cloud services versus managing multiple cloud providers.

The benefits of a CSB model is to make the adoption of cloud computing less expensive, easier, more secure and more productive for the State of South Carolina to navigate, integrate, consume and extend cloud services, particularly when cloud services span multiple, diverse cloud services providers.

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Examples of value-added business and technical CSB functions include, but are not limited to:

- Reducing the risk of consuming services (e.g., via compliance)
- Integrating diverse cloud services, including software as a service (SaaS)
- Adding significant value to services (e.g., context and analytics)
- Providing financial transparency
- Centralizing cloud services functionality (e.g., service aggregation, archival and auditability)
- Providing a central point for governance (e.g., for U.S. federal government mandates and/or state government mandates)
- Offering various IT services to help consumers with CSB-related project implementations
- Streamlining and simplifying the IT services acquisition process

A non-CSB model and a CSB model is illustrated below:
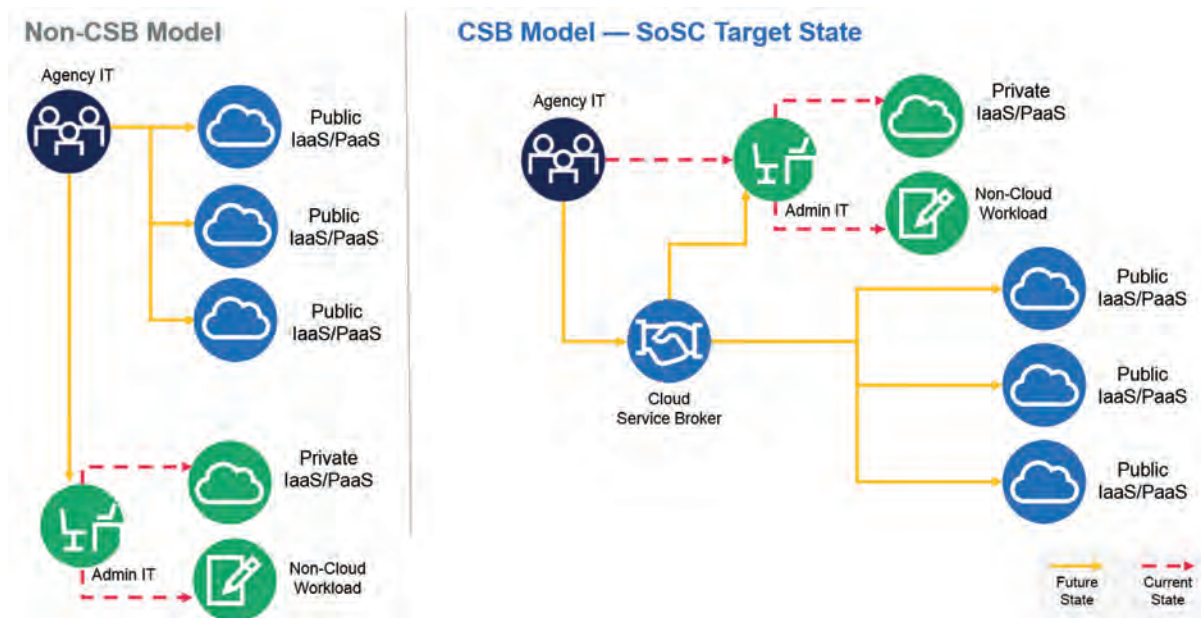
CLOUD COMPUTING STRATEGY

Cloud Computing Vision

To provide secure, reliable, agile and cost–effective cloud enabling capabilities to the State of South Carolina.

Goal 1 | Standardize an Approach for Managing Cloud Computing

The State of South Carolina will define and adopt a unified statewide strategy to host qualified IT workloads in the cloud. Key objectives for this goal include:

Objectives	Summary Description
1.1 Enable Life Cycle Management for Cloud Resources	The CSB will deploy uniform controls for life cycle management of cloud compute and storage resources (independent of the cloud service provider). Consistent life cycle management will start at provisioning time to retirement. Life cycle management will include (but is not limited to) the following activities: ■ Managing provisioning workflow approval steps ■ Assigning ownership of compute resources (e.g., virtual servers) to a user or agency ■ Managing lease time of compute resources (defined by the agency customer on the CSB portal) by sending reminder notifications such as approving lease time extension and enforcing compute resources (e.g., virtual servers) retirement
1.2 Establish Clear Roles and Responsibilities	Developing and adopting CSB capabilities will require change. New processes will be developed for agency customers consuming CSB provisioned cloud services and new processes will be developed and adopted by the Department of Administration from a support perspective. The Department of Administration (with implementation guidance provided by the CSB) will clearly define and communicate the roles and responsibilities for agency customers, the Department of Administration and the CSB as it relates to the strategy, management, and administration of infrastructure-based cloud resources.
1.3 Enable CSB Capabilities	The Department of Admin will partner with external service providers to develop and deploy CSB capabilities. CSB capabilities serve as the foundation for enabling a standardized approach for managing cloud computing. CSB capabilities are grouped into four categories. The type of capabilities to be deployed by CSB category include the following:* ■ Aggregation: Cloud Scale Provisioning, Consistent Management and Unified View, Single Sign-On, SLA Management, Unified Billing, Ease of Access, Customer Support ■ Customization: Layering new data and process functions, Visibility and Analytics, Incorporating a new look and feel to the service ■ Integration and Governance: Migration Skills, Policy Enforcement, Community Management

*Note: See the appendix for more detail regarding each capability

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Goal 2 | Increase Service Resiliency and Reliability

The State of South Carolina will leverage best-in-class data centers from industry leading cloud service providers to increase service resiliency and reliability. Key objectives for this goal include:

Objectives	Summary Description
2.1 Enhance Disaster Recovery Capabilities	The Department of Admin (with implementation guidance provided by the CSB) will enhance business resumption and continuity by optimizing costs and improving workload availability by leveraging cloud-based backup and disaster recovery solutions.
2.2 Leverage the State's Data Classification Policies	The CSB will integrate logic derived from the State's data classification policies to develop decision models to aid in assessing cloud workload hosting options (e.g., matching workload/application based on data availability to the most appropriate hosting options from a resiliency and reliability perspective).
2.3 Define an Exit Strategy to Mitigate Vendor Lock-In Risk	The state will define an exit strategy prior to selecting a CSB. The exit strategy will outline the business and operational plans if a cloud provider goes out of business or if the state decides to terminate the contract with the cloud provider. The state will ensure a multivendor environment is leveraged to mitigate vendor lock-in and maximize potential relationships with many partners.

Goal 3 | Enable Standards for Cloud Readiness Assessment and Transition Planning

The State of South Carolina will establish qualifying standards to aid agencies in determining application and infrastructure workload cloud readiness. Standards will include (but not limited to) attributes related to: security, privacy, performance, application architecture, and availability. The state will also provide a formal approach to guide agencies in their migration to cloud infrastructure services. Key objectives for this goal include:

Objectives	Summary Description
3.1 Leverage cloud readiness assessment decision models for all candidate workload	The Department of Administration (with guidance provided by the CSB) will develop and leverage consistent methodologies and tools in determining the suitability of candidate workload for migration to cloud service.
3.2 Leverage predictive financial models for forecasting candidate cloud workload cost	The Department of Admin (with guidance provided by the CSB) will leverage predictive total cost of ownership models to aid with cloud financial planning. Example cost elements will include, but is not limited to: transition costs, operating costs, data ingress costs, data egress costs, etc.
3.3 Ensure security and privacy compliance policies are consistently applied to all cloud workload	The Department of Administration (with guidance provided by the CSB) will consistently assess and recommend security and compliance policies for candidate agency cloud workload. Formal policies will be enforced through CSB governance/compliance workflow and supporting processes.

Goal 4 | Optimize Usage and Financial Transparency for Agencies

The State of South Carolina will enable clear and easy to understand usage and billing dashboards for agencies subscribing to cloud IaaS and PaaS infrastructure services. Enabling cloud resource usage and billing transparency will provide agencies the visibility to more effectively and efficiently manage their cloud IaaS and PaaS resources.

| Objectives	Summary Description
4.1 Provide timely and accurate usage and billing for all cloud workload	The Department of Admin (with guidance provided by the CSB) will provide agency customers transparent usage and billing metrics for consuming cloud-based (IaaS and PaaS) services. Usage and billing information will allow agency customers to better understand and control cloud based (IaaS and PaaS) costs.
4.2 Transition agency IT infrastructure spend from Capital Expenditures (capex) to Operating Expenditures (opex)	Agency customers of the infrastructure-based cloud services will experience a shift of IT infrastructure spend from capex to opex, which will result (generally) in a more consistent and predictable spend pattern. The shift in spend from capex to opex will require a revised approach to agency IT planning and budgeting for cloud services.
4.3 Capture, measure and report qualitative and quantitative benefits from cloud (IaaS and PaaS) migration	Department of Administration (with guidance provided by the CSB) will assist agency customers of infrastructure-based cloud services in identifying the qualitative value proposition and the quantitative cost and benefits related to migration to cloud services. Department of Administration will leverage its benefits realization toolkit to identify and report on agency benefits realized and report to agency executive stakeholders on a regular reporting period regarding key agency success factors and agency lessons learned.

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TARGET STATE CLOUD ENVIRONMENT

Overview

The state will leverage the expertise of external CSBs to enable cloud services capabilities. The graphic below represents a high-level conceptual view of the State of South Carolina's target state cloud delivery model as enabled by an external CSB. The target state model consists of four layers and the attributes in each layer is described below. This target state will require a long-term commitment to fully achieve.

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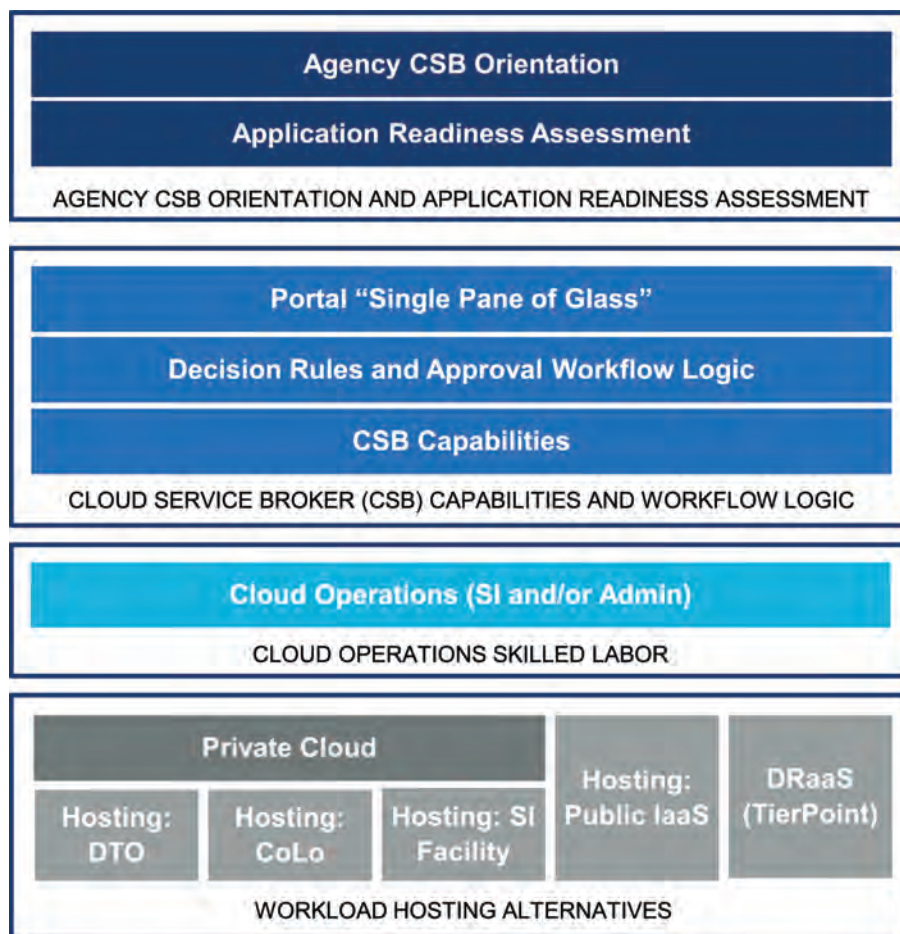
Agency CSB Orientation and Application Readiness Assessment

Agency CSB Orientation and Application Readiness Assessment represents the first phase in a state agency's cloud services adoption process.

- Agency CSB Orientation represents a mandatory information session that will provide agency IT leaders with an orientation to the CSB's service offerings. This information session will cover a range of topics including resource provisioning, life cycle management, financial and resource transparency, and an introduction to the application readiness assessment process.
- Application Readiness Assessment represents a mandatory review process for agency applications and/or workload to be hosted in the cloud. The readiness assessment is intended to serve as a compliance aid to agency IT and business leaders. Initial readiness assessment focus areas will include data classification policy compliance, and documentation related to application and/or workload functional and non-functional attributes.

CSB Capabilities and Workflow Logic

CSB capabilities represent the enabling component to the state's cloud strategy. An external service provider will partner with the state in developing the aggregation, customization, integration and governance/compliance capabilities.

The State of South Carolina's future IT infrastructure environment will be hybrid in nature, consisting of on-premises, private cloud and public cloud services. The state will be seeking services from multiple cloud providers, which will require the role of a CSB. The state is seeking a CSB provider to offer a range of expertise for its hybrid IT initiatives. This includes not only technical expertise to bridge the different delivery mechanisms, but also business acumen, alignment of outcomes, and expertise in financial, policy, governance and regulatory compliance issues. As the state increases its hybrid footprint, it will continually redefine its requirements for the features, forms and functions needed for seamless and sustained operations.

The State of South Carolina will require its CSB partner to fulfill a diverse range of requirements. A sample list of the potential requirements are illustrated in the tables below.

CSB Requirements	Details	Additional CSB Services
Advanced	Provisioning of Self-Service IT Tools/ITaaS, Availability of Blueprints, Migration Services, Transformation Services, License Management, Licensed/White Labeling	Security, Management Services, Service Arbitrage, Analytics, Cloud Federation, Interoperability of Public and Private Clouds
Basic	Service Catalog, Service User and Provisioning, Authentication, Authorization and Access Control, User and Service Administration, Monitoring, Reporting and Auditing, Help Desk, Ticketing and Support, Billing, Metering and Chargeback, Unified Service Delivery, Single Sign-On	
Core	Aggregation, Integration, Customization, Governance	

The requirements have been grouped into four different categories. The core requirements serve as foundational capabilities. Basic requirements are those that will be layered on top of the core CSB requirements and advanced CSB requirements will be layered on top of the CSB basic requirements. Additional CSB requirements are included on the right-hand side in the previous table.

Cloud Operations Skilled Labor

The skills and experience provided by the external CSB professional service team are a critical component to South Carolina's target state cloud requirements. The required skills and experience the state is seeking from an external CSB provider's professional services team includes deep experience in managing and operating a hybrid IT environment. Key skills and experience include:

- Multisourcing capabilities
- Service integration and management capabilities that enable the building and managing of an integrated hybrid IT operating model
- Management of traditional data center environments
- Management of private cloud environments
- Management of Public Cloud IaaS/PaaS environments (e.g., Amazon Web Services [AWS], Microsoft Azure, Google, and other public cloud service providers)
- Maintains the relationship with the cloud and non-cloud providers, and ensures end-to-end visibility and management of the hybrid environment

Workload Hosting Alternatives

The State of South Carolina's target state hosting environment will be hybrid in nature. The target state hybrid IT environment may consist of a combination of the below alternatives:

- On-premises hosting via the Department of Administration
- Colocation (Co-Lo) hosting
- System Integrator (SI) hosting facilities[1]
- Public Cloud (IaaS/PaaS) hosting
- Certified U.S.-based Government Cloud (IaaS/PaaS) hosting

# Organization and Governance: Cloud Center of Excellence (CCoE)

A critical success factor for the adoption of new approaches and technologies such as cloud computing is to effectively address the organizational, governance and communication requirements. The Department of Administration will ensure that stakeholders are:

- Involved in cloud planning
- Remain informed about new cloud capabilities
- Address expectations and/or concerns about cloud computing adoption

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Key objectives to assist in the organizational change include:

- Developing and implementing a cloud computing communication, outreach and training plan. The cloud computing communication plan will leverage the broader IT statewide communication plan framework. The cloud computing communication plan will identify stakeholders and their communication, outreach and training needs and will develop appropriate material to satisfy those needs
- Establishing a CCoE which is to be staffed with rotational members with varying expertise based on the nature of the activities that the CCoE delivers. The CCoE will provide strategic and operational leadership in the cloud adoption process. Key features of the CCoE include:
  - Standardizing procedures across the state related to cloud adoption
  - Demonstrating value through economies of scale
  - Focused expertise around cloud computing for the State of South Carolina
  - Building institutional knowledge around cloud
  - Developing and sharing cloud best practices
  - Support across multiple agencies and functional disciplines across the State of South Carolina

A conceptual representation of the State of South Carolina's CCoE structure is illustrated in the diagram below.
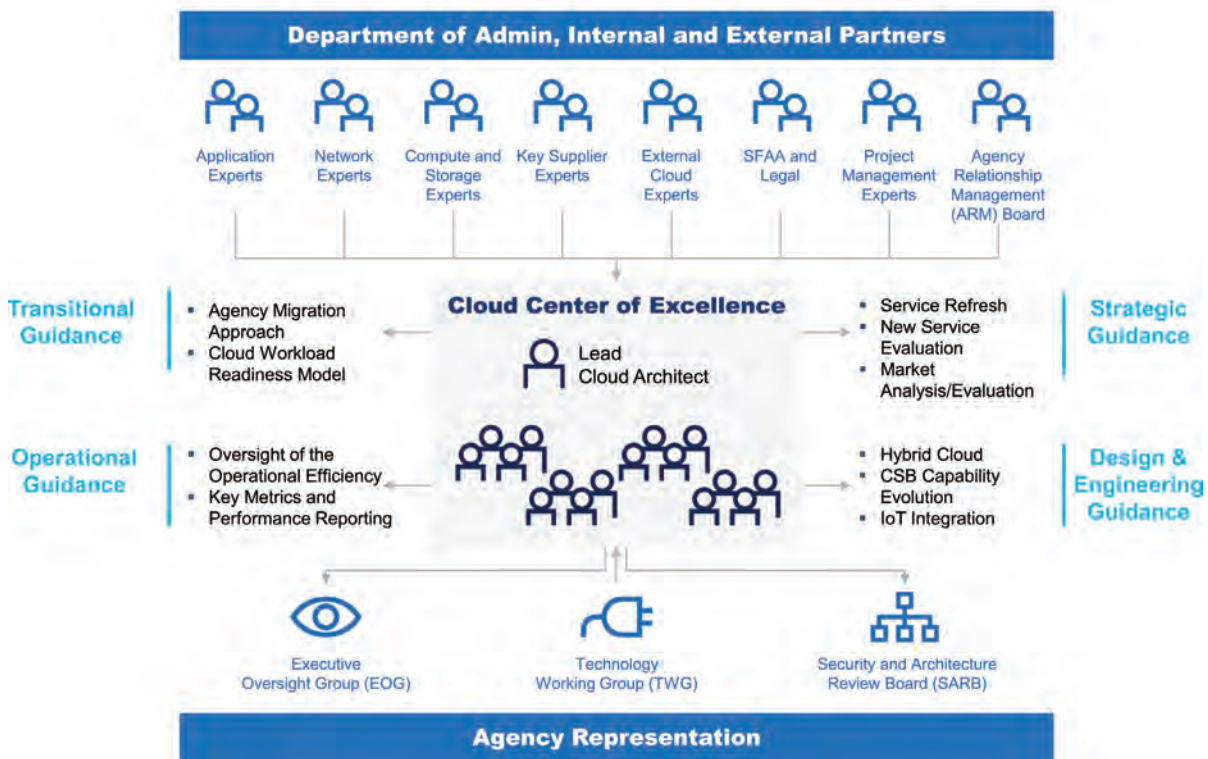
The diagram above highlights three layers of participants and their associated objectives. The participant groups are:

- *Department of Administration, State Agencies and External Partners*
- *Core CCoE members*
- *Agency Representation*

Department of Administration, State Agencies and External Partners

This participant group functions as a rotational source of subject matter experts available to the CCoE. The exact mix and make-up of participants will depend on the particular topic(s) the CCoE is tasked with addressing. For example, if the CCoE is tasked with assisting in the development of select contract terms and conditions related to security and privacy of data hosted at a Cloud Service Provider, then the CCoE would be composed of a mix of subject matter experts represented from different agencies. A sample of cross agency participants could include: State Fiscal Accountability Authority (SFAA) representation, Chief Information Security Officer (CISO) representation, data privacy representation, and legal representation. The participants for this specific CCoE working group would be led by a Cloud Lead Architect who will help guide the team in achieving the working group's target objective(s). Once the objective is accomplished, the working group is disbanded. Involvement from this group of participants in the CCoE is intended to be temporary. There may be multiple working groups operating at a single time under the CCoE and the exact number of working groups will depend on the demand for the CCoE services.

CCoE Members

The CCoE is led by a Cloud Architect who oversees all aspects of cloud initiatives, owns cloud design documentation and is charged with working across all teams to define requirements. The CCoE will generally be involved in two types of engagements:
- Task-based engagements
- Consultative-based engagements

Task-Based Engagements
Task-based engagements support initiatives with a focused scope and have a shorter delivery time frame. Examples of task-based engagements include: CCoE support for the development of select contract terms for a Cloud Service Provider; CCoE support in contract negotiations with a new Cloud Service Provider or the renewal of an existing Cloud Service Provider Contract. Resources for the task-based initiatives are generally brought into the CCoE on a part-time basis and are sourced from different areas of the state or sourced externally from partners as required.

Consultative-Based Engagements
Consultative-based engagements support initiatives with a broader scope and have longer delivery time frames. Examples of consultative based engagements include: providing support and guidance on hybrid cloud design and engineering requirements; providing support, guidance and oversight on agency workload migration to the Cloud or providing guidance and/or support for a cloud workload decision model. Resources for these consultative-based initiatives are generally brought into the CCoE from other areas of the state. In this case, select individuals from the Department of Administration's infrastructure teams would be assigned to the CCoE. The Department of Administration subject matter experts' (SMEs) efforts will be focused on the CCoE initiatives and under the guidance of the CCoE Cloud Architect. The CCoE member will still maintain a reporting structure to their Department of Administration business areas. This dual reporting allows the member of the CCoE to remain focused on the CCoE's initiatives, but still maintain connections to the broader Department of Administration allowing the SME to function as a liaison between the CCoE and the Department of Administration. The connection between the CCoE and the Department of Administration ensures the CCoE does not become a "silo" organization and allows the CCoE to leverage additional resources as needed from the Department of Administration.

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Agency Representation

This group of participants will help drive the CCoE's area of focus and will also benefit from the guidance developed by the CCoE. The diagram above illustrates a high-level view of the interaction between the CCoE and the existing Department of Administration governing groups. The existing governing groups represented by the Executive Oversight Group (EOG), Technology Working Group (TWG) and the Security and Architecture Review Board (SARB) will provide and incorporate guidance from the CCoE through their established processes.

Agency Cloud (IaaS/PaaS) Adoption

An agency seeking cloud-based infrastructure services will provision cloud services through the designated CSB portal. An agency customer will not provision cloud resources directly from individual Cloud Service Providers (e.g., AWS, Microsoft Azure, Google Cloud, etc.). The CSB portal will provide a custom view of integrated services and workflow to ensure the proper compute and storage offerings are presented to the agency.

Prior to provisioning services from the CSB portal, an agency customer will participate in:
- Agency CSB Orientation
- Application Readiness Assessment

The above activities are mandatory and are intended to provide the agency customer with an overview of the CSB's capabilities. This activity will help ensure that the agency customer is meeting data classification compliance requirements and the agency has a foundational understanding of functional and non-functional attributes of the application/workload it is seeking to provision to the cloud. An agency customer will proceed to the CSB Portal provisioning process when the agency customer has successfully complied with the Agency CSB Orientation and Application Readiness Assessment requirements.
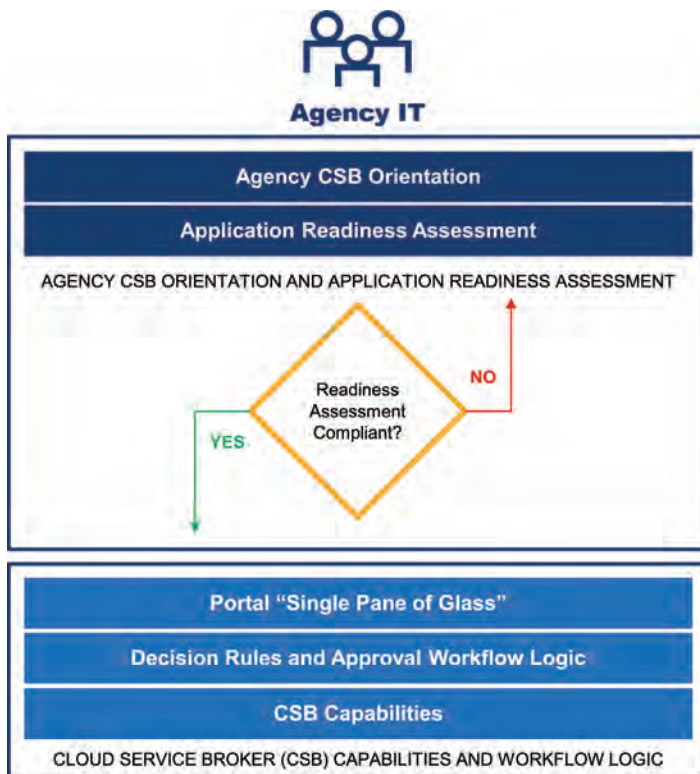

A high-level graphic illustration of the two cloud adoption approach:

A key attribute to the cloud adoption model is that all agency workload will be subject to a consistent set of decision rules and approval workflow logic for the provisioning of cloud compute and cloud storage resources. Agency workload that qualifies for CSB services will be provisioned in an expedited manner due to the automated components of the underlying CSB workflow logic.

Architectural and Technical Environment

The diagram below represents the State of South Carolina's target state hybrid cloud reference architecture. The hybrid cloud reference architecture includes on-premises, private cloud and public cloud infrastructure resources. The reference architecture also includes key CSB capabilities. The intent of the hybrid cloud infrastructure reference architecture is to illustrate at a high level South Carolina's target state hybrid cloud reference architecture. This architecture will have an overview of the different hybrid cloud and CSB components and their overall relationships.
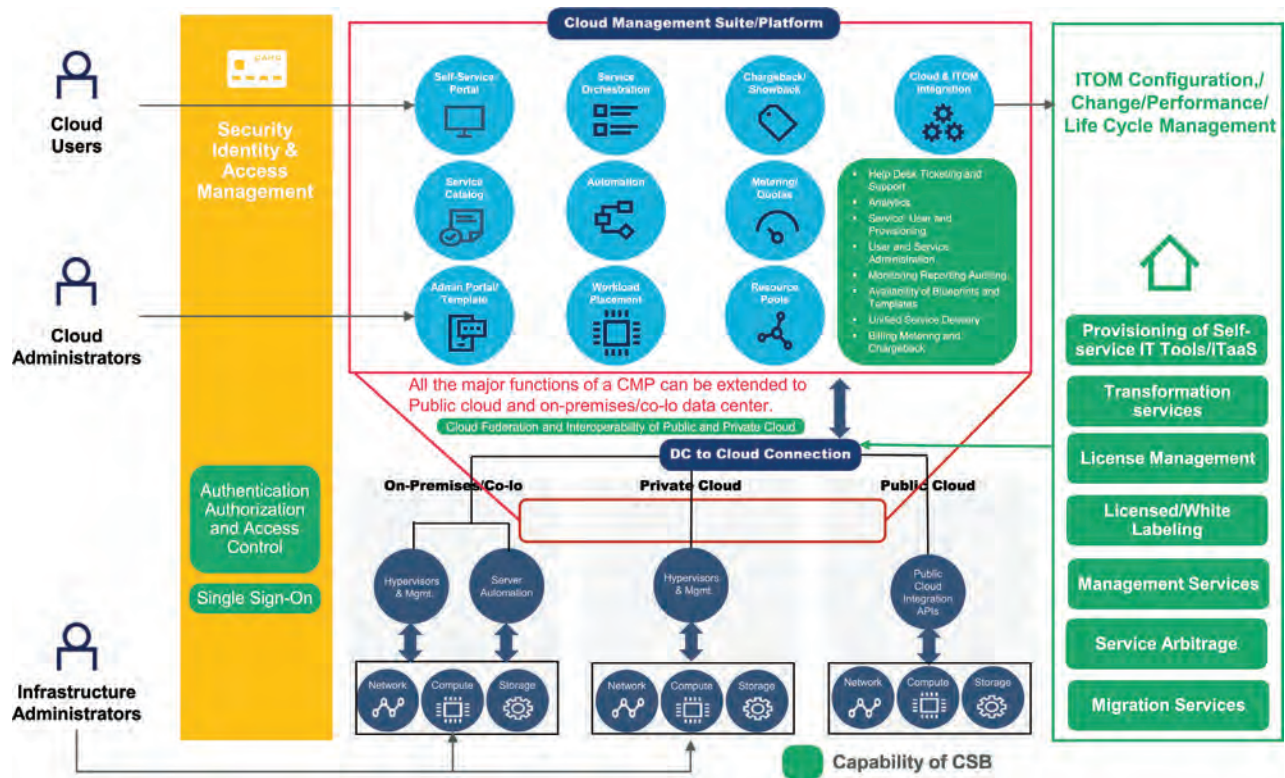
The Appendix/Reference section of this document provides a summary description of the hybrid cloud and CSB components as represented in the diagram above.

APPENDIX/REFERENCES

Note[1]: System Integrator (SI) hosting facilities represent a data center that is leveraged by a system integrator for hosting application and infrastructure workload.

CSB Capabilities Examples

CSB Capability	Summary Description
CSB Aggregation Capabilities	Enabling CSB aggregation capabilities consists of combining multiple services at scale. Components of aggregation capabilities include: ■ Cloud Scale Provisioning — A feature that allows end users to provision resources on their own, and set up or launch a service or application without the intervention of dedicated IT personnel ■ Consistent Management and Unified View — A portal to manage public, private and hybrid cloud environments for building, testing, deploying, and managing applications and related workload on a cloud service provider's infrastructure ■ Single Sign-On — Capability to authenticate once and be subsequently and automatically authenticated when accessing various other authorized target systems ■ SLA Management — Capability includes creation of SLA performance reports to ensure that the state is receiving ■ maximum benefits ■ Unified Billing — Allocation of cost to each department based on usage. Metering provides a measuring capability at some level of abstraction appropriate to the type of service ■ Ease of Access — Simplifies the process of accessing the services by bringing all the different services to a single platform ■ Customer Support — Managing the customer issues
CSB Customization Capabilities	Enabling CSB customization capabilities consists of configuring, customizing or adding to the existing capabilities of a cloud service. This capability could include the layering of new data and process functions, providing enhanced or custom visibility and analytics, or incorporating a new look and feel to a cloud service. Customization brokerage capabilities consists of implementing and managing of change in people, processes and technologies. Components of the customization capability include: ■ Layering new data and process functions — Developing a decision making framework to align to agency requirements, versus mandating a single/monolithic approach ■ Visibility and analytics — CSB analytics capabilities are based on real-time Key Performance Indicators (KPIs) consumed through a dashboard type interface versus the more traditional periodic and historical reporting method. This capability supports the storage, analysis and monitoring of agency relevant KPIs and agency relevant SLAs pertaining to agency specific business goals ■ Incorporating a new look and feel to the service — Developing a new look and approach to the service to better meet the state's overall functional needs

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CSB Capability	Summary Description
CSB Integration and Governance Capabilities	Enabling CSB integration and governance capabilities consists of combining multiple cloud services to deliver an integrated result. Components of integration and governance capabilities include: ■ Migration skills — Leveraging the required skills and tools to successfully migrate IT assets (e.g., user profiles, agency data, etc.) from on-premises compute and storage systems to the cloud service provider's application and infrastructure environment ■ Policy Enforcement — Collaborate with agency users to define, register and enforce (in near-real time) fine-grained, role based cloud services policies (e.g., authentication and authorization, operations, process level attributes — data validation, task approval). ■ Community management — Enabling individual agency users to manage their individual profiles, provision services, communicate, and corroborate with each other

Hybrid Cloud and CSB Component Terminology Reference Table

| Key Hybrid Cloud and CSB Components	Summary Description
Resource Pools	The key building block of the IaaS private cloud, Public Cloud and On-premises/Co-Lo is the resource pool. Pools enable infrastructure consolidation and smart sharing of compute, network and storage resources across the data center(s). They improve hardware utilization and allow for intelligent workload placement.
Workload Placement Engine	This provides the ability to easily start, stop and move workloads in the resource pools, enabling cloud functions such as auto scaling, cost optimization, capacity management, high availability and disaster recovery. This is also called scheduler, dynamic resource management, etc.
Self-service portal(s) and the service catalog	These provide the "menu" of services available for deployment by users or administrators of the private cloud. A service may consist of a single workload, a workload plus some automation tasks, or multiple interdependent workloads plus automation. The service catalog can also provide an expected "price" for services to the cloud user at acquisition time.
Automation	This is the engine room of the private cloud and public cloud and delivers the major benefit — speeding up deployment time by automating repetitive tasks. Automation involves automatic completion of a task, typically to deploy a single workload instance or platform. Automation can be delivered by a CSB, by tools such as Chef or Puppet, or by custom scripts and coding.
Metering Systems (HC)	Chargeback and Showback systems use the metering data to report on resource usage by user or group. Metering is also crucial for capacity management and for alerting administrators when resources need to be added to the resource pools.

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Key Hybrid Cloud and CSB Components	Summary Description
Service Orchestration	Service orchestration delivers entire application environments automatically to users of the hybrid cloud. This requires orchestration of the workload placement engine, automation tools and resource pools to deliver a service from the service catalog to the cloud user. An entire process delivers a service (which may include multiple related workloads, business workflows, approvals, security, and so on). Service orchestration can also provide auto scaling and optimization in concert with the workload placement engine.
Security Identity and Access Management	Capabilities which are typically represented as modules and options available for protecting data, and keeping it compliant with regulatory and statutory requirements, and identity and access management across all types of clouds.
Service and User Provisioning	This refers to integrated policy-based automatic provisioning of the brokered cloud services, typically through a centralized self-service portal.
Authentication, Authorization and Access Control	Authentication and authorization services distinguish between consumers, and what they can access.
User and Service Administration	This represents centralized and automated move, add and change requests, and option to delegate administration controls.
Monitoring, Reporting and Auditing	This is monitoring and reporting of user activity and administrative events. Auditing refers to a systematic evaluation of a cloud system by measuring how well it conforms to a set of established performance criteria.
Help Desk, Ticketing and Support	These represent first-line support for all third-party services delivered by a provider through its CSB role.
Billing, Metering and Chargeback	Billing is an allocation of cost to each department as per usage. Metering provides a measuring capability at some level of abstraction appropriate to the type of service (for example, storage, processing, bandwidth and active user accounts). IT chargeback is a discipline and accounting activity to recover the costs of IT to aid in the management of IT resources, and segment shared costs into profit centers.
Unified Service Delivery	This is the ability to deliver an integrated end-to-end solution aggregating services from all select cloud providers.
Single Sign-On (SSO)	Single sign-on provides the capability to authenticate once, and be subsequently and automatically authenticated when accessing various target systems. It eliminates the need to separately authenticate and sign on to individual applications and systems, essentially serving as a user surrogate between client workstations and target systems. Target applications and systems still maintain their own credential stores and present sign-on prompts to client devices. Behind the scenes, SSO responds to those prompts and maps the credentials to a single login/password pair. SSO is commonly deployed in enterprise, web and federated models.
Provision of Self-Service IT Tools, IT as a Service (ITaaS)	Self-provisioning, commonly known as the cloud self-service, is a feature among many cloud service providers that allows their end users to provision resources by themselves, and set up or launch a service or application without the intervention of dedicated IT personnel or the service providers themselves. This gives users greater freedom in using services within the bounds set by the provider.
Availability of Blueprints and Templates	This is the availability of a predefined library of supported or pre-integrated cloud solutions.
Migration Services	Migration services provide for migration of applications, data, user profiles and other IT assets from on-premises systems into cloud applications and infrastructure.
Transformation Services	These are consulting and implementation services that include cloud readiness assessments, cloud design and roadmap planning, architecture and optimization, for example, to support and enhance enterprise cloud strategy.
License Management	License management is the availability of predefined reselling contracts and conditions, and provision of a self-service portal and/or additional services to write, review and maintain service and operational-level agreements/contracts/subscriptions on behalf of the clients.
Licensed/White Labeling	This represents the ability of cloud services to be branded as per the client before further selling to end customers. Such a service enables third-party company branding with control over appearance, policy and support, for example, along with access to infrastructure.
Cloud Federation and Interoperability of Public and Private Cloud	This is the capability to communicate, execute programs or transfer data among various cloud services under specified conditions.

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Key Hybrid Cloud and CSB Components	Summary Description
Management Services	These are services provided for end-to-end management of all processes in each stage of the application life cycle.
Service Arbitrage	Cloud service arbitrage is similar to cloud service aggregation. The difference between them is that the services being aggregated are not fixed. Indeed, the goal of arbitrage is to provide flexibility and opportunistic choices for the service aggregator.
Analytics	Analytic tools give the ability to dynamically view crucial traffic, usage and revenue data in time series form, and present data visually. Additionally, some analytic engines may summarize application ratings, ideas and feedback (soft data). For most vendors, this refers to usage and performance analytics.
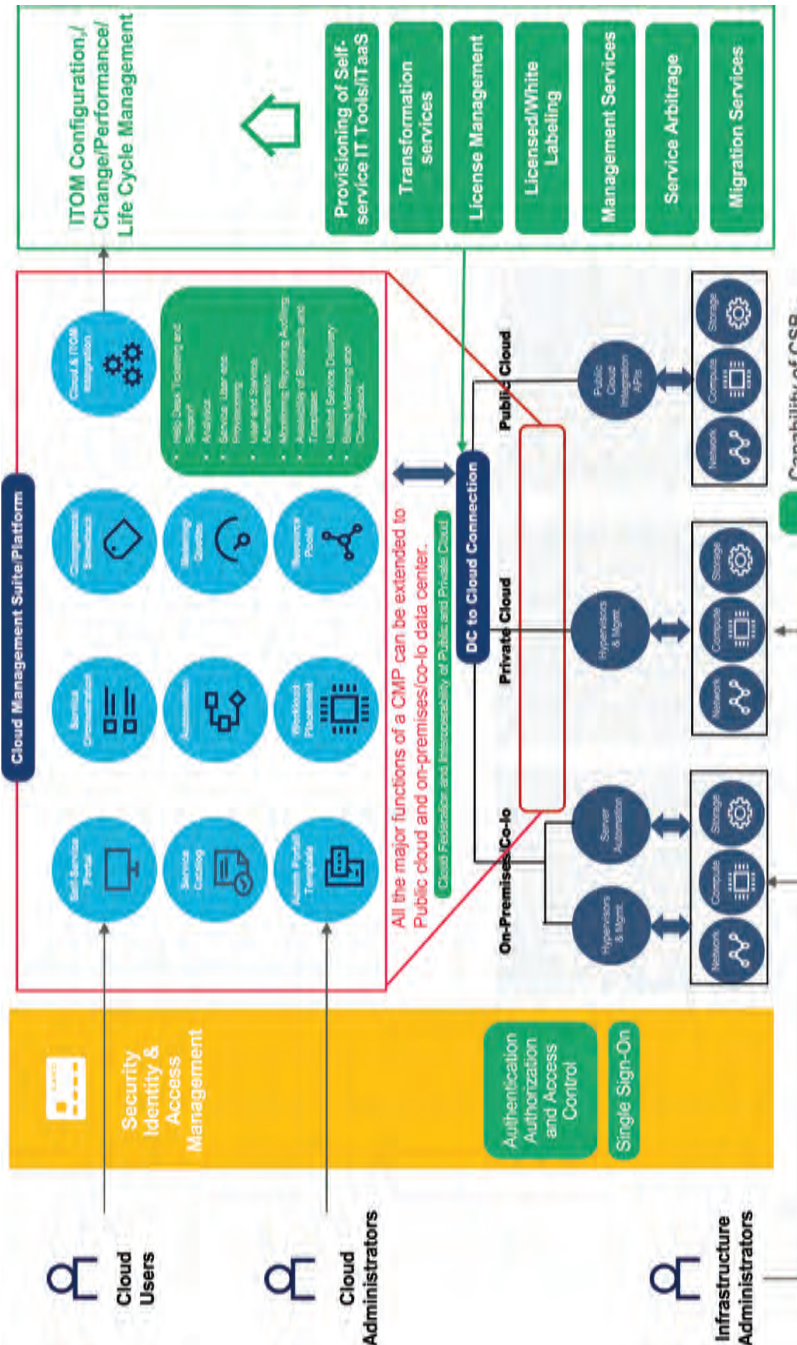
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Development of the South Carolina 2018 Cloud Computing Strategy

The cloud strategy core team and the Security and Architecture Review Board (SARB), provided input and oversight to this plan.

The cloud strategy core team consists of the following members:

- James Brown, Department of Administration, Division of Information Security
- Rod Davis, Department of Health and Human Services
- Doug Griswold, Department of Administration, Division of Technology
- Kristen Hutto, South Carolina State Fiscal Accountability Authority
- Lindsey Kremlick, Division of Program Management
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- Mason Summers, Department of Administration
- Michael Thomas, Department of Administration
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