WHITEPAPER

API-led Connectivity

The Next Step in the Evolution of SOA

Executive Summary

Key Challenges

- Companies must embrace digital transformation in order to stay relevant to their customers, else risk ceding market share to competitors who are able to adapt more quickly.
- At its core, digital transformation is driving companies to reframe their relationships with their customers, suppliers and employees through leveraging new technologies to engage in ways that were not possible before.
- These new technologies - SaaS, mobile, and the Internet of Things (IoT) - demand a new level of connectivity that cannot be achieved with yesterday's integration approaches.

Recommendations

- Adopt an API-led connectivity approach that packages underlying connectivity and orchestration services as easily discoverable and reusable building blocks, exposed by APIs.
- Structure these building blocks across distinct systems, process and experience layers, to achieve both greater organizational agility and greater control.
- Drive technology change holistically across people, processes and systems in an incremental fashion.

The Digital Transformation Imperative

We are in the midst of an unprecedented phase of digital transformation. Hospitals are extending care beyond the hospital ward; non-bank players are driving innovation in the payments space; media companies are distributing the content across multiple channels and partners. These changes are irreversibly reshaping industry boundaries and business models, and in the process, changing the winners and losers across verticals.

Technology is *the* critical enabler of digital transformation. Mobile and cloud, for years viewed as trends on the horizon, are now proven drivers for IT-enabled business disruption, both inside and outside the enterprise. The API, once seen as a tool for programmers, is providing both a new route to market as well as enabling disintermediation of the value chain that supports that route to market. For example, via its Product Advertising API, Amazon sells its goods through third-parties, thus extending its distribution reach. At the same time, the IT infrastructure on which these APIs run has in turn been made available for other uses through the Amazon Web Services API.

Business and IT leaders must act now in order to ensure their businesses stay relevant and competitive. Customers have the means to quickly identify and switch to companies that can better meet their needs, and businesses who do not act now will be left behind

However, digital transformation is not easily realized. It is certainly not the result of implementing a single application or a single technology. Rather, digital transformation can only be achieved when organizations are able to bring multiple technologies together to create truly distinctive and differentiated offerings. In order to do so, they must bring data from disparate sources to multiple audiences, such as to customers, suppliers and employees. It is in this context that connectivity must be viewed as an executive concern and why Deloitte points to the CIO as being more appropriately described as the "Chief Integration Officer"[11]. Ultimately, connectivity is not only a critical enabler of digital transformation, it is arguably the biggest differentiator of success.

Despite its importance, far too many organizations are not approaching connectivity with this strategic mindset. Either, it's not a consideration at all — think lines of business heads driving credit card purchases of SaaS applications, without reflecting on how they will connect those applications to underlying ERP systems — or too often it is only considered with a short-termist approach, which values the success of an individual project to the detriment of the enterprise as a whole.

Traditional methods for integration applications do not work for digital transformation. These approaches, designed at a time with fewer endpoints and slower delivery expectations, often cannot move at the pace today's business requires. Just as digital transformation requires companies to embrace a new set of technologies, so they must embrace a new level of connectivity. This whitepaper proposes a new approach to integration - API-led connectivity - that extends traditional service oriented approaches to reflect today's connectivity needs. We'll outline the core of this approach and implementation challenges and discuss how IT leaders can realize this vision in their own organizations.

Why existing connectivity approaches will fail

The technologies underlying digital transformation have enabled companies to engage with their stakeholders in new and innovative ways. These technologies, notably SaaS, mobile and IoT, have dramatically increased the number of endpoints to connect to. Where once an organization may only have had to consider its internal systems, it must now consider an exponentially larger set of endpoints both inside and outside the enterprise. For example, financial payment transactions previously carried out by checks, are now transacted by an expanded set of channels — including telephone, online and mobile banking.

Moreover, the frequency with which these new systems change has also increased. For example, whereas the database schema of a core banking system may change only on an annual basis, the requirements of the online and mobile banking applications connecting to those systems may change weekly, daily or even hourly. It is this speed of innovation that is a defining characteristic of digital transformation and IT must strive to enable rather than hinder such change.

[1] Deloitte Tech Trends 2015, CIO as Chief Integration Officer, http://www2.deloitte.com/us/en/pages/technology/articles/tech-trends-2015-cio-as-chief-integration-officer-report.html

IT leaders then must meet two seemingly contradictory goals: they must ensure stability and control over core systems of record, while enabling innovation and rapid iteration of the applications that access those systems of record. This is the challenge now variously referred to as bi-modal or two-speed IT.

Existing connectivity approaches are not fit for these new challenges. Point-to-point application integration is brittle and expensive to maintain. Service-oriented Architecture (SOA) approaches provide some instruction in theory, but have been poorly implemented in practice. The principles of SOA are sound: well-defined services that are easily discoverable and easily re-usable. In practice, however, these goals were rarely achieved. The desire for well-defined interfaces resulted in top-down, big bang initiatives that were mired in process. Too little thought, if any, was given to discovery and consumption of services. And using SOAP-based WebServices technology to implement SOA proved to be a heavyweight approach that was ill suited then and even more ill suited now for today's mobile use cases.

A new approach is required, one that leverages existing investments, and enables IT to seize the moment to drive transformational change; one that enables agility, yet also allows IT to maintain visibility and control. This change is a journey that requires shifting IT's mindset away from project delivery, to delivering assets as services and enabling Line of Business IT to self-serve and build their own connections, processes and applications, while Central IT governs access, SLAs and data quality. In short, IT has to become a platform for the business.

API-led connectivity: The evolution of SOA

While connectivity demands have changed, the central tenets of SOA have not, that is, the distillation of software into services that are well-defined, re-usable and discoverable.

This vision is perhaps even more important given the proliferation of endpoints. The complexity of providing multiple stakeholders customized views of the same underlying data source, whether it be a core banking system or an ERP system, increases exponentially with the number of channels through which that data must be provided. It also reinforces the need for data at the point of consumption to be decoupled and independent from the source data in the system of record, becoming variously more coarse-grained or fine-grained as the use case requires.

This problem lends itself to a service oriented approach in which application logic is broken down into individual services, and then re-used across multiple channels. Yet, the heavyweight, top-down implementation approaches previously noted are not a fit for the agility that today's digital transformation initiatives demand.

Microservices

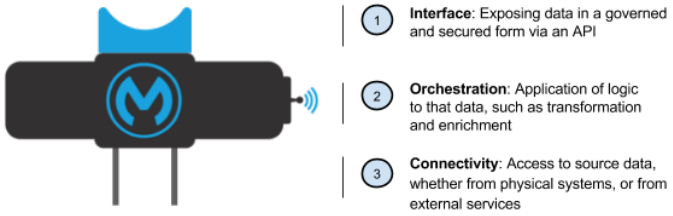
Microservices are a hot topic amongst enterprise architecture leaders. In our view, we believe that microservices not only validate a service oriented approach but are in fact one interpretation of how that approach should be implemented, by taking the need for well-defined services and re-usability to an extreme. In doing so, it highlights the need for governance, and that successful implementation must also consider non-technology factors such as development processes and methodologies. In this way, the principles and approach behind API-led connectivity are entirely consistent with a Microservices approach and vice versa.

To meet today's needs we propose a new construct, API-led connectivity, that builds on the central tenets of SOA, yet re-imagines its implementation for today's unique challenges. API-led connectivity is an approach that defines methods for connecting and exposing your assets. The approach shifts the way IT operates and promotes decentralised access to data and capabilities while not compromising on governance. This is a journey that changes the IT operating model and which enables the realization of the 'composable enterprise', an enterprise in which its assets and services can be leveraged independent of geographic or technical boundaries.

API-led connectivity calls for a distinct 'connectivity building block' that encapsulates three distinct components:

- Interface: Presentation of data in a governed and secured form via an API
- Orchestration: Application of logic to that data, such as transformation and enrichment
- Connectivity: Access to source data, whether from physical systems, or from external services

Figure 1: Anatomy of API-led connectivity



Designing with the consumption of data top of mind, APIs are the instruments that provide both a consumable and controlled means of accessing connectivity. They serve as a contract between the consumer of data and the provider of that data that acts as both a point of

demarcation and a point of abstraction, thus decoupling the two parties and allowing both to work independently of one another (as long as they continue to be bound by the API contract). Finally, APIs also play an important governance role in securing and managing access to that connectivity.

However, the integration application must be more than just an API; the API can only serve as a presentation layer on top of a set of orchestration and connectivity flows. This orchestration and connectivity is critical: without it, API to API connectivity is simply another means of building out point-to-point integration.

APIs vs API-led connectivity

Stripe, as an "API as a company" dis-intermediating the payments space, is an archetype of the API economy. Yet at MuleSoft's 2014 CONNECT conference, Stripe's CEO John Collison was quoted saying "you don't slather an API on a product like butter on toast". Thought of in isolation, the API is only a shim that while hiding the complexities of back-end orchestration and connectivity does nothing to address those issues. Connectivity is a multi-faceted problem across data access, orchestration and presentation, and the right solution must consider this problem holistically rather than in a piecemeal fashion. To only consider APIs is to only solve only one part of the connectivity challenge.

"Three-layered" API-led connectivity architecture

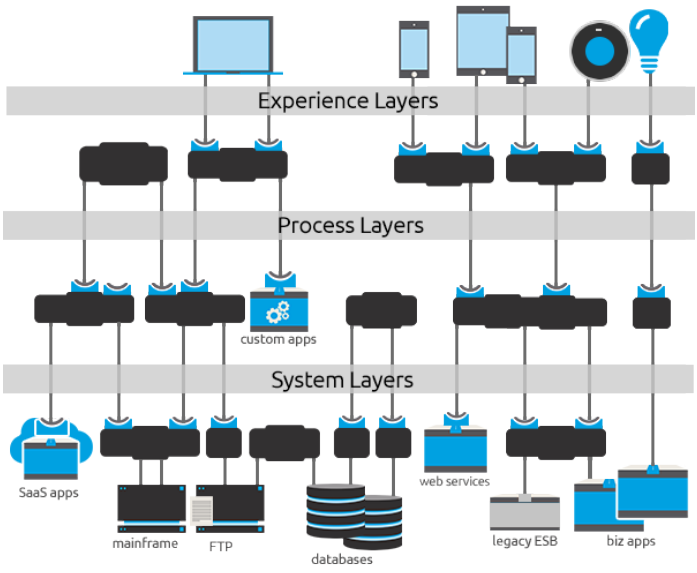
Large enterprises have complex, interwoven connectivity needs that require multiple API-led connectivity building blocks. In this context, putting in a framework for ordering and structuring these building blocks is crucial. Agility and flexibility can only come from a multi-tier architecture containing three distinct layers:

- System Layer: Underlying all IT architectures are core systems of record (e.g. one's ERP, key customer and billing systems, proprietary databases etc). Often these systems are not easily accessible due to connectivity concerns and APIs provide a means of hiding that complexity from the user. System APIs provide a means of accessing underlying systems of record and exposing that data, often in a canonical format, while providing downstream insulation from any interface changes or rationalization of those systems. These APIs will also change more infrequently and will be governed by Central IT given the importance of the underlying systems.
- Process Layer: The underlying business processes that interact and shape this data should be strictly encapsulated independent of the source systems from which that data originates, as well as the target channels through which that data is to be delivered. For example, in a purchase order process, there is some logic that is common across products, geographies and retail channels that can and should be distilled into a single service that can then be called by product-, geography- or channel-specific parent services. These APIs perform specific functions and provide access to non-central data and may be built by either Central IT or Line of Business IT.
- Experience Layer: Data is now consumed across a broad set of channels, each of which want access to the same data but in a variety of different forms. For example, a retail branch POS system, e-commerce site and mobile shopping application may all want to access the same customer information fields, but each will require that information in very different formats. Experience APIs are the means by which data can be reconfigured so that it is most easily consumed by its intended audience, all from a common data source, rather than setting up separate point-to-point integrations for each channel.

Each API-led connectivity layer provides context regarding function and ownership

Layer	Ownership	Frequency of Changes
System Layer	Central IT	6-12 months
Process Layer	Central IT and Line of Business IT	3-6 months
Experience Layer	Line of Business IT and Application Developers	4-8 weeks; more frequently for more mature companies

Figure 2: API-led connectivity architecture approach



Benefits of API-led connectivity

The benefits of thinking about connectivity in this way include:

Business

- IT as a platform for the business: By exposing data assets as a services to a broader audience, IT can start to become a platform that allows lines of business to self-serve.
- Increase developer productivity through re-use: Realizing an API-led connectivity approach is consistent with a service oriented approach whereby logic is distilled to its constituent parts and re-used across different applications. This prevents duplication of effort and allows developers to build on each other's efforts.
- More predictable change: By ensuring a modularization of integration logic, and by ensuring a logical separation between modules, IT leaders are able to better estimate and ensure delivery against changes to code. This architecture negates the nightmare scenario of a small database field change having significant downstream impact, and requiring extensive regression testing.

Technical

- Distributed and tailored approach: An API-led connectivity approach recognizes that there is not a one-size-fits-all architecture. This allows connectivity to be addressed in small pieces and for that capability to be exposed through the API or Microservice.
- Greater agility through loose coupling of systems: Within an organization's IT architecture, there are different levels of governance that are appropriate. The so-called bi-modal integration or two-speed IT approach makes this dichotomy explicit: the need to carefully manage and gate changes to core systems of record (e.g. annual schema changes to core ERP systems) whilst retaining the flexibility to iterate quickly for user facing edge systems such as web and mobile applications where continuous innovation and rapid time to market are critical. Separate API tiers allow a different level of governance and control to exist at each layer, making possible simultaneous loose-tight coupling.
- Deeper operational visibility: Approaching connectivity holistically in this way allows greater operational insight, that goes beyond whether an API or a particular interface is working or not, but provides end-to-end insight from receipt of the initial API request call to fulfilment of that request based on an underlying database query. At each step, fine grained analysis is possible, that can not be easily realized when considering connectivity in a piecemeal fashion.

Customer journey to API-led connectivity

Realizing an API-led connectivity vision must be much more than a technology decision. It requires a gradual but fundamental shift in IT organizations' architectural vision, development approach and the way developers approach their roles. The challenge is one as much about process change as it is about technology implementation.

However, realizing the API-led connectivity vision is not a discrete goal, but rather a continuous journey. Moreover, it is a goal that can be only be realized in incremental steps. Through partnering with dozens of Fortune 500 companies on their API-led connectivity digital transformation journeys, we have distilled best practice into the following steps:

Case Study
Top-5 Global Pharmaceutical Company

A pharmaceutical company's key route to market is its

- Start-up mode: In order for the API-led connectivity vision to be successful, it must be realized across an organization. However, in large enterprises it is simply not possible to wipe the slate clean and start from scratch. Consequently, the API-led connectivity customer journey must start with a vertical slice of the business, for a specific use case or for a specific line of business. By bounding the problem, the scope of change is reduced and the probability of success increased. Training and coaching to drive role modeling of new behaviours is critical at this stage.
- Scale the platform: Once initial proof points have been established, these use cases will naturally become lightning rods within the organization that will build mindshare and become a platform to leverage greater adoption. In addition, the service oriented approach results in the natural creation of reusable assets which exponentially increases the value of the framework as the number of assets increases.
- Build Center of Enablement (COE): Once scale has been established, it's critical to quickly codify best practice and provide a platform for discovery and dissemination through the organization. The result of such a process is mass adoption across the enterprise. The core of this COE may also be built during the start-up mode and scaled as required.

Case Study
Top 5 Global Bank

Digital transformation is often considered as external to the firm. However, whether in terms of enabling transformation outside the company, or in and of itself, digital transformation is a powerful phenomenon *inside* organizational boundaries also.

This multinational financial services company wanted to drive a firm wide architecture driving application development consistent with one of six best practice messaging patterns

This approach has initially seeded into one line of business. This success prompted subsequent rollout across 13 lines of business globally, connecting more than 1,000 applications in production.

In the initial startup mode, the enterprise seeded adoption via a central group which was better able to seed adoption and prove out the approach. As the company continues to scale across the business however, it is looking towards API-led connectivity as the means to decentralize elements of the architecture to drive scale, yet maintain control.

Central to the ability to realize this vision was a center of excellence which helped to codify knowledge and disseminate best practice. MuleSoft helped to build out this COE through delivering on its proven customer journey approach.

MuleSoft: The API-led connectivity platform

MuleSoft's Anypoint Platform™ is the only solution that allows enterprises to truly deliver on their digital transformation through realizing API-led connectivity. In particular, Anypoint Platform is the only solution that enables end-to-end connectivity across API, service orchestration and application integration needs through a single unified platform. This allows developers to rapidly connect, orchestrate and enable any internal or external endpoint. The result is a 2x to 5x faster time to launch new initiatives, connect systems, and unlock data across the enterprise and a 30% reduction in integration costs.

Furthermore, unlike alternatives, MuleSoft's Anypoint Platform can be rapidly deployed on-premises, or accessed as a cloud solution. Since MuleSoft's solutions are easy to use and understand, any developer can quickly become productive without lengthy training in vendor-specific technology resulting in 10% higher employee productivity and 70% higher productivity for app development teams.

Finally, MuleSoft's experience in partnering with our customers to drive digital transformation initiatives allows our customer success teams to bring expertise in change management, organizational design and IT development best practices to complement our technology offerings and truly partner to drive success.

Anypoint Platform is the world's leading integration solution and is trusted by 35% of the Fortune 500. MuleSoft is the only integration provider to be named a Leader across all three of Gartner's connectivity focused Magic Quadrant reports: the Gartner Magic Quadrant for On-Premises Application Integration Suites, the Gartner Magic Quadrant for Enterprise Integration Platform as a Service (iPaas) and the Gartner Magic Quadrant for Application Services Governance.

MuleSoft's mission is to connect the world's applications, data and devices. MuleSoft makes connecting anything easy with Anypoint Platform™, the only complete integration platform for SaaS, SOA and APIs. Thousands of organizations in 60 countries, from emerging brands to Global 500 enterprises, use MuleSoft to innovate faster and gain competitive advantage.