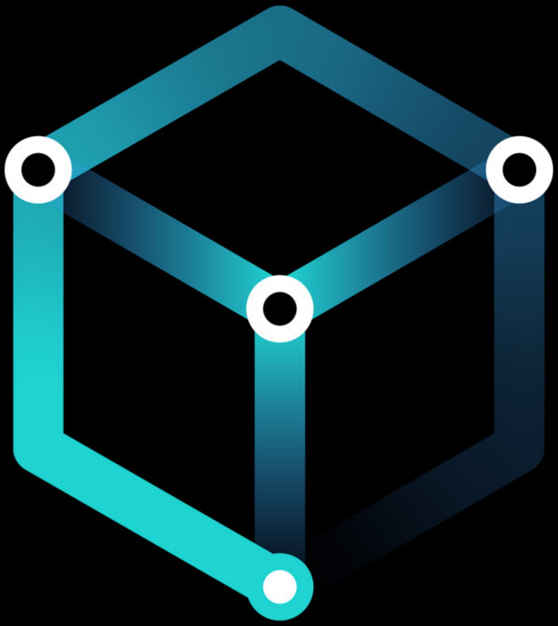
IBM **Cloud**



Agile Integration Methodology:

Container-Based and Microservices-Aligned Lightweight Integration Runtimes

Embrace digital transformation with agile integration centered around an equally agile approach, giving you the ability to move quickly to meet the demands of multicloud, decentralization and microservices.

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Executive Summary

Organizations pursuing digital transformation must embrace new ways to use and deploy integration technologies, so they can move quickly in a manner appropriate to the goals of multicloud, decentralization and microservices. Integration must transform to allow organizations to move boldly in building new customer experiences, rather than forcing models for architecture and development that pull away from maximizing the organization's productivity.

Many organizations have started embracing agile application techniques such as microservices architecture and are now starting to see the benefits of that shift. The approach described in this paper compliments and accelerates agile development practices. We look to bring the same concepts to bear on an enterprise's API strategy, their ESB infrastructure, and their approaches to asynchronous communication over messages and events. This enables them to achieve more effective ways to manage and operate their integration services in their private or public cloud.

This white paper is derived from an ebook that explores the merits of what we refer to as an agile integration methodology - a container-based, decentralized and microservices-aligned approach for integration solutions that meets the demands of agility, scalability and resilience required by digital transformation.

Integration Has Changed

IDC estimates that spending on digital transformation initiatives will represent a $20 trillion market opportunity over the next 5 years. What's behind this staggering explosion of spending? The ever-present, ever-growing need to build new customer experiences through connected experiences across a network of applications that leverage data of all types.

That's no easy task – bringing together processes and information sources at the right time and in the right context is difficult at best, particularly when you consider the aggressive adoption of SaaS business applications. New data sources need to be injected into business processes to create competitive differentiation.

To drive new customer experiences organizations must tap into an ever-growing set of applications, processes and information sources – all which significantly expand the enterprise's need for and investment in integration capabilities.

The Value of Application Integration for Digital Transformation

When you consider your agenda for building new customer experiences and focus on how data is accessed and made available for the services and APIs that power these initiatives, you can see several significant benefits that application integration brings to the table:

- **Effectively addressing disparity** – Access data from any system in any format and build homogeneity from it, no matter how diverse your multicloud landscape grows.
- **Expertise of the endpoints** - Modern integration includes smarts around complex protocols and data formats, but it also incorporates intelligence about the actual objects, business and functions within the end systems.
- **Innovation through data** – Applications owe much of their innovation to their opportunity to combine data beyond their boundaries and create meaning from it, a trait particularly visible in microservices architecture.
- **Enterprise-grade artifacts** – Integration flows inherit a tremendous amount of value from the runtime, which includes enterprise-grade features for error recovery, fault tolerance, log capture, performance analysis, and much more.

The integration landscape is changing to keep up with enterprise and marketplace computing demands, but how did we get from SOA and ESBs to modern, containerized, agile integration methodology?

[1]IDC MaturityScape Benchmark: Digital Transformation Worldwide, 2017, Shawn Fitzgerald.

The Journey So Far – SOA and the ESB pattern

Before we can look forward to the future of agile integration, we need to understand what came before. SOA (service oriented architecture) patterns emerged at the start of the millennium, and at first the wide acceptance of the standards SOA was built upon heralded a bright future where every system could discover and talk to any other system via synchronous exposure patterns.

This was typically implemented in the form of the ESB (enterprise service bus) – an architectural pattern that was aimed at providing synchronous connectivity to backend systems typically over web services. While many enterprises successfully implemented the ESB pattern, it became something of a victim of its own success.

- ESB patterns often formed a single infrastructure for the whole enterprise, with tens or hundreds of integrations installed on a production server cluster. Although heavy centralization isn't required by the ESB pattern, the implemented topologies almost always fell prey to it.
- Centralized ESB patterns often failed to deliver the significant savings companies were hoping for. Few interfaces could be re-used from one project to another, yet the creation and maintenance of interfaces was prohibitively expensive for any one project to take on.
- SOA was more complex than just the implementation of an ESB, particularly around who would fund an enterprise-wide program. Cross-enterprise initiatives like SOA and its underlying ESB struggled to find funding, and often that funding only applied to services that would be reusable enough to cover their creation cost.

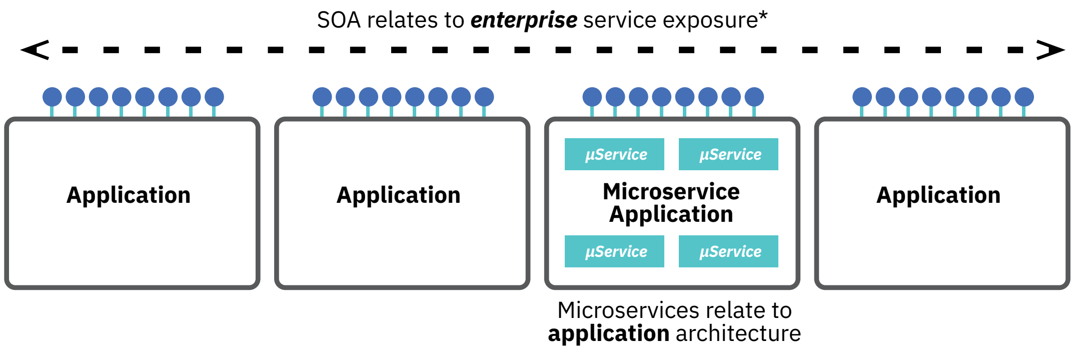
The result was that creation of services by this specialist SOA team sometimes became a bottleneck for projects rather than the enabler that it was intended to be. This typically gave the centralized ESB pattern a bad name by association.

All that said, the centralized ESB pattern does bring some benefits, especially if they have a highly skilled integration team with a low attrition rate, and who receive a predictable and manageable number of new integration requirements. A single, centralized ESB certainly simplifies consistency and governance of implementation. However, many organizations have more fluid and dynamic requirements to manage, and are also under pressure to implement integration using similar cloud native technologies and agile methods as are being used in other parts of the organization. A case in point is the move to microservices architecture typically found in the application development space.

Service oriented architecture (SOA) vs microservice architecture

SOA and microservices architecture share many words in common, but they are in fact completely separate concepts.

Service-oriented architecture and the associated ESB pattern is an enterprise-wide initiative to make the data and functions in systems of record readily available to new applications. We create re-usable, synchronous interfaces such as web services and RESTful APIs to expose the systems of record, such that new innovative applications can be created more quickly by incorporating data from multiple systems in real time.


SOA relates to *enterprise* service exposure*
Application
Application
µService
µService
Microservice Application
µService
µService
Application
Microservices relate to **application** architecture

Microservices architecture, on the other hand, is a way of writing an individual application as a set of smaller (microservice) components in a way that makes that application more agile, scalable, and resilient.
So in summary, service oriented architecture is about real-time integration between applications, whereas microservices architecture is about how we build the internals of applications themselves.

The Case for Agile Integration

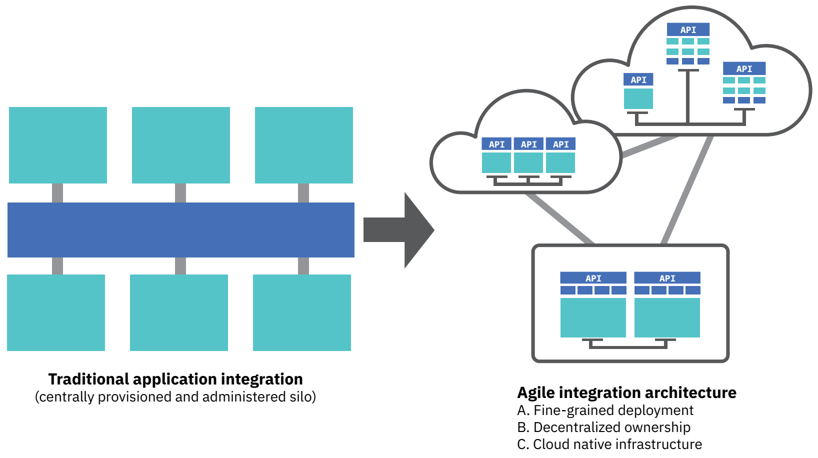
Why have microservices concepts become so popular in the application space? They represent an alternative approach to structuring applications. Rather than an application being a large silo of code running on the same server, the application is designed as a collection of smaller, completely independently-running components.

Microservices architecture enables three critical benefits:

1. **Greater agility** – Microservices are small enough to be understood completely in isolation and changed independently.
2. **Elastic scalability** – Their resource usage can be fully tied into the business model.
3. **Discrete resilience** – With suitable decoupling, changes to one microservice do not affect others at runtime.

With those benefits in mind, what would it look like if we re-imagined integration, which is typically deployed in centralized silos, with a new perspective based on microservices architecture? That's what we call an "agile integration methodology."

Agile integration is defined as "a container-based, decentralized and microservices-aligned architecture for integration solutions."


API
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API
Traditional application integration
(centrally provisioned and administered silo)
Agile integration architecture
A. Fine-grained deployment
B. Decentralized ownership
C. Cloud native infrastructure

There are three related, but separate aspects to agile integration:

Aspect 1: Fine-grained integration deployment.
What might we gain by breaking out the integrations in the siloed ESB into separate runtimes that could be maintained and scaled independently? What is the simplest way that these discrete integrations be made consistently available across and beyond the enterprise via APIs and events?

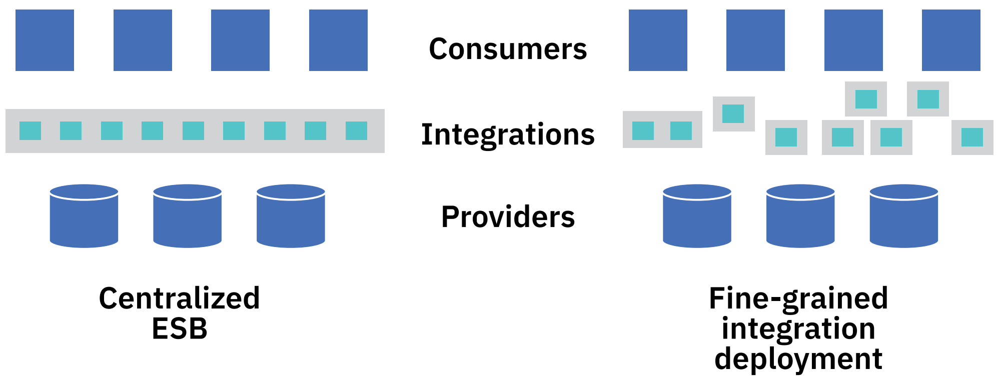
Aspect 2: Decentralized integration ownership.
How should we adjust the organizational structure to better leverage a more autonomous approach, giving application teams more control over the creation and exposure of their own integrations?

Aspect 3: Cloud native integration infrastructure.
How can we best leverage the container-based infrastructure that underpins cloud native applications, to provides productivity, operational consistency, and portability for both applications an integrations across a hybrid and multi-cloud landscape.

Aspect 1: Fine-grained Integration Deployment

Traditional integration is characterized by the heavily centralized deployment of integrations n the ESB pattern. Here, all integrations are deployed to a single heavily nurtured (HA) pair of integration servers has been shown to introduce a bottleneck for projects. Any deployment to the shared servers runs the risk of destabilizing existing critical interfaces. No individual project can choose to upgrade the version of the integration middleware to gain access to new features.

Using the same concepts as microservice architecture, we could break up the enterprise-wide ESB into smaller, more manageable and dedicated pieces. Perhaps in some cases we can even get down to one runtime for each interface we expose. These “fine-grained integration deployment” patterns provide specialized, right-sized containers, offering improved agility, scalability and resilience, and look very different to the centralized ESB patterns of the past. Figure 1 demonstrates in simple terms how a centralized ESB differs from fine-grained integration deployment.



Simplified comparison of a centralized ESB to fine-grained integration deployment

Fine-grained integration deployment draws on the benefits of a microservices architecture. Let’s revisit what we listed as microservices benefits in light of fine-grained integration deployment:

- **Agility:** Different teams can work on integrations independently without deferring to a centralized group or infrastructure that can quickly become a bottleneck. Individual integration flows can be changed, rebuilt, and deployed independently of other flows, enabling safer application of changes and maximizing speed to production.
- **Scalability:** Individual flows can be scaled on their own, allowing you to take advantage of efficient elastic scaling of cloud infrastructures.
- **Resilience:** Isolated integration flows that are deployed in separate containers cannot affect one another by stealing shared resources, such as memory, connections, or CPU.

Learn more about fine-grained deployment in our comprehensive Agile Integration e-book, available now for download.

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Learn more about how decentralized ownership can help you modernize your integration with our full Agile Integration eBook.

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Aspect 2: Decentralized integration ownership

A significant challenge faced by service-oriented architecture was the way that it tended to force the creation of centralized integration teams and infrastructure to implement the service layer.

This created ongoing friction in the pace at which projects could run since they always had the central integration team as a dependency. The central team knew their integration technology well, but often didn't understand the applications they were integrating, so translating requirements could be slow and error prone.

Many organizations would have preferred the application teams own the creation of their own services, but the technology and infrastructure of the time didn't enable that.

The move to fine-grained integration deployment opens a door such that ownership of the creation and maintenance of integrations can also be distributed out to the application teams. It's not unreasonable for business application teams to take on integration work, streamlining the implementation of new integrations.

Furthermore, API management has matured to the point where application teams can easily manage the exposure of their own APIs, again without resorting to separate centralized integration team.

Microservices design patterns often prefer to increase decoupling by receiving event streams of data and building localized data representations rather than always going via API calls to retrieve data in real time. Agile integration also considers how best to enable teams to publish and consume event streams both within and beyond application boundaries.

Aspect 3: Cloud-native integration infrastructure

Integration runtimes have changed dramatically in recent years. So much so that these lightweight runtimes can be used in truly cloud-native ways. By this we are referring to their ability to hand off the burden of many of their previously proprietary mechanisms for cluster management, scaling, availability and to the cloud platform in which they are running.

This entails a lot more than just running them in a containerized environment. It means they have to be able to function as "cattle not pets," making best use of the orchestration capabilities such as Kubernetes and many other common cloud standard frameworks.

Clearly, agile integration requires that the integration topology be deployed very differently. A key aspect of that is a modern integration runtime that can be run in a container-based environment and is well suited to cloud-native deployment techniques. Modern integration runtimes are almost unrecognizable from their historical peers. Let's have a look at some of those differences:

- **Fast lightweight runtime:** They run in containers such as Docker and are sufficiently lightweight that they can be started and stopped in seconds and can be easily administered by orchestration frameworks such as Kubernetes.
- **Dependency free:** They no longer require databases or message queues, although obviously, they are very adept at connecting to them if they need to.
- **File system based installation:** They can be installed simply by laying their binaries out on a file system and starting them up—ideal for the layered file systems of Docker images.
- **DevOps tooling support:** The runtime should be continuous integration and deployment-ready. Script and property file-based install, build, deploy, and configuration to enable "infrastructure as code" practices. Template scripts for standard build and deploy tools should be provided to accelerate inclusion into DevOps pipelines.
- **API-first:** The primary communication protocol should be RESTful APIs. Exposing integrations as RESTful APIs should be trivial and based upon common conventions such as the Open API specification. Calling downstream RESTful APIs should be equally trivial, including discovery via definition files.
- **Digital connectivity:** In addition to the rich enterprise connectivity that has always been provided by integration runtimes, they must also connect to modern resources. For example, NoSQL databases (MongoDb and Cloudant etc.), and messaging services such as Kafka. Furthermore, they need access to a rich catalogue of application intelligent connectors for SaaS (software as a service) applications such as Salesforce.
- **Continuous delivery:** Continuous delivery is enabled by command-line interfaces and template scripts that mesh into standard DevOps pipeline tools. This further reduces the knowledge required to implement interfaces and increases the pace of delivery.
- **Enhanced tooling:** Enhanced tooling for integration means most interfaces can be built by configuration alone, often by individuals with no integration background. With the addition of templates for common integration patterns, integration best practices are burned into the tooling, further simplifying the tasks. Deep integration specialists are less often required, and some integration can potentially be taken on by application teams as we will see in the next section on decentralized integration.

Adopting a "cattle approach" impacts the ways in which your DevOps teams will interact with the environment and the solution overall, create increasing efficiencies as more solutions are moved to lightweight architectures.

Modern integration runtimes are well suited to the three aspects of an agile integration methodology: fine-grained deployment, decentralized ownership, and true cloud-native infrastructure.

Along with integration runtimes becoming more lightweight and container friendly, we also see API management and messaging/eventing infrastructure moving to container-based deployment. This is generally in order to benefit from the operational constancy provided by orchestration platforms such as Kubernetes that provides auto scaling, load-balancing, deployment, internal routing, reinstatement and more in a standardized way, significantly simplifying the administration of the platform.

Agile Integration for the Integration Platform

Throughout this paper, we have been focused on the application integration features as deployed in an agile integration architecture. However, many enterprise solutions can only be solved by applying several critical integration capabilities. An integration platform (or what some analysts refer to as a “hybrid integration platform”) brings together these capabilities so that organizations can build business solutions in a more efficient and consistent way.

Read Ovums latest report on the factors driving hybrid integration platform adoption.

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Many industry specialists agree on the value of this integration platform. Gartner notes:

The hybrid integration platform (HIP) is a framework of on-premises and cloud-based integration and governance capabilities that enables differently skilled personas (integration specialists and non-specialists) to support a wide range of integration use cases.... Application leaders responsible for integration should leverage the HIP capabilities framework to modernize their integration strategies and infrastructure, so they can address the emerging use cases for digital business.

One of the key things that Gartner notes is that the integration platform allows multiple people from across the organization to work in user experiences that best fits their needs. This means that business users can be productive in a simpler experience that guides them through solving straightforward problems, while IT specialists have expert levels of control to deal with the more complex enterprise scenarios. These users can then work together through reuse of the assets that have been shared; while preserving governance across the whole.

Satisfying the emerging use cases of the digital transformation is as important as supporting the various user communities. The bulk of this paper will explore these emerging use cases, but first we should further elaborate on the key capabilities that must be part of the integration platform.

[2]Hype Cycle for Application Infrastructure and Integration, 2017, Elizabeth Golluscio.

IBM Cloud Pak for Integration

IBM Cloud Integration brings together the key set of integration capabilities into a coherent platform that is simple, fast and trusted. It allows you to easily build powerful integrations and APIs in minutes, provides leading performance and scalability, and offers unmatched end-to-end capabilities with enterprise-grade security. IBM Cloud Pak for Integration is built on the open source Kubernetes platform for container orchestration.

IBM Cloud Pak for Integration is the most complete hybrid integration platform in the industry including all of the key integration capabilities your team needs:

Application and Data Integration
Connects applications and data sources on-premises or in the cloud, in order to coordinate exchange business information so that data is available when and where needed.

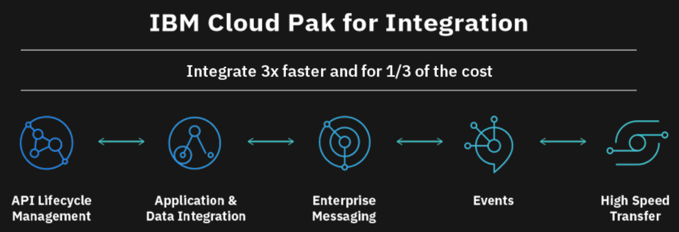
API Lifecycle
Exposes and manages business services as reusable APIs for select developer communities both internal and external to your organization. Organizations adopt an API strategy to accelerate how effectively they can share their unique data and services assets to then fuel new applications and new business opportunities.

Enterprise Messaging
Ensures real-time information is available from anywhere at anytime by providing reliable message delivery without message loss, duplication or complex recovery in the event of system or network issue.

High Speed Data Transfer
Move huge amounts of data between on-premises and cloud or cloud-to-cloud rapidly and predictably with enhanced levels of security. Facilitates how quickly organizations can adopt cloud platforms when data is very large.

Secure Gateway
Extend Connectivity and Integration beyond the enterprise with DMZ-ready edge capabilities that protect APIs, the data they move, and the systems behind them

Through this teaser e-book, hopefully you've gotten a broader perspective of the various critical capabilities required as part of an integration platform, a sense of the requirements for those capabilities to work together, and an appreciation of how an agile integration methodology can be adopted to enable greater agility, scalability and resilience for the platform.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Application & Data Integration
Enterprise Messaging
Events
High Speed Transfer

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