



## ABSTRACT

This document describes the Black & Veatch integration strategy. It provides guidance around technology selection, describes integration use cases, and presents integration patterns for consideration.

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## 1 Executive Summary

An Integration Strategy typically covers four dimensions: Integration Personas, Integration Domains, Endpoints and Deployment and Operating Models. Black & Veatch's initial release of an Integration Strategy will focus on the aspects required to replicate current capabilities and to address key current needs. The strategy will continue to evolve to encompass the 4 dimensions more fully over time.

*Figure 1 from Gartner presents the 4 dimensions of a Hybrid Integration Platform (HIP) Strategy in more detail:*

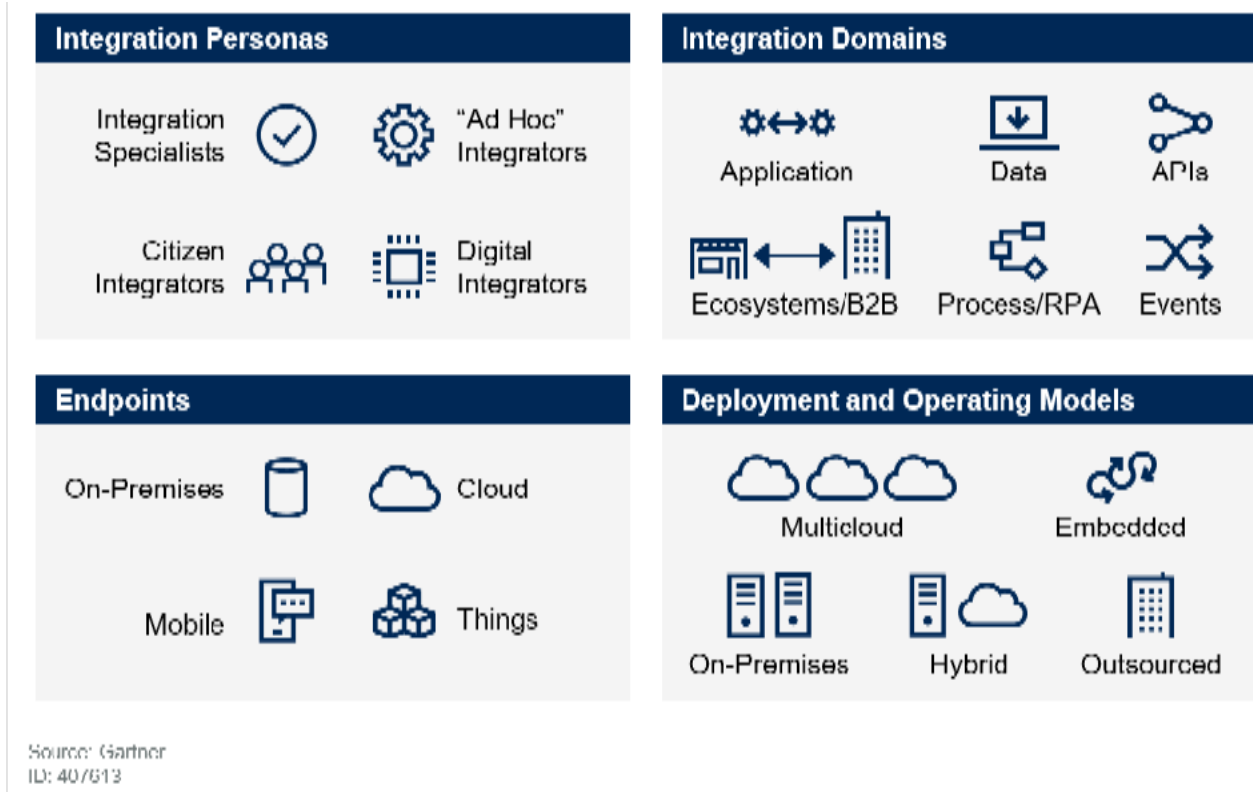
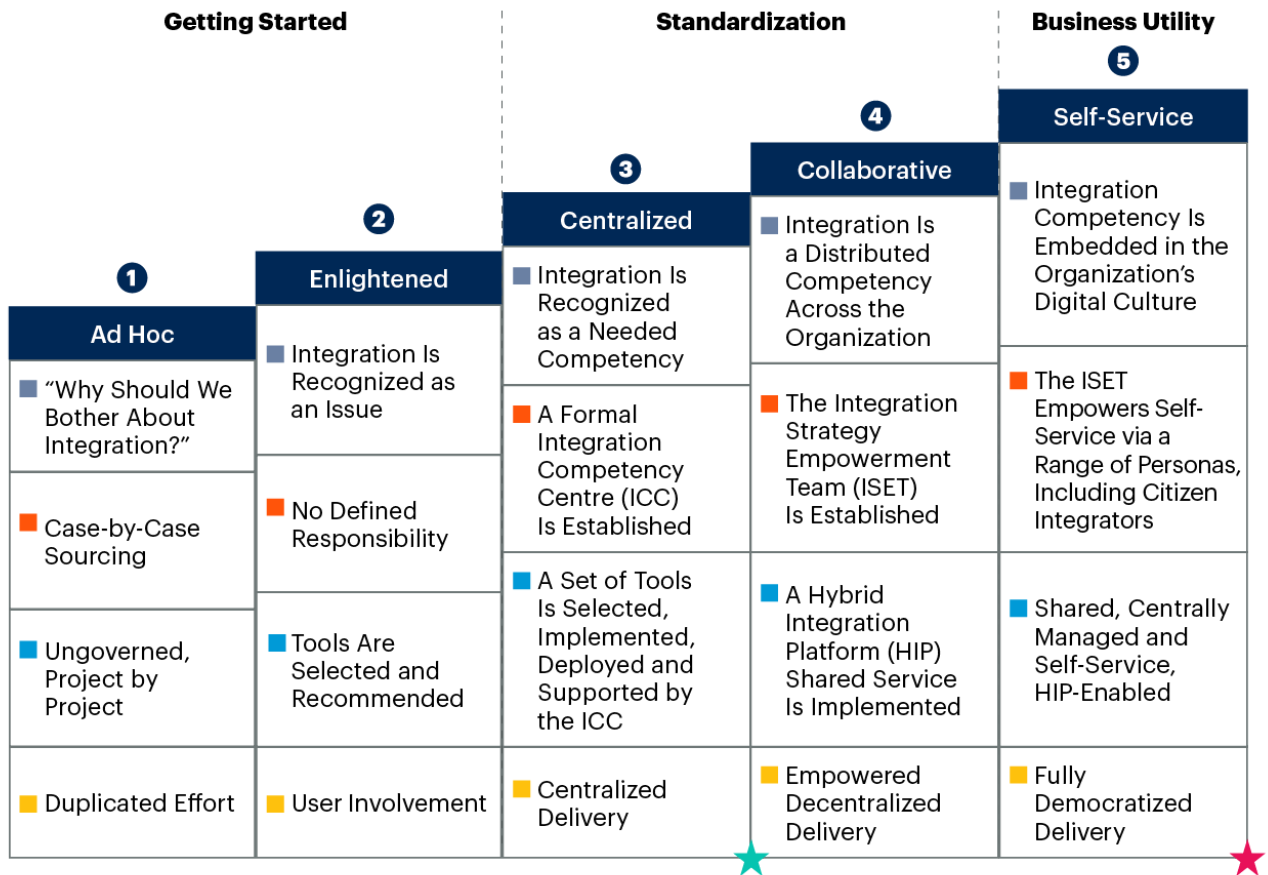


Figure 1: The Four Dimensions of Hybrid Integration Platforms

Gartner identifies 5 Integration Maturity Model stages, as shown in Figure 2:

■ Integration Delivery 
 ■ Integration Strategy 
 ★ Striving 
 ■ Engagement Model 
 ★ Future of Applications



Source: Gartner  
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During 2021 – 2022 Black & Veatch will establish and formalize its integration maturity at level 3, with some traces of level 4 in accordance with the diagram above. Then, in 2022 – 2023, the corporate culture will be driven towards Integration Maturity Model level 5, pushing key integrations into the hands of Citizen Integrators to allow them to perform integrations at business speeds.

## 2 Overview

Black & Veatch's approach towards an Integration Strategy is to use the Hybrid Integration Platform (HIP) model as described above in *Figure 1: The Four Dimensions of Hybrid Integration Platforms*. This approach does not imply that a single platform or technology solution is used. Rather, it provides a high-level guidance around the approach. This strategy must ultimately be supplemented with lower-level guidance that maps technologies to use cases and integration patterns. The sections that follow articulate the scope of the integration strategy for the purpose of providing technology selection guidance.

Ultimately, the execution of the strategy will incorporate all four dimensions of the Hybrid Integration Strategy, but for release 1, a subset will be focused on.

### 3 The Four Dimensions of the Hybrid Integration Platform (HIP)

#### 3.1 Integration Personas

**Definition:** Integration Personas are the classes of users expected to leverage a “target” HIP (that is, an implementation of a suitable subset of the HIP capability framework) to deliver integration tasks and projects. Those users can be integration specialists, ad hoc integrators (i.e. developers, application teams, SaaS superusers, data scientists) and citizen integrators (i.e. business users) — increasingly assisted by AI-powered “digital integrator” technologies.

Persona	Description
Integration Specialist	ICC resources who focus on integration exclusively
Ad-hoc Integrators	Developers, SaaS Superusers, Data Scientists
Digital Integrators	AI Powered Systems such as Informatica’s CLAIRE platform that aid or automate human integrator activities
Citizen Integrators	Business Users

#### 3.1 Integration Domains

**Definition:** Integration Domains are types of integration use cases the target HIP is meant to support. These include Application, Data, Ecosystem/B2B, Process/RPAs, APIs and Event Integrations.

Domain	Description
Application	Business Applications running in the Enterprise. ARCGIS is an example of an Application.
Data	Databases or Datastores within the Enterprise. Our Data Lake is an excellent example.
Ecosystem/B2B	These transactions happen between Black and Veatch and a 3 <sup>rd</sup> party. Our connection to water SCADA systems is an example.
Process/RPAs	Process systems are pipeline systems that process data, enrich data, or otherwise execute a process based on the data it receives. Oracle Eloqua is an example of a Process/RPA platform used at Black and Veatch.
APIs	APIs are service endpoints used to execute work. These endpoints can also point to external sources as well as internal. Salesforce is a system that has several APIs.
Events	Event data is data generated by an action taken inside of system. Event data is unique in that the data is frequently time sensitive. ServiceNow is a system that generates a lot of event data that is currently unhandled in the Black and Veatch Enterprise.

#### 32.1.1.1 *Data*

Data is everywhere. Access to data for the purpose of processing should occur in one of two places:

- 1) The System-of-Record
- 2) The Data Lake

Not all data is required to be real-time or near real-time for integration purposes. That type of data may be hosted and then extracted from the Data Lake to provide a way to offload processing from the Systems-of-Record. To accommodate this paradigm, Systems-of-Record may require enhancement to incorporate intelligent caching for service exposure.

#### 32.1.1.1 *API and Event Integration*

Many API's are for integration, and some are for data display. **Support for API's and Event Integrations are a stretch goal for this release.** Active systems can generate many events every hour. Many of those events could prove to be useful for security monitoring. Event processors are critical to providing this type of capability. In addition, Black & Veatch has products in development that will trigger events based on user actions. With respect to notifications, it's important to note that thousands of notifications could be generated in minutes. Typical methods of integration do not work in this paradigm. Here, event processors or streaming platforms are required to support the necessary throughput

### 3.1 Endpoints

Definition: Endpoints are where the systems that must be integrated reside (e.g. on-premises, cloud(s), mobile and IoT (Internet of Things) devices).

### 3.1 Deployment and Operating Models

Definition: Deployment and Operating Models are where target HIP capabilities must be deployed and operated from (e.g. cloud (including multiple clouds), on-premises, hybrid (cloud and on-premises), embedded (in application systems or IoT devices) and outsourced).

## 4 The Integration Strategy Approach and Value Realization

Integrations are complex and part of the overall cost issue related to Integrations is that inherent complexity. If value in the form of cost reductions is to be realized the overall integration strategy. To facilitate the value realization three design patterns have been created that cover the full spectrum of Integrations required.

### 4.1 One Platform to Rule them All

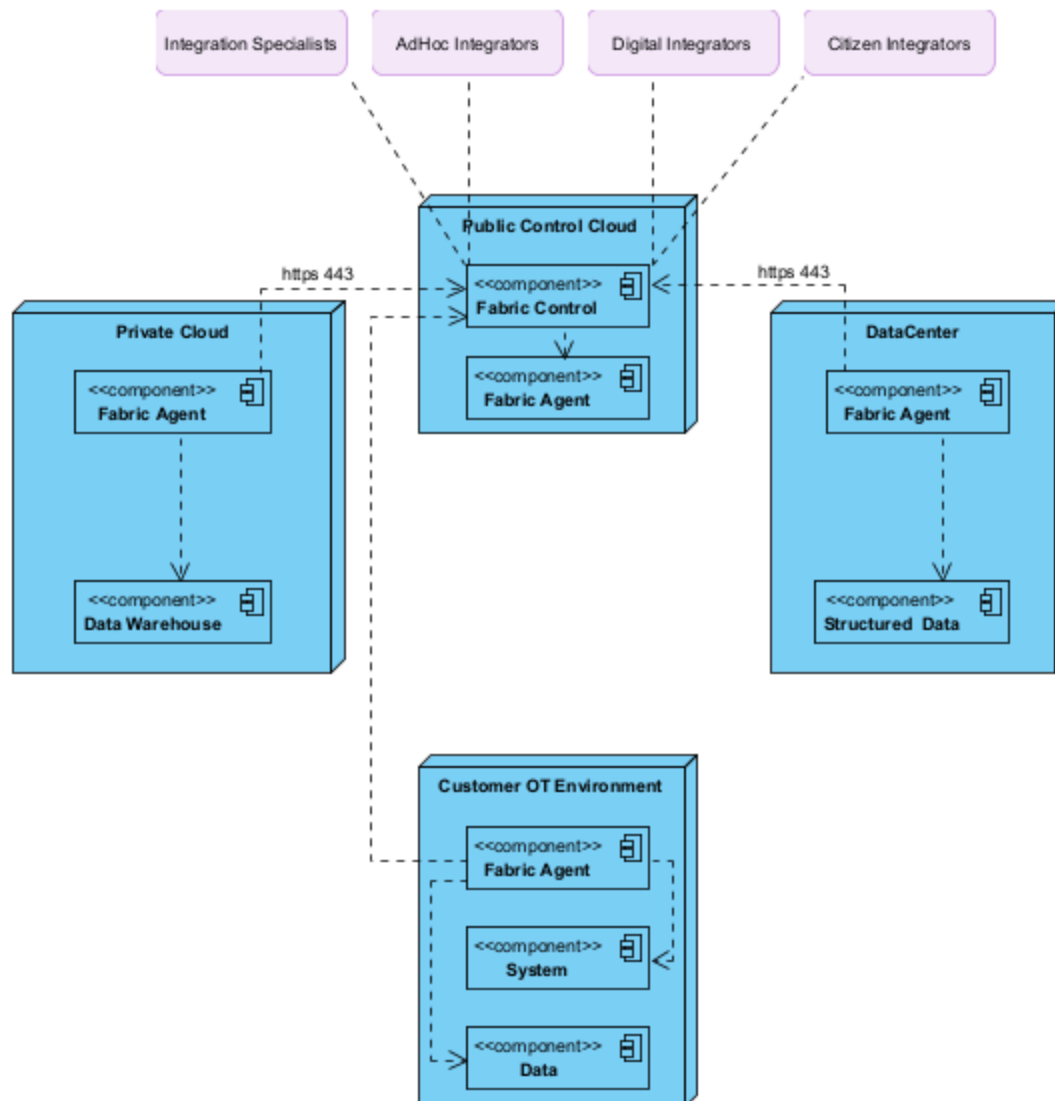
It is very tempting in the process of integrating these systems to make exceptions for legacy or existing platforms or even allow some group or subset to use a different integration platform than the rest of the enterprise. This temptation should be avoided at all costs. Key to the value realization of this strategy and to the strategy that Gartner has laid out is the concept of building on previous work. A level 5

integration strategy, as defined by Gartner, is not a collection of individual integrations but a comprehensive system and process. In order for Black and Veatch to be successful we need to build on this integration platform over time and have the platform work harder for us rather than against us. For this reason, we should standardize and embrace only one Integration platform and vendor.

As an example. After connecting some number of integrations to our platform a catalog of integrations would be useful feature. If our integrations platforms are in multiple systems then compiling, curating, and maintaining this catalog becomes significantly more difficult.

#### 4.1 Pattern One : Agent

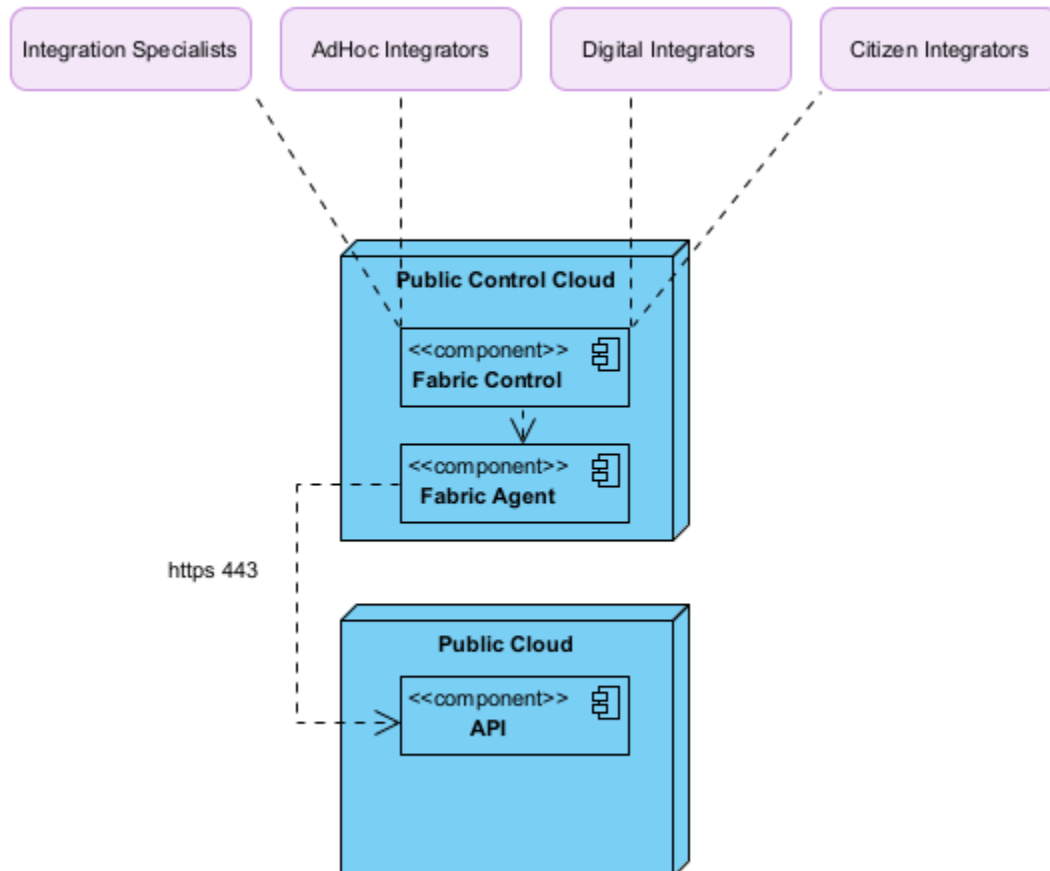
This Design pattern uses a containerized agent install in the same location as the data. This agent communicates to the Fabric Control Center that is located in a Public Cloud belonging to the IPASS vendor. Key to securing this design is the fact that the agent only communicates in outbound manner by polling the Fabric Control center.





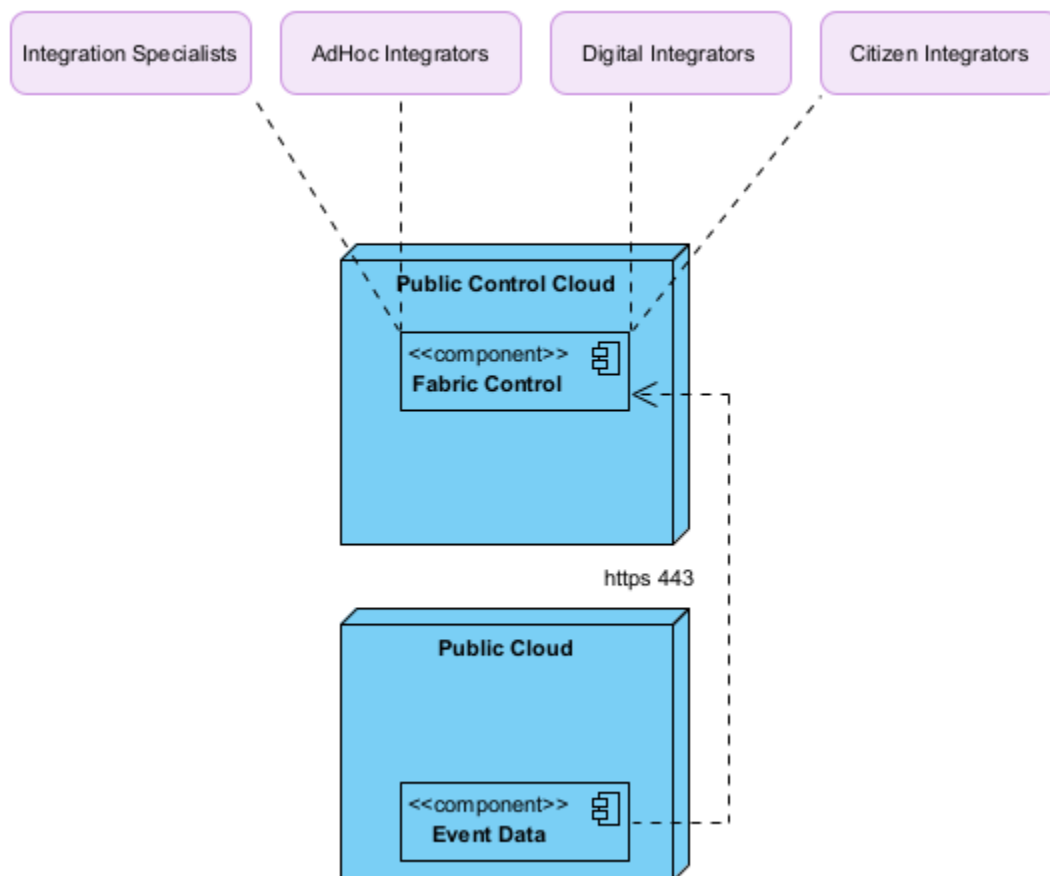
## 4.1 Pattern Two: Pull

Design pattern two uses a pull methodology to connect to Public Cloud environments via established APIs. In this design, the Fabric Control center spawns a Fabric Agent in the Public Control cloud. That agent then connects to various REST or SOAP APIs to pull data into the IPASS platform.



## 4.1 Pattern Three: Push

Design pattern three uses a push methodology to handle data being pushed from Public cloud systems to the Fabric Control center. This data is then sent downstream as desired. It is key to note, that environments contained in Design Pattern one send their event data to the localized Fabric Agent and this design pattern is only for systems where a Fabric Agent is not installed locally in the environment. It is expected that this design pattern would only be used with Public Cloud Environments.



## 4.1 Full Integration Design Pattern

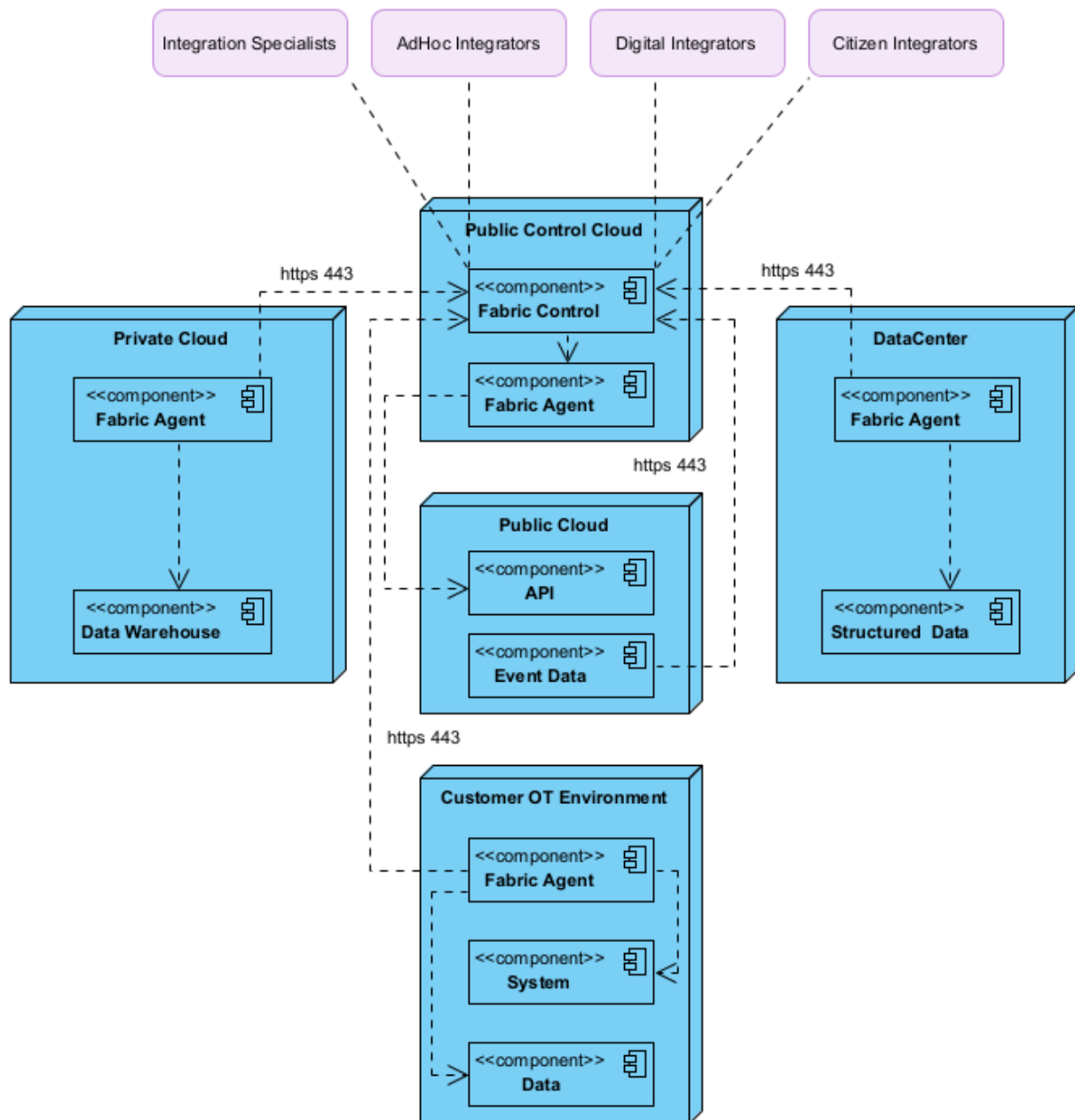


Figure 3- Full Enterprise Integration Strategy

Key Element	Description
Fabric Control	The Fabric Control component is a centralized manager of Fabric Agents. The Fabric Control holds the instructions for each Fabric Agent. This is done to ensure Fabric Agents communicate in an outbound manner only. This is key to the securing the platform.

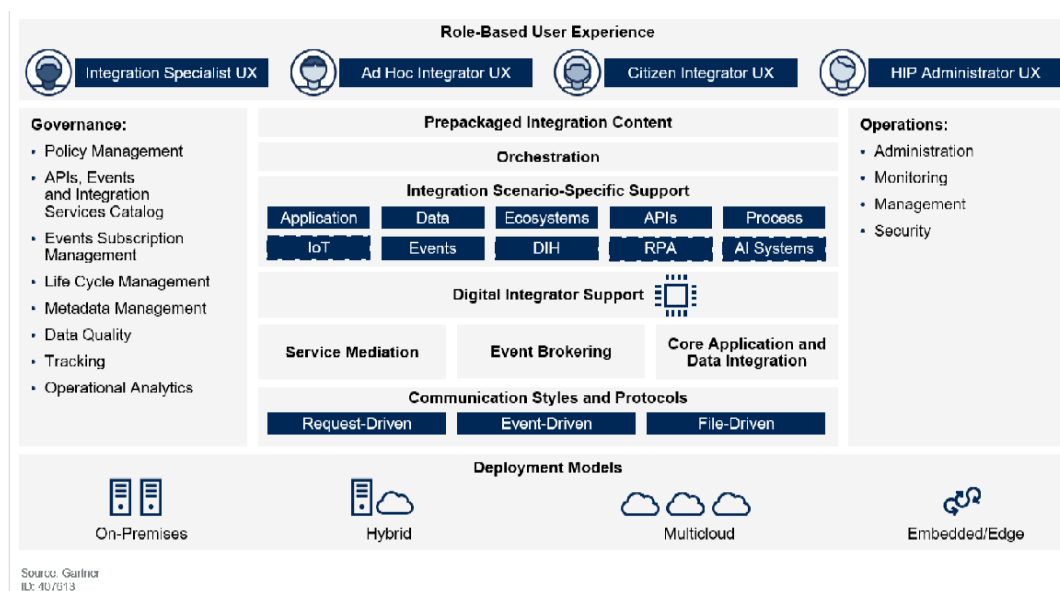
Fabric Agent	The Fabric Agent is a small container that does the work of the architecture. Each agent connects to the Fabric Control for instructions on what to do next, updates and deployments.
Public Control Cloud	The Public Control Cloud is the cloud hosted IPASS platform. It is highly advantageous for us to have this as a public hosted cloud.
Private Cloud	Any of the Private cloud platforms such as Azure, GCP or AWS
Public Cloud	Any of numerous SaaS solutions that are running in Public Cloud
Customer OT Environment	A NON Black & Veatch Operational Technology Environment typically at a field location of some kind.
Structured Data	This data can be in database, a file, a tab delimited file, a comma delimited file, data warehouse or many other structured and semi-structured data sources

## 5 Integration Competency Center (ICC)

When considering what it means to be at Integration Model Level 3 Maturity, based on Figure 2: The Five Stages of Gartner's Integration Maturity Model, above, it can be noted that integration is managed and governed with the help of a formally defined Integration Competency Center (ICC). As a part of the execution of this strategy, Black & Veatch will formalize the Center through the usage of resources from the current integration service provider led by the Architecture team. Collectively, these resources will play the role of the Integration Specialists and in some cases Ad Hoc Integrators.

The ICC team is responsible for understanding the Systems-of-Record, approved usage of data, privacy and security concerns, and available services. This provides Black & Veatch with economies of scale in addition to the centralized governance needed for Integration Model Level 3 Maturity.

**NOTE:** All integrations are required to be reviewed and approved by the ICC unless clearly excluded.



### 5.1 Key Functions of the ICC

A high-performance ICC will perform the following functions for the Enterprise.

- Classification and Documentation of all System of Record Data Objects

Data should be grouped into logical objects in the enterprise. An example of this is the Account Object in Salesforce. Systems that contain source of truth versions of Objects should be classified as System of Record objects. The ICC should identify, document and curate the enterprise's system of record objects and sources. ICC performance should be measured on how many systems of records are communicating with one of the three design patterns in this document.

- Road mapping, documenting, and cataloging every integration in the enterprise

The ICC's core function should be to build a roadmap to 100% compliance with this integration strategy. This will include documenting, cataloging, and building a road map to when every integration in the enterprise is using one of the three design patterns in this document.

- DevOps monitoring of the Enterprise's integrations

The ICC should be required to monitor the Fabric Control center for issues or errors. This work should be scoped as a single task not as a "per integration" task as our ICC does it today. There are significant cost savings by having the ICC operate in this manner.

- Training Citizen Developers

The ICC should hold open classes for Ad-Hoc or Citizen developers who want to learn about our design patterns.

- Adherence to the three Integration Design Patterns in this document

The ICC shall ensure that all integrations regardless of platform follow one of the three design patterns in this document.

- Deprecating legacy integrations running in Microsoft Biztalk and replacing it with one of the three design patterns in this document

Old Platforms are one of the greatest security threats in the enterprise. One of the core functions of the ICC should be to roadmap a pathway to removing legacy platforms like BizTalk from the enterprise completely. While it will take time to completely remove it, that amount of time should be tracked and measured.

- Integration Cost Management Optimization

All three design patterns in this document use a cloud native pricing model. All cloud pricing should be monitored for spikes in cost or optimizations that can be done to reduce compute costs. The ICC should have a goal of reducing the total cost of ownership of an integration by 10% each year.