REPLY
SOLIDSOFT

DEVELOPING APPLICATIONS USING MICROSERVICES AND MICROSOFT AZURE SERVICE FABRIC

ABSTRACT

Microservices based architectures allow for increased scalability and agility when developing and maintaining Customer focused services. Solidsoft Reply employs Microsoft Azure Service Fabric, a distributed systems platform to package, deploy, and manage scalable and reliable Microservices and containers while supporting native cloud development.

INTRODUCTION

Speed, agility and cost effectiveness are defining factors of operational efficiency. This is also true for the IT infrastructure and the application design. The emergence of cloud computing has opened up opportunities in this regard, that were unimaginable only a few years back.

Solidsoft Reply, a Reply Group company specialises in enterprise strength solutions using Microsoft technologies both on-premises and with the Microsoft Azure cloud platform, are focusing on leveraging the benefits of Microservices architecture by using the Microsoft Azure Service Fabric.

What is a Microservice application?

A Microservices application is made up of independent components named 'Microservices'. These Microservices implement single functions addressing independent concerns. Moreover, each Microservice has well-defined contracts (API contracts) to communicate with other Microservices and to share data. One of the significant benefits of Microservices is that they can be updated self-sufficiently. This can decrease the chance of experiencing downtime and in turn increases agility compared to traditional, monolithic approaches. This leads to a faster and cheaper application which can keep running as only one service is updated at a time.

Microservices can be organised in containers which can be distributed via several Virtual Machines or servers. While this creates a high degree of flexibility it also adds to the complexity of such an infrastructure. To manage this complexity a central 'brain' keeping track of all the services, and their resource requirements is needed. This brain is called cluster manager. It "schedules," or places Microservices onto machines assigned to the cluster, in order to maximize the cluster's overall resource utilization, while honouring each Microservice's requirements for high accessibility and data replication. Microsoft Azure Service Fabric is one example of a cluster manager that also offers further lifecycle management capabilities.

What is the Microsoft Azure Service Fabric

Microsoft Azure Service Fabric is a distributed systems platform for the packaging, deployment, and management of scalable and reliable Microservices and containers. Microsoft Azure Service Fabric also addresses the significant challenges of developing and managing cloud native applications. The Service Fabric helps developers and administrators to focus on the implementation of workloads that are scalable, reliable and manageable by avoiding the issues that are regularly caused by complex infrastructures.

Service Fabric provides the intelligent cluster-based service orchestration, routing, and state management that offer high levels of resilience, availability, and scalability, eliminating the risk associated with meeting demanding SLAs.

For these reasons, Solidsoft Reply selected the Microsoft Azure Service Fabric for designing and implementing the European National Medicines Verification System (EMVS).

The major benefits for using Microsoft Azure Service Fabric are:

- Deploy and evolve the services at the lowest cost and at the highest speed.
- Low costs due to the rapid response of the service to meet the changing business requirements.
- Exploit the widespread skills of developers in the mainstream marketplace, for instance it is not necessary to use specialist developers as services can be created through widely used developer languages.
- Ability to de-couple packaged applications from user journeys, services and interactions (which do

not belong to the context of the packaged application).

Regarding Microservices based architecture services each have a single purpose and are independently deployable and configurable. Service Fabric manages the placement of each Microservice instance within a cluster and the routing of network traffic to and from that instance. Service Fabric automatically replicates service instances and their data, whilst handling recovery when a service instance fails. This self-healing feature significantly reduces the risks associated with service unavailability and data loss as well as eliminating many of the scenarios that may require a full system failover between data centres.

An example: Keep the state as part of the Microservices. State Management:

- An exact copy of the data is ready to take over, which eliminates single point of failure.
- Every service can store its own state locally and keeps instances with replicated states so if a failure occurs, the backup can take over immediately.
- Makes Microservices very resilient.

Detecting falsified medicines in the European supply chain

The European Medicines Verification System (EMVS) represents the pharmaceutical industry's response to the European Union's Falsified Medicines Directive (FMD protects 520 million European citizens from falsified and counterfeit medicines. The FMD requires a European system to detect, identify, and eliminate falsified medicines.

Solidsoft Reply was entrusted with the project to build and operate the EMVS further. In February 2019, every pack of prescription medicine entering the European pharmaceutical supply chain must bear a unique identifier to meet regulations. The EMVS must be used to verify every pack identifier at the point of dispense. Every drug manufacturer, parallel distributor, wholesaler, hospital, and pharmacy operating across 32 nation states of the European Union and the European Free Trade Area (EFTA) are obligated to be connected to the EMVS.

The EMVS consists of a European Hub that handles product, batch, and pack data uploaded by drug manufacturers and parallel distributors (the businesses that support the distribution of pharmaceutical products across national borders). As Figure 1 displays, the European Hub distributes this data to national systems for each market in which the product is authorised. Followed by marketing authorization that is granted at a national level, and each country has its own national system
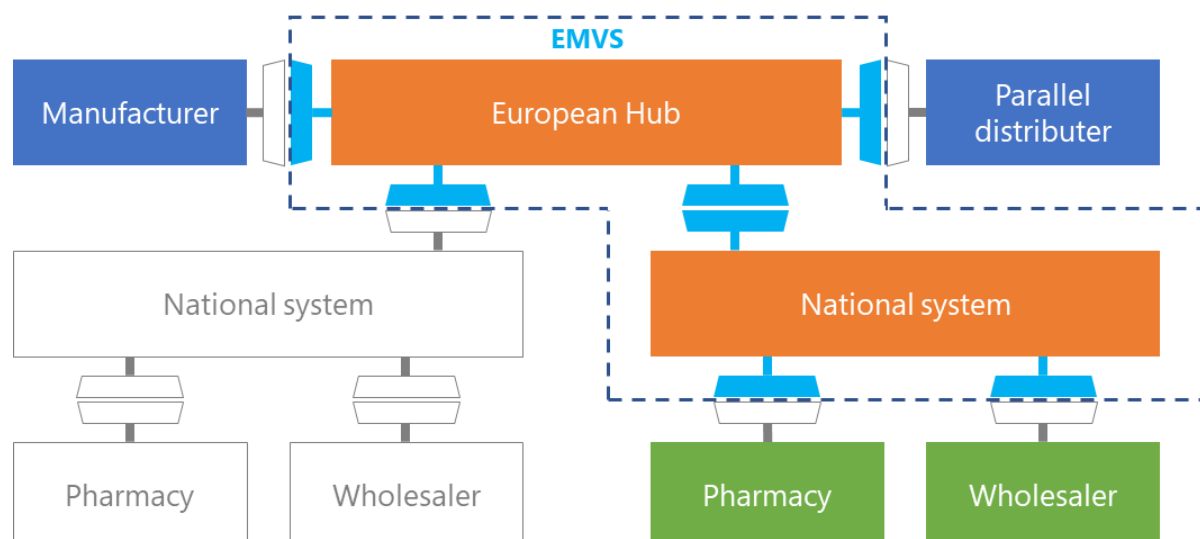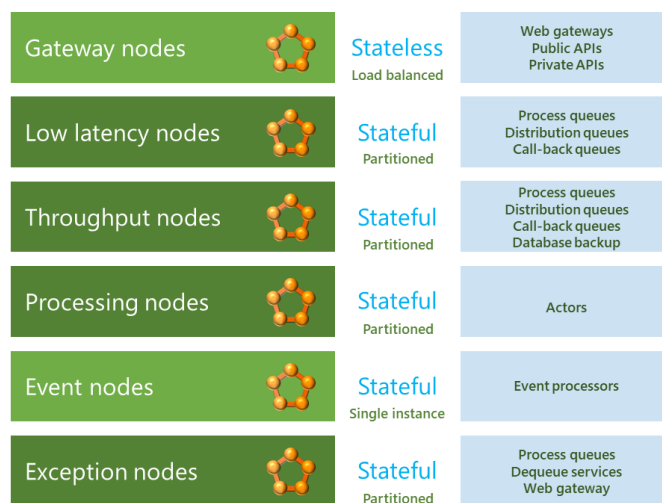

Figure 1. The EMVS components

Wholesalers, hospital pharmacies, and community pharmacies connect to the national system in the market in which they are located. They use the EMVS to verify the unique identifier of each pack of prescription medicine and to record any event in which the pack identifier is decommissioned. In some cases, pack state changes are communicated across multiple markets via the European Hub. When a potential falsified medicine is detected, the wholesaler or pharmacist is informed, and an alert is generated and returned to the manufacturer and stakeholder organisations for further investigation.

The EMVS must reliably and consistently support the legal requirements placed on all European pharmacists and wholesalers to verify every pack of prescription medicine. It must minimise the cost-per-pack of verification and scale and perform effectively across the continent. To accomplish this process, **Solidsoft Reply** built the European Hub as a cloud-based solution on the Microsoft Azure platform. Most markets have opted to purchase a blueprint of the national system, a type of reference architecture that meets a set of requirements specified by European industry stakeholders. **Solidsoft Reply** provides a cost-effective, cloud-hosted National Blueprint System (NBS) built on similar technology and architecture as the European Hub. Up until now, already 12 countries have engaged Solidsoft Reply to implement their National Blueprint Solution. These NMVO markets are: Croatia, Sweden, Denmark, Ireland, Bulgaria, Slovenia, Cyprus, Malta, Lithuania, the Czech Republic, Iceland and Switzerland and Liechtenstein. 10 months ahead of the legal deadline, Solidsoft Reply has successfully connected all 12 of the markets to the European Hub. (LINK: see Press Release)

Building on Microsoft Azure Service Fabric

Gateway nodes		Stateless Load balanced	Web gateways Public APIs Private APIs
Low latency nodes		Stateful Partitioned	Process queues Distribution queues Call-back queues
Throughput nodes		Stateful Partitioned	Process queues Distribution queues Call-back queues Database backup
Processing nodes		Stateful Partitioned	Actors
Event nodes		Stateful Single instance	Event processors
Exception nodes		Stateful Partitioned	Process queues Dequeue services Web gateway

Solidsoft Reply chose Service Fabric as the most appropriate platform to build a Microservice based solution to meet the demands of the legal requirements. Service Fabric provides the intelligent cluster-based service orchestration, routing, and state management that the EMVS requires. Service Fabric offers high levels of resilience, availability, and scalability as the Solidsoft Reply development team took advantage of the first-class support in Service Fabric for stateful service models to support the asynchronous, persisted interchanges that the EMVS needs and enable scalable, resilient workflows.

To maintain great performance at scale, the EMVS depends on careful partitioning of different workloads and data. As Figure 2 demonstrates, the solution practices a layered architecture with separate clusters for different types of stateful and stateless workload. Each cluster can be sized and configured appropriately and scaled independently and dynamically.

Built on Microservices

The main Microservices in EMVS:

- **Gateway services**, including the web front ends, the API used for public access to the European Hub, and a private API used for administration and configuration of the system. Stateless gateway services upload master data store, verify packs, and synchronize their state against the master store.

- **Latency services** include the queues that handle non-volatile master and reference data, including product, batch, and pack-related information. The solution must meet demanding low-latency requirements to ensure that verification of all packs of prescription to meet regulations, as medicine does not result in a significant loss of performance for existing systems and applications. Low latency services work with the data partitioning capabilities of Cosmos DB to ensure consistent low-latency pack verification at scale.

- **Throughput services** include the queues that handle volatile service state during the processing and distribution of pack data. Pack state triggers the notification systems used for reporting and escalation.

- **Processing services** use workflow actors to represent product pack data and master data. Actors also represent product recalls, reporting services, and escalation requests.

- **Event services** are stateless Microservices that monitor the activities of the transaction queues and provide history for the auditing and other logging systems.

- **Exception services** handle system-level issues such as retries and deferred requests, then notify the system administrators and reporting services.

The EMVS must scale appropriately to handle different European and national workloads. The scalability strategy is established on Microservices, allowing the system to adapt quickly to changing conditions and demands. Microservices also support the very high accessibility that is necessary for a system of this size. Any significant outage could adversely affect a large part of the pharmaceutical industry across Europe or within individual national markets, resulting in very large backlogs of deferred work that must be processed as part of the recovery cycle.

Service Fabric automatically replicates service instances and their data and handles recovery when a service instance fails. This self-healing feature significantly reduces the risks associated with service unavailability and data loss as well as eliminating many of the scenarios that might otherwise require a full system failover between data centres.

The requirements for the EMVS have been specified by industry stakeholders, and are expected to change and evolve over time. In addition, individual markets may want to customize their systems. Microservices support rapid evolution and change to the system with minimal disruption to running services.

Benefits of Microsoft Azure Service Fabric

Before Service Fabric, the first version of the European Hub was built and piloted using earlier Microsoft Azure PaaS features. Despite the success of the pilot in a single market, it was clear that the original architecture did not provide sufficient scalability for European roll-out. The second generation of the European Hub, built using Service Fabric and Cosmos DB, addressed these concerns.

The Solidsoft Reply development team worked closely with the Microsoft Service Fabric product group for a year prior to the release of Service Fabric to ensure that the architecture would meet its scalability, performance, and availability requirements. In particular, the design of Reliable Queues in Service Fabric evolved to address a number of concerns raised during EMVS development.

Service Fabric and Azure services also provided the following benefits in the ongoing development of the NBS:

- **Accelerated development:** The investment made in designing and implementing Service Fabric patterns in the European Hub has directly benefitted the implementation of the NBS. It customs the same patterns and approaches to handle interchange with the European Hub and to manage other asynchronous processing at the national level. The ability to repurpose architectural and design patterns has significantly accelerated the development of the NBS in the face of demanding timescales.

- **Agile development:** Service Fabric, with its support for Microservice architecture, complements the agile methodology used to deliver NBS functionality. The Solidsoft Reply development team has been able to support national pilot programs and roll-out before the fixed end-date of February 2019.

- **Automated testing:** Comprehensive and rigorous testing of complex distributed systems is always challenging. Solidsoft Reply built its own automated test framework to support the needs of the EMVS program. The framework provides a comprehensive approach to black-box and grey-box testing of the system as a whole, as well as the individual European and national-level components of the EMVS. The framework provides readily available test metrics via Microsoft Power BI.

- **Compliance:** The pharmaceutical industry is highly regulated. The EMVS complies with GAMP 5 GxP best practice standards and constitutes a verified system with detailed traceability of functionality back to the formal requirements and functional specification, and an emphasis on robust configuration management of individual releases and environments. Solidsoft Reply operates the European Hub and National Systems on behalf of its customers and implements comprehensive operational management processes used Azure-hosted tooling.

Summary

Service Fabric, combined with other Azure services, provided Solidsoft Reply with a modern platform to address the requirements of the European Union and the European pharmaceutical industry in building, deploying, and managing the EMVS. In this competitive market, Solidsoft Reply were ahead in the European Union service to propose using a solution with a fully public, cloud-based back-office infrastructure on Microsoft Azure.

Service Fabric provided Solidsoft Reply the edge with its powerful, approach to building highly scalable, available Microservice based solutions that can evolve over time in an agile, cost-effective manner. The use of this platform represents significant cost savings for the pharmaceutical industry, serving them to meet their legal responsibilities and to provide world-class protection to citizens across the continent.

For Solidsoft Reply, this technological platform has enabled the company to move beyond its strong history as an enterprise-level integration specialist to a cloud-centric provider of large distributed systems and services.

SOLIDSOFT REPLY

Solidsoft Reply have been producing bespoke applications on Microsoft platforms for over 25 years. Since the launch of BizTalk; Microsoft's original integration platform, Solidsoft Reply has been producing enterprise strength, integration solutions. Recently, Solidsoft Reply have been pioneering the use of Logic Apps, API Management and Service Bus on the Azure platform as well as utilising BizTalk 2016's Azure capability to create hybrid solutions. Solidsoft Reply are a recognised leader in the UK who have achieved numerous awards for their solutions.

Solidsoft Reply are experts in Service Fabric with vast experience in architecting platforms to ensure the optimal deployment of Microservices.